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Transit Trade[♦]

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Abstract

In this paper, we estimate the effects of transit systems that substantially streamline administrative processing of trade flows. In so doing, we use a unique dataset that consists of the entire universe of El Salvador's export transactions over the period 2007-2013 and includes information on the transactions channeled under a new transit regime established with neighboring countries over the same period. Results suggest that this new transit system has been associated with decreased order servicing and variable trade costs. As a consequence, firms' exports increased primarily through higher shipping frequencies. Furthermore, the effects have been strong on foreign sales of time-sensitive goods. This evidence informs one of the main policies covered in the 2013 WTO Agreement of Trade Facilitation.

Keyword: Transit Trade, Border Effects, Order Costs, Inventory, Shipping Frequency
JEL-Code: F10, F13, F14

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Transit Trade

Customs transit is one of the cornerstones of European integration and of vital interest to European businesses. It enables goods to move more freely and makes customs clearance formalities more accessible. It does so by temporarily suspending duties and taxes that are applicable to goods at import…(European Communities, 2001).

1 Introduction

The design of administrative procedures can be a key determinant of how regulations affect economic outcomes. In this paper, we provide novel evidence from an international trade perspective. In particular, we use a unique dataset to examine -for the first time to our knowledge- the effects of a trade policy covered in the 2013 WTO Agreement of Trade Facilitation that harmonizes clearance and processing procedures of cross border shipments.

Shipments that cross a border are subject to regulations and procedures that impose costs on importing and exporting firms. For example, while trade between Mexico and the United States has been largely free from tariffs, until a few years ago Mexican trucking companies carrying imports to the United States were required to transfer them to domestic counterparts at the bilateral border, which added time and costs to an already non-seamless trucking flow between both countries (see Fox and Londoño, 2014).

Consider the exports from El Salvador -the country for which we have data and will study in this paper- to a non-border partner such as Panama (see Figure 1). In this case, goods have to be transported through intermediate countries when shipped overland. This is technically known as *international transit.* Importantly, transit accounts for a substantial portion of foreign trade. In El Salvador, road accounts for 96% of the exports to the neighboring Central American countries Costa Rica, Guatemala, Honduras, Nicaragua, and Panama, and roughly one third of these exports are carried through a country which is not the final destination of the shipment.[1] Without explicit special provisions for such a transit, deliveries undergo a succession of import and export border clearance procedures including the filling of paper-based documents and the loading and unloading of trucks. These repetitive procedures create substantial congestion at the borders and lead to significant transaction cost escalation (see Arvis et al., 2008). Under well-functioning transit regimes, instead, the administrative burden is decentralized away from entry points to lower the costs of border crossing. Shipments flow through third countries under customs control but without being cleared by customs (see Arvis et al., 2007). More precisely, customs clearance is delayed, so that there is no need to import and re-export the products at intermediate points nor to pay

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[1] Overland trade is overwhelmingly prevalent among neighboring countries. For instance, the median share of road and rail in total intra-EU trade is 95.7% (see Cristea et al., 2013).

import duties, domestic consumption taxes, or other charges, or go through the processes associated with import regulations.[2]

In practice, countries have designed different procedures to accomplish this goal. In the most basic and common variants, there are separate controls at each side of the border and procedures require the submission of paper documents. In contrast, in the most advanced versions, transit regimes involve unified border transit controls along with the use of a common electronic document to simultaneously comply with all relevant transit border formalities. This streamlining of border procedures allows for a substantial reduction in delays and trade costs and can therefore facilitate international transit operations and cross-border trade.

In this paper, we assess the trade effects of such changes in transit-related border administrative processes. We employ the implementation of one of the few operating regional transit systems in the developing world, the Central American International Transit of Goods (hereafter TIM for its name in Spanish – *Tránsito Internacional de Mercancías*), which covers border crossings between Costa Rica, El Salvador, Honduras, Nicaragua, Panama, and Mexico, to examine whether and how a reduction in frictions related to transit affects trade costs and trade. The TIM implied the simplification of clearance procedures, the gradual adoption of a single electronic form, and the interconnection of all participating border agencies to enable a one-step clearance control at each bilateral border. This substantially lowered the document preparation costs and sped up document review and processing at these borders. Moreover, the TIM facilitated information flows on each order and specifically real-time control of shipments. This is likely to have resulted in significant reductions in order servicing costs and generally in trade costs (see Sarmiento et al., 2010).

We focus on two main questions. First, does the establishment of a transit regime such as the TIM affect firms' exports? In answering this question, we exploit the fact that the TIM was sequentially implemented across trade corridors –i.e., origin-customs-specific destination combinations- to primarily carry out difference-in-differences estimations on a unique dataset that includes all firms' export transactions originated in El Salvador (and Guatemala) over the period 2007-2013 and informs which of these transactions were processed under the new regional transit system.

Second, how does a transit regime affect firms' exports? We develop a simple heterogeneous firm model featuring inventory management whereby exporters trade off order servicing and production costs

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[2] Transit can take place in the country of destination/origin of the goods (national transit) or in a third country where the products are carried out from an entry post to an exit post (international transit). Thus, a complete transit operation consists of a sequence of national and international transit links (see Arvis et al., 2007). The trade facilitation policy described above is not only relevant for trade with non-border partners, but for all shipments crossing two different customs territories, as exports to immediate neighbor countries can receive a similar treatment when originated in internal customs.

with inventory accumulation costs to determine the optimal shipment frequency.[3] This model explicitly predicts that a decrease in order servicing costs leads to an increase in the number of shipments and, consistent with standard trade models, that a drop in variable trade costs translates into an expansion of export volumes and values. Our estimates confirm these predictions. Combined with these estimates, the model also allows us to back out the associated effects on order servicing and variable trade costs, thereby complementing our assessment of the policy impact. Thus, this theoretical framework provides economic intuition to our estimation results.

Our findings suggest that the adoption of the TIM has resulted in a reduction in order servicing costs of about 27%. As a consequence, the average growth rate of exports channeled through this simplified transit regime has been 2.7 percentage points larger than their counterparts subject to standard transit procedures. In particular, TIM's positive effect on firms' exports can be mainly traced back to an increased number of shipments. In terms of the latter, the differential growth rate associated with the TIM has been 1.2 percentage points. Furthermore, estimates specifically indicate that induced trade cost reductions and trade impacts have been heterogeneous across products. In particular, exports of time-sensitive goods have benefited more from transit facilitation.

From an interpretation point of view, it should be mentioned that the implementation of the TIM entailed an important redesign of transit procedures along with the introduction of new technologies that made such redesign possible. Hence, the size of the effects we identify corresponds to that associated with the multiple complementary components of the trade reform.[4]

In order to convincingly achieve such identification, we tackle the two main issues our empirical strategy is confronted with: self-selection into TIM and general equilibrium effects expressed as market-stealing phenomena. While the TIM was mandatory in specified trade corridors, we cannot entirely rule out self-selection of firms or export flows into this new transit regime due to potential endogenous choice of transport modes or trade corridors (or transport companies using them) or less than perfect enforcement in given routes. We address this concern in different forms. First, we explicitly examine whether the TIM has been associated with modal or route changes and do not find any support to that presumption. Second, we exploit the dimensions of our rich dataset to estimate alternative specifications that make it possible to include fixed effects that account for unobserved factors that might lead to endogenous use of the TIM at various levels including firm-year, firm-product-year, firm-destination-year, and even firm-product-destination-year, such as exporter productivity and importing country-by-

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[3] Given that in our set-up inventory costs are captured by per-period export costs, all our results are easily interpreted in terms of fixed and variable trade costs as in standard models (see, e.g., Melitz, 2003). Furthermore, while we model inventory on the seller side to highlight export decisions as in these models, modeling it on the buyer side delivers similar predictions.

[4] In other words, we are not able to attribute the effects to the different components. Carballo et al. (2016) examine how the adoption of information and communication technologies as a means to comply with virtually unaltered procedures established by trade regulations affected firms' foreign sales and can therefore be considered a first attempt to measure the incidence of one of the two components.

(exporter)-product demand shocks. Third, even though these fixed effects go a long way in absorbing unobserved variables that may result in self-selection, we carry out several additional robustness check exercises to thoroughly deal with this issue. Thus, we estimate the impact at a more aggregated level (i.e., product-destination-year) where the role of potential endogenous firms' choices is attenuated. Moreover, we perform two placebo tests whereby we artificially assume either that the TIM was used in years in which the regime was directly not in place or that it was utilized one year before the actual first usage. In addition, we conduct an event study and hence track the relative evolution of exports of TIM and non-TIM observations over time before, during, and after the TIM's adoption. Finally, we resort to instrumental variable estimation whereby we use availability of the TIM to export a certain product to a certain destination from a given geographical origin as established by the relevant legislation or the national implementation schedules across destinations as alternative instruments for the actual TIM usage. Remarkably, the results from all these estimations corroborate our baseline findings.

The interpretation of the magnitudes of TIM's estimated effects is difficult if firms strategically interact. In particular, firms' exports processed under the TIM may have grown partially and even totally at the expense of their counterparts not enjoying comparable transit facilitation advantages. If this would have been the case, the impact of TIM on El Salvador exports, if any at all, would be smaller than that indicated by our estimated effects. In order to evaluate whether and to what extent spillovers are an issue, we separately estimate the baseline equation for both a sample consisting of exports under the TIM ("treated") and exports under the preexisting transit regime that involve the same product at the HS 2-digit or the HS 4-digit levels and the same destination ("untreated") and a sample comprising exports under the TIM ("treated") and exports subject to the previous transit scheme that are made up of different HS 2-digit or HS 4-digit products and different destinations ("residual"). While the estimated coefficient on the TIM is larger in the former sample than in the latter sample as one would expect if some market stealing indeed occurred, the latter is still relatively large and highly significant. Conditional on the cross-effects in question being limited to the product-destination combinations as defined above, this would suggest that the TIM has indeed had a net positive impact on the exports of the country as a whole. Finally, we also check the external validity of our results by replicating the analysis on Guatemalan data. TIM's estimated effects on Guatemalan firms' exports are virtually identical to those on their Salvadoran peers.

Our paper relates and contributes to both the international trade literature and the ongoing policy discussions on trade facilitation. First, we provide new insights on the border effect (see, e.g., McCallum, 1995; Head and Mayer, 2000 and 2010; Anderson and van Wincoop, 2003; Chen, 2004; Hillberry and Hummels, 2008; Nitsch and Wolf, 2013). This literature suggests that frictions related to borders are large, but the reduction of non-tariff barriers in the EU had little effect on European integration. Different from this literature, we investigate how trade responds when well-defined policy-driven border frictions are reduced in a context in which border crossing can be sequential and multiple. In so doing, we use highly detailed firm-level data that make it possible to observe that policy change at the transaction level. Our results indicate that border administrative requirements and processing are an important obstacle to trade and that reducing these obstacles has immediate export effects. Evidence from European countries does not immediately extend to developing economies and particularly to specific trade facilitation policies such as those included in the WTO Agreement on Trade Facilitation. The contrast between the results for Central America and those for Europe can be at least partially explained by the difference in the initial trade costs. In particular, these costs are substantially higher in El Salvador than they were in Europe in the early 1990s -which was when the border removal measures examined in the papers referred to above were adopted-, as the latter came after a long process of integration started in the 1950s.

Second, we show that shipping frequency is a key margin of adjustment to changes in trade policy and how this policy can affect order servicing costs and variable trade costs by combining estimated export effects with a theoretical model that embeds inventory in an exporter heterogeneity setting. Thus, we complement recent work stressing the importance of inventory and shipping frequency in international trade and for macroeconomic adjustment mechanisms (see, e.g., Huang and Whalley, 2008; Alessandria, 2010; and Clark et al., 2014; Békes et al., 2014; Kropf and Sauré, 2014; Hornok and Koren, 2015).

Third, while countries around the world have invested substantial resources in their trade infrastructures and even multilateral initiatives such as the WTO-led Aid for Trade program have been created to support these national efforts, little is known about how this influences trade. This paper concentrates on one featured Aid for Trade case study to show whether, to what extent, and how these investments in trade infrastructure make a difference (see WTO-OECD, 2013). In particular, for the first time to our knowledge, we assess the impact of a transit regime that streamlines procedures on firms' exports. We thereby add to the limited rigorous evaluations of these kinds of interventions (see Cadot and de Melo, 2014). These evaluations include a few fresh studies that examine the effects of exiting and entering customs processing times on firms' exports and imports (see Volpe Martincus et al., 2015; and Fernandes et al., 2015).

Fourth, we shed completely new light on a key trade policy area which is probably one of the less well documented and understood disciplines covered by the WTO Agreement on Trade Facilitation and in which developing countries will have to work in upcoming years to implement the commitments derived from this agreement (see WTO, 2014).

The remainder of this paper is organized as follows. Section 2 places transit trade in a historical context and describes Central America's regional transit regime TIM. Section 3 introduces the dataset and presents basic statistics and preliminary evidence. Section 4 explains the empirical strategy. Section 5 discusses the estimation results, and Section 6 concludes.

2 Transit Trade and the TIM

2.1 Transit Trade: Antecedents

Long-distance trade crossing several territories has existed for centuries (see Helpman, 2011).[5] Thus, in the Roman Empire, goods were transported between far apart regions (see McCormick, 2001). The collapse of the Empire in the fifth century C.E. left behind a pronounced political fragmentation in Western Europe. Several states were created and accordingly customs and duties and charges multiplied, thereby negatively affecting long distance trade (see, e.g., Arvis, 2004). Duties included both, on trade and on transit. As for the latter, for instance, in Middle Ages' Italy, *telonei* (indirect taxes) were collected at gates (*portaticum*) and landing places (*repaticum*). Even though their rates were low, their number was very high. For example, ships going from Linz to Vienna along the Danube River were subject to 77 different customs checks and duties (see Nicali, 2002).[6] As inland transportation between cities progressed, different strategies began to be used to facilitate transit and trade. The transit system applied in the Duchy of Milan in Northern Italy is illustrative in this regard. Shipments of goods were sealed by customs officers at the main inland gateway of the duchy and carnets were issued. Upon arrival at the final destination, seals were removed and duties paid. At this stage, local officers sent all relevant data about the shipment in transit to the central office in Milan (see Favier, 1971).

These transit principles developed during the Renaissance underlay the single door-to-door transit regime called International Road Transport (TIR for its name in French – *Transports Internationaux Routiers*) established in Western Europe in the early 1950s. This regime consisted of a single harmonized manifest (carnets TIR) issued in the country of origin and used at every border, authorized operators whereby only qualified operators could participate, a mutually recognized system of privately managed guarantees, an overseeing agency –the United Nations Economic Commission for Europe (UNECE)-, and a clearing house of carnets and guaranties – the International Road Transport Union (IRU) federating the national association of operators. The TIR eliminated duplication of procedures and significantly sped up movements of goods across borders.[7] The transit regime later evolved into a common transit regime for the EU and EFTA and a single transit regime for the EU as a customs union and became fully computerized with the NCTS- New Computerized Transit System (see Arvis et al., 2008; European Communities, 2001).

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[5] The so-called *Silk Road* connecting Europe and Asia is probably one of the best well-known and well-documented trading routes (see Richthofen, 1877).

[6] It should be mentioned herein that the fiscal burden was reduced through *free fairs* and *free zones* (see Nicali, 2002).

[7] See Arvis (2004) for a detailed description of the TIR.

In contrast, well-functioning transit regimes are virtually absent in most developing regions. The reasons include both inappropriate design due to lack of cooperation between relevant public and private parties and pressure from interest groups (e.g., TRIE in Western Africa) and inability of implementation due to institutional weakness (e.g., Sub-Saharan Africa) (see Arvis et al., 2008). The picture does not differ much among partners of trade agreements. Only 36.4% of the agreements notified to the GATT/WTO by June 2013 -that typically involve neighboring countries- have provisions to facilitate transit (see Neufeld, 2014).

The TIM experience, which we examine below, reveals that developing countries are likely to reap substantial gains from putting in place efficient transit schemes.

2.2 The TIM

Until very recently, Central American exporters with shipments in transit had to clear customs at each side of the bilateral borders among these countries and sequentially present various paper documents to the different intervening agencies, including printed copies of international transit declarations, country-specific sanitary and phytosanitary certificates, and migration arrival and departure cards that had to be filled at each border office. This can be seen in Figure 2, which shows in a stylized manner the border controls to which road-based shipments from El Salvador to Panama through Honduras, Nicaragua, and Costa Rica were subject and how the administrative processing of these shipments at each border office looked like. In particular, according to a survey conducted at El Amatillo, a border crossing between El Salvador and Honduras, 12 sets of copies of generally the same declaration and complementary documents had to be prepared and distributed among officials of intervening agencies (see Sarmiento, 2013). Transit of goods in Central America was therefore characterized by lack of coordination of border agencies, cumbersome and slow customs and administrative procedures, and limited use of information technologies.

In recent years, countries in the region adopted the TIM, a new electronic transit system to manage and control the movement of goods in transit that is partially based on the European system. This system involves (1) stronger within and across country interagency cooperation; (2) a process reengineering, whereby previous multiple paper-based declarations were harmonized into a single and comprehensive document that gathers all data required by customs, migration, and phytosanitary agencies, and the creation of a single unified border transit control; and (3) the use of information technologies to interconnect the intranet system of all agencies participating in the project to manage and track the international transit process, and to carry out risk analysis and cargo controls (see Sarmiento et al., 2010). Figure 3 shows how the shipment from El Salvador to Panama is processed under the new scheme. Instead of repetitive paper-based procedures initiated at the border, firms can now complete a single electronic document (DUT for its name in Spanish – *Documento Único de Transporte*) at their closest customs office. This substantially lowered the time and costs of document preparation. Furthermore, under the new system, firms can start the transit there and finish it in the final destination in the importing country. At the borders, controls are carried out at only one of the customs offices on each side by scanning the bar code in the DUT, which shows intervening officials all the relevant information on the shipment in the system, thus not requiring the presentation of multiple paper documents. More specifically, shipments in transit are now processed under the logic of an electronic single window, whereby transporters interact simultaneously and in the same place with all border agencies –customs, migration, and quarantine- without using printed copies of documents. This new process significantly expedited border crossings (see Sarmiento et al., 2010). Moreover, the information system introduced with the TIM provides trading and transport companies with real-time data on their shipments thereby making it easier to control orders and to manage their servicing and inventories in general.

El Salvador was the first country to adhere to the TIM as a transit territory. Crucially for our identification purposes, the TIM entered into force gradually over the period 2011-2013 for road-based shipments originating in this country. More precisely, individual corridors or specific origin-customs-destination segments –the so-called fiscal routes- were sequentially incorporated into the regime. In a first phase, the TIM was applied on trade operations starting in internal, “non-border” customs (San Bartolo, Comalapa, and Santa Ana), the Free Trade Zones, and the coastal customs at Ajacutla, and going to Guatemala (and specific destinations therein) and Mexico through La Hachadura or San Cristobal or to (specific destination in) Honduras and Nicaragua through El Poy or El Amatillo and Guasuale, respectively (see Salvadoran customs’ Administrative Decision DGA-0013-2011 and fiscal routes colored in black in the upper panel of Figure 4). Note that, when originated in the aforementioned customs, shipments are in transit within El Salvador. The reason is that there is an intermediate customs territory between the origin and the final destination, in this case, El Salvador general customs territory. This is why international transit is applicable and TIM was required for these exports. All exports to the two immediate neighboring countries, Honduras and Guatemala, initiated at border customs, do not transit in El Salvador. Hence, these exports just need a standard customs export declaration and accordingly have not been directly affected in terms of how they were administratively processed. In this way, El Salvador’s customs established a compulsory use of the TIM in all relevant fiscal routes as allowed by the TIM implementation status in regional partner countries at that time. In other words, there was no explicit selection of corridors by Salvadoran customs authorities.

In a second phase, the TIM was primarily extended to exports to Nicaragua through El Espino y Las Manos and to Costa Rica and Panama via El Amatillo, Guasaule, Peñas Blancas y Paso Canaos (see Salvadoran Customs’ Administrative Decision DGA-011-2012 and fiscal routes colored in red in the upper panel of Figure 4). This addition of corridors was due to decisions of other Central American countries to take part in the new transit regime (i.e., Costa Rica and Panama) or to incorporate new fiscal routes (i.e., Guatemala, Honduras, and Nicaragua). Critical from an identification point of view, these decisions can be considered exogenous to El Salvador's firms because they were taken by countries other than El Salvador and were non-origin/destination specific. In the third phase, new corridors joined through 2013 as the TIM was further phased-in in such neighboring countries.

This stepwise implementation of TIM generated variation in regime usage status both across export flows in a given point in time and over time. In particular, use of the TIM can vary both across firm-product-destination(-buyer) triples (quadruples) in a given year and within firm-product-destination(-buyer) triples (quadruples) over years. The reason is that firms can and do sell different products to different buyers located in different regions of a given destination and that these goods can be shipped through different routes. Take for instance a firm based in San Salvador that ships to a Nicaraguan buyer in Managua through El Amatillo and Guasaule but services a Nicaraguan buyer in Esteli through El Espino. In the first case, the firm could start using the TIM as early as in 2011, but in the latter case the TIM only became an option in 2012 (see the lower panel of Figure 4).[8]

3 Dataset and Descriptive Evidence

Our main dataset combines two databases. The first database includes transaction-level export data from 2007 to 2013 kindly provided by the Salvadoran customs DGA (by its name in Spanish *Dirección General de Aduanas*). Specifically, each record includes the firm's tax ID, the product code (8-digit HS), the customs through which the shipment exits El Salvador, the destination country, the foreign buyer, the transport mode, the export value in US dollars, and the quantity (weight) in kilograms.[9] The second database is also transactional and corresponds to the regional transit scheme TIM. It shares several fields with the customs database, which makes it possible to merge them. The TIM database therefore allows us to identify which specific transactions were processed under the regional transit scheme and when.

The TIM applies to road transit trade among Central American countries -Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama-, trade with Mexico, and trade with other countries by sea transiting through their territories (e.g., exports from El Salvador to Germany via Puerto Cortez in Honduras) (see the upper panel of Figure 4). In this paper we consider both road-based exports to neighboring countries and primarily multimodal exports to third countries.[10] In the analysis below we

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[8] Alternatively, products with certain characteristics (e.g., time-sensitiveness, fragility) might have to be transported on roads meeting certain criteria (e.g., quality of the surface, number of lanes, etc.).

[9] In addition, we have information on the customs verification channel and the time it takes to clear customs. Approximately 93% of all export shipments in our sample period were not physically inspected and 77% of those subject to such intrusive controls were released within one day as their non-inspected counterparts. We therefore do not explicitly use these data in the estimations.

[10] Given that the TIM also applies to relevant exports to extra-regional countries, it is not obvious that it should specifically affect the share of Central American in these exports.

therefore impose the condition of common destinations and common transport modes across status of usage of the transit regime and hence exclude air-shipped exports.

The upper panel of Table 1 reports El Salvador's total exports and key aggregate extensive margin indicators along with share accounted for by the Central American neighbors listed above in 2010 and 2013. Exports grew 27% over the period to reach 5.1 billion USD in 2013, 45% of which goes to the regional partners. Approximately 2,300 exporters made more than 400,000 shipments to sell 3,277 products to almost 9,300 buyers in 2013. The second and third panels of Table 1 inform the portion of exports along the respective dimensions processed under the TIM. Around 26% of the total export value and 28% of the export transactions were channeled through the TIM in 2013. These shares increase to 36.5% and 30% when only considering sales to other Central American countries and to around two thirds when exports to immediate neighbors Honduras and Guatemala are excluded, with the latter being a stricter measure of the actual use of TIM and thus of its degree of implementation.

Table 2 characterizes the average Salvadoran exporter in these years in terms of both their total foreign sales and their road-based sales to Central American partners. On average, in 2013 exporting firms sold 7.5 products to 6 buyers in 2 countries for approximately 2 million US dollars. In so doing, each of these firms made 173 annual shipments through 2 customs. Figures are similar for sales to the region, but the average total values, which is half of that when all destinations are considered – 1 million US dollars.

4 Empirical Methodology

We primarily estimate the effects of TIM on firms' exports by making use of the variation in transit procedures across firm-product-destination exports in a given period and within these exports over time as driven by the staggered implementation of the transit regime (see Section 2). In so doing, we control for unobserved factors such as firms' productivity and foreign demand that may affect firms' sales abroad and utilization of the transit scheme. In particular, our empirical model of exports is as follows:

$$lnX_{fpct} = \alpha TIM_{fpct} + \lambda_{fpc} + \delta_{ft} + \rho_{pct} + \varepsilon_{fpct} \qquad (1)$$

where f denotes firm, p stands for product at the HS-8 digit-level, c indicates country, and t indexes year (i.e., transaction-level data are aggregated by year). The main variables are X and TIM. The former represents export value.[11] The latter is a binary indicator that takes the value of 1 if firm f has used the simplified transit regime in shipping product p to destination country c in year t and 0 otherwise.[12] The

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[11] The presentation hereafter focuses on firms' exports, but *mutatis mutandis* also applies to other export outcomes along the extensive margin (e.g., number of shipments and number of buyers) and the intensive margin (e.g., average exports per shipment and average exports per buyer).

[12] Regrettably, detailed, disaggregated before and after data on transit times are not available. This is why we estimate the total impact of TIM using a binary indicator and combine the estimates with a theoretical model to back out the implied cost changes.

coefficient on TIM, α, is the parameter of interest and combines the elasticity of TIM on trade costs with the trade cost elasticity of exports. If TIM reduces order processing costs and variable trade costs due to streamlined and faster customs clearance, then, based on standard trade models (and our model developed in Appendix B), we expect $\alpha > 0$. The literature shows that this is not a foregone conclusion. For instance, Head and Meyer (2000) and Chen (2004) find little evidence that a reduction of industry level non-tariff barriers increase European integration. In these cases, $\alpha = 0$ is expected.

The remaining terms of Equation (1) correspond to control variables. Thus, λ_{fpc} is a set of firm-product-destination fixed effects that captures, for instance, the firm's knowledge of the market for a given product in a given country; δ_{ft} is a set of firm-year fixed effects that accounts for time-varying firm characteristics (e.g., size), competences (e.g., delivery of goods according to the specifications agreed upon), overall performance (e.g., productivity), and firm-level public policies (e.g., export promotion) as well as the companies' changing abilities to comply with customs' and other border agencies' regulations; ρ_{pct} is a set of product-destination-year fixed effects that controls for product-destination shocks such as changes in international transport costs across products and importing countries and fluctuations in demand for goods across markets; and for time-varying trade costs associated with customs and other administrative procedures in the various destinations; and ε is the error term.

In estimating Equation (1), we use first-differencing to eliminate the firm-product-destination fixed effects. Note that, as typically the case when using this strategy to evaluate programs on more than two periods, the TIM indicator has to be differenced along all other covariates (see Wooldridge, 2002).[13] We therefore estimate the following baseline equation:

$$\Delta lnX_{fpct} = \alpha\Delta TIM_{fpct} + \delta'_{ft} + \rho'_{pct} + \varepsilon'_{fpct} \qquad (2)$$

where $\Delta TIM_{fpct} = TIM_{fpct} - TIM_{fpct-1}$; $\delta'_{ft} = \delta_{ft} - \delta_{ft-1}$ accounts for firm heterogeneity; $\rho'_{pct} = \rho_{pct} - \rho_{\tilde{p}ct-1}$ absorbs all product-destination shocks; and $\varepsilon'_{fpct} = \varepsilon_{fpct} - \varepsilon_{fpct-1}$.

By comparing changes over time in exports under the new transit regime and thus subject to shorter and less costly processing and those for exports that have not been processed under the regime and thus with no change in their processing times and costs, we are controlling for observed and unobserved time-invariant factors as well as time-varying ones common to both groups that might be correlated with use of the simplified transit system and exports. In addition, Equation (2) includes fixed effects that account for systematic differences across firms and product-destination shocks, thus substantially reducing the risk of omitted variable biases and particularly of heterogeneity in export dynamics.

As explained in Sub-section 2.2, the TIM was implemented by specific origin-customs-destination segments. Hence, standard errors should in principle be clustered at that level. Given that data on firm location (i.e., municipality of origin) are incomplete, we use instead as a baseline standard errors that are

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[13] Keeping the program indicator in levels would lead to misleading results (see Wooldridge, 2002).

clustered by main customs-destination, which are generally more conservative.[14] Note, however, that the conclusions we draw are identical when we re-estimate Equation (2) on the sample restricted to those observations for which we have origin information and utilize standard errors clustered by municipality of origin-main customs-destination.

The baseline equation assumes that the effect of transit time on exports is symmetric across firms, products, and destinations. There are, however, reasons to believe that the effect of TIM on trade costs differs among groups of companies, goods and countries, in which case such a restriction would not hold. Thus, for instance, impacts can be larger for time-sensitive products (e.g., Volpe Martincus et al., 2015). Hence, we also generalize this equation to explore the existence of heterogeneous effects across those groups as follows:

$$\Delta lnX_{fpct} = \sum_{i=1}^{I} \alpha_i \Theta_i \Delta TIM_{fpct} + \delta'_{ft} + \rho'_{pct} + \varepsilon'_{fpc} \quad (3)$$

where i indexes the groups of firms, products, or countries; and Θ is the corresponding group indicator.[15]

5 Estimation Results

5.1 Baseline Results: Does a Transit Regime Affect Exports?

The first column of Table 3 presents OLS estimates of Equation (2) for the entire sample. According to this baseline specification which controls for time-varying firm and product-destination factors, use of the system has been associated with 61.6% higher export growth.[16] The sample median (logarithm) annual growth rate of firm-product-destination exports is 4.3%, so this would imply that, at the median, those processed under the TIM would have had a rate 2.7 percentage points higher than those without changes in their administrative transit procedures.[17]

This estimate cannot be automatically interpreted as informing the impact of El Salvador's total exports. The reason is that the distribution of export flows is heavy-tailed with a large majority of relatively small export flows (see, e.g., Eaton et al., 2012; di Giovanni and Levchenko, 2013; Gaubert and

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[14] These standard errors allow for an unrestricted covariance structure over time within main customs-destination, thus also accounting for serial correlation.

[15] The non-conditional effects of the variables that form the interaction terms are already accounted for by the sets of fixed effects.

[16] We have also directly estimated the fixed effect model given by Equation (1) using a procedure that handles multiple large sets of fixed effects. Results are in line with those reported here. These results are available from the authors upon request.

[17] It is worth mentioning that this estimated impact primarily corresponds to the first use of the regime. This can be seen by estimating Equation (2) on the "First TIM" subsample. This latter subsample creates a common "before treatment" period for both "treated" and "control" observations. It includes all exports that never used the TIM before ("First TIM"), that is, we are strictly comparing exports that experienced a simplification of their transit procedures in a certain year and exports with no changes in their transit procedures in the same year conditional on both having been channeled under the old procedures in the past. Thus, for 2012 we only include exports that did not use the TIM in 2011 and for 2013 we consider exports that were not processed under the TIM in 2011 and 2012. Estimates of Equation (2) based on this sample are virtually identical to that obtained from the whole sample. These estimates are available from the authors upon request.

Itskhoki, 2015; Freund and Pierola, 2015; and Bernard et al., 2015). If these flows experienced disproportionally higher growth rates in response to the TIM, then they would strongly influence our estimated average impact but generate little additional trade. In order to assess to what extent the granularity of exports is an issue, we re-estimate Equation (2) by weighted least squares (WLS), using the 2010 export values as weighting factors. The estimates are reported in the third column of Table 3. Although smaller than the baseline, these estimates still point to an economically important effect. In particular, with a weighted median growth rate of 1.2%, they suggest that the new transit regime has raised foreign sales' growth by 0.5 percentage points. As a consequence, Salvadoran aggregate exports would have been roughly 6% smaller in the absence of the TIM.[18] Given the TIM's prorated development and implementation costs and its annual operative costs, this implies a benefit/cost ratio of approximately 40 US dollars per dollar invested in the scheme.[19]

We primarily use standard errors clustered by main customs-destination for inference purposes. Admittedly, exports might be potentially correlated across customs for given destinations and across destinations for given customs. Hence, we also utilize alternative clustered standard errors to account for these other potential correlations (see Table 3). In addition, we consider standard errors clustered at the firm and (8 digit- and 2 digit-) product levels as well as their combination with each other and with the destination level and, for the subsample for which data on firms' location are available, standard errors clustered by municipality of origin-main customs-destination (see Table A1 in Appendix A). The message from the estimates remains the same under these alternative clusterings.

5.2 *Robustness*

We next go through several robustness checks that address a number of issues that might affect the validity of our estimation results. These issues essentially include zeroes, omitted variables, self-selection into the new transit regime, and cross effects.[20] Overall, the results of the checks confirm our initial findings.

First, our baseline estimating sample exclusively consists of continuing firm-product-destination exports. Given the pervasiveness of zeroes in international trade -especially at this level of aggregation-,

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[18] This figure takes into account that our estimating sample does not include air-shipped exports.

[19] On the costs side, the TIM's total development and implementation costs (approximately USD 4.5 millions) are prorated among the countries in the region according to their participation in the successive stages of the process. The annual operative costs correspond to the overall compensation of officials supervising transits and inspecting the respective shipments at each customs office throughout the country. There are 72 officials in charge of the transport control with an average annual compensation of USD 8,500, 20 officials who perform non-intrusive inspections with an average annual compensation of USD 11,000, 24 officials who conduct thorough physical inspections with an average annual compensation of USD 16,000, and 37 customs managers with an average annual compensation of USD 20,000. On the benefit side, we only consider additional exports to Central America and Mexico, which is the primary area of application.

[20] While very limited in number, there are a few drop outs from the TIM in our data. These might be associated with switching in buyers or might simply be measurement errors. Note, however, that results are identical if the TIM is assumed to be an absorbing state i.e., once used, it is used consistently onwards. These results are available from the authors upon request.

we examine the consequences of their inclusion. In particular, we estimate a variant of Equation (2) in which the dependent variable is the mid-point growth rate. This specification makes it possible to incorporate appearing and disappearing firms' exports into the sample. Estimates are presented in the fourth column of Table 3 and are similar to the baseline results.

Second, the fixed effects in our main equation may not be enough to control for unobserved factors that might have influenced exports. For instance, firms using the TIM may have received support from the country's competitiveness assistance program FONDEPRO to implement upgrading and marketing strategies in specific product lines or export markets that could lead to increased foreign sales in specific sectors or destinations, in which case we would be overestimating the effect of interest. Moreover, the TIM could have not only affected exports directly but also indirectly by facilitating importing of critical inputs (see, e.g., Kasahara and Lapham, 2013; Bas and Strauss-Kahn, 2014). Thus, firms may have used the TIM to import certain inputs, which could have favored the production and foreign sales of specific goods. More generally, there might have occurred shocks to input provision that might have differential effects on production across goods or changes in firms' competencies in producing these different goods. Furthermore, firm-product-destination exports under the TIM might have different average growth rates than their counterparts not using the TIM in the absence of any intervention. To address these concerns, we have also estimated alternative specifications of Equation (2) including firm-destination-year or firm-product-year fixed effects -instead of merely firm-year fixed effects- or firm-product-destination fixed effects. Estimates of these alternative specifications along with those not including fixed effects are reported in the first panel of Table 4.[21] These estimates essentially corroborate our initial findings.

From a theoretical point of view, Table 4 can be seen as reporting estimates of two broad sets of specifications that distinguish two impact channels, namely, specifications that include destination-year fixed effects and hence account for the destinations' multilateral resistance terms and specifications that exclude these fixed effects and accordingly allow for changes in the price level in the destination markets. These estimates show that the effect of the TIM is weaker when the destination-year specific factors are not absorbed and thus the destinations' prices are not controlled for. The explanation is that, if these prices can vary and they decrease in response to the lower border costs made possible by the TIM, exports would be indirectly discouraged, thereby partially offsetting the direct increase associated with such cost reduction.

As discussed above, the TIM was gradually implemented across fiscal routes as defined by origin-customs-importing country-specific destinations segments, so that the TIM usage can vary across firm-

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[21] On the other hand, larger set of fixed effects impose larger restrictions on the estimation sample. However, this does not seem to drive our results. Estimates based on specifications that do not include fixed effects or only include firm or product-destination fixed effects confirm that the new transit regime has had a significant positive impact on export growth although smaller in absolute value (see Columns 1-3 in the first panel of Table 4). Alternative specifications that just include firm-year fixed effects, product-year fixed effects, destination-year effects or their alternative pairwise combination at a time yield similar results. These alternative results are available from the authors upon request.

product-customs-destination-year combinations. Similarly, firms may have resorted to different transport companies, which may have served different routes or simply follow different administrative practices. We exploit our detailed transaction-level information and estimate variants of Equation (2) on data at the firm-product-customs-destination-year level and at the firm-product-transport company-destination-year level. In these cases, we also include firm-product-destination-year fixed effects to control for potential more granular time-varying unobserved confounding factors than before and customs-year and transport company-year fixed effects to account for changes in the overall levels of efficiency of the different customs offices and carriers, respectively.[22] Further along these lines, we also estimate alternative modified versions of Equation (2) incorporating firm-product-destination-year fixed effects on data at the firm-product-destination-buyer-year level (see Section 2) and semester frequency data, which feature buyer-year and semester fixed effects to isolate the possible contaminating incidence of unobserved buyers' demand shocks and seasonality, respectively. Estimation results, which are shown in the second panel of Table 4, are also in line with the baseline.[23]

Additionally, if shipments are ordered in advance, simplified procedures can potentially have lagged effects on exports. Hence, we also control for these effects by estimating expanded versions of Equation (2) that include the change in TIM status indicator lagged up to two years.[24] The estimates of these equations are presented in the third panel of Table 4. According to these estimates, the TIM has a positive and significant impact on firms' exports even after taking into account the sluggish response of trade to changes in transit conditions. As expected, this response declines over time.[25]

Previous estimations substantially reduce the scope for self-selection into the new transit scheme by accounting for multiple confounding factors. However, they might arguably not be enough to entirely rule it out. Thus, our firm-year fixed effects control for all time-varying firm-level factors that might drive potential endogenous selection into the TIM (e.g., larger or more productive firms might be more likely to us it). Nevertheless, if enforcement was imperfect, the concern remains that firms may have purposely opted to process specific export flows through the TIM. In this regard, the TIM may have induced firms to change their transport mode and specifically their route choices. In order to assess whether this was the case, we regress the share of road in exports at the firm-product-destination-year level and a binary indicator that takes the value of one if there was a change in the exiting customs on a binary indicator taking the value of one is a firm used the TIM in shipping the product to the destination in question and zero otherwise, along with firm-year and product-destination-year fixed effects on data at the firm-

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[22] As shown below, the TIM does not seem to have induced changes in existing customs and hence in routes.

[23] Note that buyers (customs) are not biunivocally associated with use or non-use of the TIM as this also depends on the location of the firm and the exiting customs (the location of the buyers).

[24] Including these lagged TIM status indicator requires that the firm-product-destination flow be present in the data continuously over the period to enter the estimation. This causes the estimation sample to reduce.

[25] Note that the estimated effect on our baseline explanatory variable increases as we introduce additional lags of this variable. The same holds if we estimate Equation (2) on the same observations. This suggests that such a pattern of results is primarily driven by the samples on which the equation is actually estimated.

product-destination level. The estimated coefficient on the TIM indicator is non-significant in both regressions. This implies that the TIM does not appear to have noticeably affected firms' modal or route decisions.[26]

Of course, this latter evidence is at best indicative and does not suffice to completely preclude firms' endogenous allocation of firm-product-destination exports across transit schemes. More precisely, already best performing exports might be explicitly chosen to be channeled through the TIM. If this holds true, we would observe a gap between TIM and non-TIM exports before the first actual use of the new transit procedures or even before the implementation of the regime altogether. We investigate whether this was the case by carrying out two placebo tests. In these tests, we regress current (t) export changes in future ($t + j$ where $j \geq 1$) changes in transit procedures, which amounts to assess the plausibility of the key identifying assumption of our difference-in-differences-type of estimation: exports processed under the TIM and their counterparts channeled according to the old transit procedure have had parallel trends before the establishment of the TIM. In particular, we first use data over the period 2007-2010 in which the TIM was not in force in El Salvador to conduct a falsification exercise whereby we assume that firm-product-destination exports using the TIM in 2011 onwards use it in 2008-2010. Second, we artificially allocate the first TIM use to the immediately previous period and re-estimate Equation (2) on the sample of firm-product-destination-year exports actually not using TIM. Estimation results from these placebo tests are shown in Columns 1 and 3 of the first panel of Table 5. Note that, for comparison purposes, in Columns 2 and 4 we include estimates for the period 2010-2013 when we restrict the samples to those firm-product-destination combinations that are also present in the former samples. Reassuringly, none of the former estimated coefficients are significantly different from zero, but the latter are, so that no differences in export trajectories appear to have prevailed in the pre-TIM period but only in the TIM period.[27]

In the same vein, we conduct an event analysis (see, e.g., McCrary, 2007). In particular, we track the behavior of firm-product-destination export flows subject to the TIM in a given year one year before and one year after the adoption of this new transit regime.[28] More formally, we estimate the following equation

$$lnX_{fpct} = \sum_{j=-1}^{1} \alpha^{j}\, TIM_{fpct} + \lambda_{fpc} + \delta_{ft} + \rho_{pct} + \varepsilon_{fpct}$$

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[26] These results are available from the authors upon request.

[27] The number of observations differs across columns in the first panel of Table 5 because in the last columns we restrict the sample to non-TIM observations, thus excluding the year in which the first TIM was observed. Note also that the number of observations in these two columns do not coincide with that corresponding to the first TIM estimates presented in Table 3 since we impose here a common set of firm-product-destinations across estimations. Results do not change when we do not impose this condition. These alternative results are available from the authors upon request.

[28] We cannot look at longer periods before and after due to the limitations imposed by our data.

The estimates of this equation are shown in second panel of Table 5. In accordance with a causal interpretation of the findings reported so far, these estimates are not significant before the first use of the TIM and become significant once transit was facilitated.

Moreover, we resort to instrumental variables to estimate Equation (2). More specifically, we instrument the actual use of the TIM with the availability of the associated streamlined transit procedures for firms located in a given municipality exporting a given product (through a given customs) to a given destination in the year in question. Alternatively, we also apply instrumental variables to estimate a modified version of Equation (2) that includes firm-year fixed effects and product-destination fixed and where we instrument observed TIM utilization with access to the implied transit technology across destinations and over time as determined by national implementation of the scheme: the TIM entered into force for all road-based shipments originated in free trade zones and non-border customs and going to Guatemala and Honduras and for all road-based shipments to Nicaragua (and to the rest of the world through these countries) in 2011 and for all road-based shipments destined to Costa Rica and Panama (and to the rest of the world through these countries) in 2012.[29] Estimates of these equations along with the relevant test statistics and those of the respective OLS counterparts are reported in the lower panel of Table 5. The F test statistics indicate that our instruments are strong and, importantly, the instrumental variable and the OLS estimates are entirely consistent with each other.

Finally, there is the question of whether the estimated impacts reported in previous tables can be linearly taken as the TIM's net contribution to El Salvador's trade. The true is that this estimated impact can only be seen as informing net export gains for the country as a whole under the assumption of absence of cross-effects. However, this assumption might have been violated due to potential market stealing. More specifically, firms' exports processed under the TIM might have expanded partially or even entirely at the expense of counterparts subject to the former transit procedures. In such as case, our estimated coefficient would primarily correspond to the upper bound of the program's aggregate effect. In order to assess whether and to what extent interactions between firms' exports drive our results, we assume that, if present, the negative cross-firm externalities are specific to foreign sales of given product-destination combinations.[30] Based on this assumption, we estimate our differenced Equation (2) on alternative subsamples that involve comparisons between TIM exports ("treated") and their non-TIM counterparts in the same products to the same destinations ("untreated") and between the former ("treated") exports and those without changes in their transit conditions in other product-destination combinations ("residual"). The estimates of these equations are presented in Table 6. These estimates reveal that the impact of the TIM is larger when estimated on firms' exports sharing the same product-

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[29] This is a stylized description of the country-level TIM's phase-in process (see Section 2).

[30] In addition to the baseline HS 8-digit level, products at the HS 6—digit and the HS 4--digit levels are considered to allow for potential substitutability across finely defined HS 8-digit products belonging to each of these categories.

destination pairs than when estimated on firms' exports in different product-destinations. While this might be seen as pointing to the existence of market stealing, note that when we directly compare "untreated" and "residual" export flows, differences tend to be statistically non-significant. Importantly, the TIM's estimated effect on firms' exports is still significantly positive and economically sizeable on the sample with no product-destination overlapping. Keeping in mind that the accuracy of these results critically depends on the assumptions made on the nature of the spillovers and that they should accordingly be seen as indicative, this evidence tends to support the conclusion that the TIM does seem to have resulted in additional foreign sales for El Salvador.[31]

5.3 *External Validity*

Estimation results consistently indicate that the TIM has had a significant positive impact on Salvadoran firms' exports. It is possible, though, that the effects, if any at all, could have been different in other participating economies. In order to address this concern regarding the external validity of the findings reported so far, we look at the experience of another country with the new transit regime: Guatemala. In this country, the TIM started with a pilot project in 2008 and has also been implemented gradually over the successive years. To carry out the analysis, we use export transaction-level data comparable to those for El Salvador over the period 2007-2013, which have been kindly provided by the Guatemalan Tax Administration Agency (SAT-*Superintendencia de Administración Tributaria*)- and the respective transit data from the TIM database.[32] We specifically replicate the basic estimations in Tables 3 and 4. Results are reported in Table 7. These results are fully in line with those for El Salvador. They indicate that the TIM has also positively affected exports from Guatemalan firms and, notably, as testified by the point estimates, to a similar extent. In the final panel we reproduce our OLS estimation when pooling together data from El Salvador and Guatemala. Interestingly, the results from these exercises also coincide with the baseline.

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[31] Moreover, the TIM might have directly affected the survival of similar exports not making use of this transit scheme. In order to investigate whether such crowding out took place, we estimate a linear probability model on the sample of firm-product-destinations flows existing in 2010 for "untreated" and "residual" observations, whereby the dependent variable is a binary indicator taking the value of one if the export flow is present in 2011, 2012 or 2013 and zero otherwise and the main explanatory variable is a binary indicator that takes the value of one if there is at least an export flow with the TIM and zero otherwise (or their number) along with firm and product-destination fixed effects (as defined above). According to the estimation results, the TIM does not appear to have benefited some export flows at the price of pushing others out of international markets. These results are available from the authors upon request.

[32] Available Guatemalan customs data are not as detailed as those from El Salvador. Each customs record includes the firm's tax ID, the product code (HS 8-digit), the destination country, the export value in US dollars, and the quantity (weight).

5.4 *Channels: How Does a Transit Regime Affect Exports?*

Based on previous estimates we can conclude that upgrading to a well-functioning transit system can have a large positive impact on trade. In this subsection, we develop a firm's optimization problem including inventory management that can be interpreted within standard trade models and explore the channels through which observed overall export effects arise empirically. We start with the inventory process.

In a given time period, which we normalize to unity, the exporter produces at a continuous rate and supplies q units of output to a seller. To produce each unit of output the exporter requires c units of labor hired at wages $w = 1$ such that the total cost of production is qc. In addition to production costs, there are inventory and order servicing costs.

The exporter makes N shipments of equal size q/N to deliver the total quantity and hires f labor services to place the shipments. The latter captures the costs incurred in filing documents, customs clearance, and real time information management related to the shipment. To fill the shipment, the exporter accumulates inventory. The time between shipments is $1/N$. Let $t \in [0, 1/N]$ indicate a point in time between shipments. The amount of output stored in inventory at any time t is then qt. Managing inventory requires m labor services. In order to embed these inventory management and order servicing costs into a trade model, we depart from the usual setup by assuming that both costs are non-linear.[33] This is intuitive. Due to space constraints, the more quantity an exporter accumulates in inventory the more difficult and expensive is to manage an additional unit in inventory. Similarly, order servicing costs are non-linear in the shipping frequency: the more shipments the exporter manages, the greater are the costs of spreading the quantity over yet another shipment. Also important, from a modeling point of view, this formulation allows us to keep the total cost function linear exactly as existing trade models do with production costs (see, e.g., Melitz, 2003; and Melitz and Ottaviano, 2008). Formally, we assume that inventory management costs at time t are $m(qt)^2$and order servicing costs arefN^2. Thus, to determine the total logistics costs associated with N shipments, we sum over the inventory cost and add the order servicing costs:

$$N\int_0^{\frac{1}{N}} m(qt)^2 dt + fN^2 = \frac{mq^2}{3N^2} + fN^2 \tag{4}$$

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[33] Kropf and Sauré (2014) and Hornok and Koren (2015) make different assumptions to fit inventory into a standard trade model. In particular, Kropf and Sauré (2014) provide a model where continuously arriving demand is satisfied from an inventory. The price that consumers pay increases in a tax that depends on the time between arrival and purchase of the product. Hence, demand that arrives a longer time after the shipment has been delivered pays a higher price due to storage costs. Similarly, Hornok and Koren (2015) provide a model where the preference for a product depends on the arrival date. Consumers value a product less if the arrival date is a longer time away from the preferred arrival date. Given a distribution of preferred arrival dates, firms take into account fixed shipping costs to determine the optimal shipping frequency. We model inventory and storage costs on the production side. Exporters must accumulate inventory to fill each shipment. This leads to a standard inventory costs function that depends on the average quantity managed in inventory, shipping frequency, and order servicing costs (see Baumol and Vinod, 1970).

Adding a fixed per period costs of maintaining productive and inventory capacity, F, the total cost of supplying the foreign buyer is then:

$$\frac{mq^2}{3N^2} + fN^2 + F + cq \tag{5}$$

The exporter chooses the cost minimizing shipping frequency:

$$N = \sqrt{q}(m/3f)^{(1/4)} \tag{6}$$

and substituting into the cost function we obtain $q2\sqrt{mf/3} + cq + F$.[34] In other words, the inventory and logistics cost simplify to a linear cost function akin to the standard trade models and can therefore be easily interpreted in these models. In Appendix B, we solve the exporter's optimization problem based on CES preferences and show how a decrease in per-shipment costs and variable trade costs due to the TIM affects all observable firms' export intensive and shipping frequency margins.

TIM reduces variable export costs by reducing order servicing costs and non-tariff barriers associated with lengthy processing times at the border as well as fixed costs of exporting if the streamlining of documents and electronic management of the export process it implies lowers the management overhead dedicated to export activity. Standard trade theory predicts that the reduction in variable and fixed costs of exporting allows more (smaller, less productive) firms to enter export markets.

To disentangle the channels, we estimate the effects of using the new transit system on the quantity (weight) shipped, the unit values, the number of shipments, the average value and quantity per shipment, the number of buyers, the average value and quantity per buyer, and the average number of shipments per buyer, based on Equation (2). Estimation results are presented in the first column of Table 8's upper panel and are broadly consistent with our theoretical model. These results reveal that the new transit procedures have mainly affected the number of shipments and thereby the quantity shipped as well as the number of buyers and the number of shipments per buyer, and therewith the average value and quantity of exports per buyer. Specifically, the TIM has been associated with a rise in the number of shipments of 42.5% but with a substantially smaller increase in the size of the shipments in terms of value and quantities.[35] In other words, the TIM seems to have led to an expansion of exports which primarily took place through higher shipping frequency (and faster processing) instead of greater average levels of managed inventories. This evidence based on a well-defined policy change complements findings reported in recent papers according to which shipments are important margin of adjustment in

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[34] The standard setting in the inventory literature assumes both linear inventory accumulation costs and linear order servicing costs. The implied costs of serving a foreign buyer are therefore $\frac{mq}{2N} + fN^2 + F + cq$ and the associated cost-minimizing shipping frequency is $N = \sqrt{mq/2f}$ (see, e.g., Baumol and Vinod, 1970, Taylor and Wiggins, 1997; Clark et al., 2014). These expressions generate a non-linear cost function in the quantity produced, which is non-standard from the trade theory perspective.

[35] It might be argued that this might be driven by technological constraints which limit the size of shipments of given products. However, a histogram of the share of shipments accounted for by the modal size suggests that there is substantial variability in shipment size within products. This histogram is presented in Figure C1 in Appendix C. The same holds when the data is first grouped by firms to account for the fact that products can be sold by multiple firms.

international trade (e.g., Kropf and Sauré, 2014; and Hornok and Koren, 2015).[36] Furthermore, this bespeaks that order servicing costs might play an important role as conduit for transit regimes to impact on trade. Importantly, the TIM does not appear to have influenced the unit values (fob prices).This suggests that changes in exports have been mostly driven by changes in demand due to reduction in trade costs.

To examine whether the changes in transit procedures affect the firm extensive margin we estimate a modified version of Equation (2) at the product-destination level in which the main dependent variable is the change in the number of firms registering exports in the product-destination in question and the main explanatory variable is change in the TIM indicator at this level along with product-year and destination-year fixed effects. It is also worth noting that, by aggregating away the firm dimension, these estimations are less subject not only to the self-selection problems discussed above but also to the granularity issue. The estimates of this equation are presented in the second column of Table 8’s upper panel. According to these estimates, streamlined transit procedures have had a significant positive impact on the firm extensive margin and thus they seem to have indeed helped new firms penetrate export markets. Interestingly, the pooled estimate is comparable to that obtained on the original data when weighting (see Column 3 in Table 3).

5.5 Backing Out the TIM Effects on Order Servicing Costs and Variable Trade Costs

The results show that the shipping frequency is a key channel through which trade responds to changes in border frictions. In this subsection, we use the tradeoff between inventory holding costs and order servicing featured in the previous model costs to back out the effects of TIM on order servicing and variable trade costs.

To arrive at our estimation specification, we log linearize the shipping frequency –Equation (6)- and add subscripts to obtain:

$$lnN_{fpct} = \left(\frac{1}{2} lnq(TIM)_{fpct} - \frac{1}{4} lnf(TIM)_{fpct}\right) + \lambda_{fpc} + \delta_{ft} + \rho_{pct} + \varepsilon_{fpct} \tag{7}$$

This specification highlights that the total reduced-form estimated effect of the TIM on the shipping frequency as reported in Table 8, $\alpha = 0.265$, captures changes in the total quantity and changes in order servicing costs.[37] We do not expect that the TIM affects per-unit inventory management costs and

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[36] More precisely, Kropf and Sauré (2014) use Swiss data to estimate the magnitude of fixed order costs similar as Alessandria et al (2010). Hornok and Koren (2015) estimate a gravity model to assess how fixed shipment costs affect order frequency and bilateral trade. Instead, we employ a policy experiment to show how much these fixed costs can be reduced with directed policy as negotiated in a WTO agreement. This is not only important from an economic policy point of view but also because fixed shipment costs include more than what is typically covered in standard indicators such as Doing Business. Costs associated with real time order tracking would be an example in that regard.

[37] This corresponds to the estimated effect of the TIM on the number of shipments per buyer.

therefore relegate that parameter to the firm-product fixed effects. To separate the effect on order servicing costs, we solve the optimal shipping frequency for these costs, log-linearize, and take the difference in variables before and after the TIM, which yields:

$$ln\frac{f(TIM=1)}{f(TIM=0)} = 2[ln\,q(TIM=1) - ln\,q(TIM=0)] - 4[lnN(TIM=1) - lnN(TIM=0)] \tag{8}$$

Based on the estimates shown in Table 8, Equation (8) implies that the TIM reduced order servicing costs by 0.314 log points or 27% (see the first row of Table 8's lower panel).[38]

Using the functional form of the demand equation we can also back out changes in the *ad-valorem* trade costs. As is standard in the literature, let demand be characterized by constant elasticity of substitution such that the revenues equal $r = Aq^{1-\frac{1}{\sigma}}/(1+\tau)$, where A is a demand shifter. Solving for the variable trade cost, taking logs, and differencing yields:

$$ln\frac{1+\tau(TIM=1)}{1+\tau(TIM=0)} = \left(1-\frac{1}{\sigma}\right)\left[ln\big(q(TIM=1)\big) - ln(q(TIM=0))\right] - [lnr(TIM=1) - lnr(TIM=0)] \tag{9}$$

Applying the estimates reported in the upper panel Table and three alternative elasticity estimates from the literature, we conclude that *ad-valorem* trade costs would have declined between 5% and 10% as a consequence of the TIM (see the second row of Table 8's lower panel). These estimated reductions in variable trade costs are smaller than those in the order servicing costs. This is consistent with the finding that the TIM-induced adjustments primarily occurred along the shipping frequency margin.

5.6 Heterogeneities: Are Trade Gains Distributed Evenly?

We next assess whether there are heterogeneous effects along various dimensions by estimating alternative specifications of Equation (3), in which we primarily allow for different impacts across groups of firms, products, and destinations.

We first distinguish between small exporters (i.e., firm with up to 200 employees) and large exporters (i.e., firms whose number of employees is above this threshold).[39] Estimates are shown in the left panel of Table 9.[40] These estimates indicate that exports from larger and smaller firms benefit to similar extent

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[38] Alternatively, using linear inventory management and order servicing costs instead of their quadratic counterparts, we find that the TIM reduced the latter costs by 0.373-2x0.265=-0.157 log points or about 14.5%.

[39] Employment data come from the 2011 national economic census. The number of observations is smaller than in previous tables because information on number of employees is not available for all exporting firms. We therefore also report for reference estimates of our baseline equation on this restricted sample. These estimates are in line with those shown in Table 3.

[40] The median size of the firms using the TIM in terms of their number of employees is larger than their peers not using the TIM (i.e., 64 vs. 28 employees). Note, however, that the potential influence of (time-varying) firm size on both selection into the new transit system and export performance is accounted for by the firm-year fixed effects.

from the new transit system.[41] The previous analysis informed the effects of the TIM on the export intensive margin (i.e., continuing flows). As for the firm extensive margin, we estimate a variant of Equation (3) that allows for different effects on (aggregated) small and large firms' exports as obtained on data at the product-destination-firm size category-year level (see the last two columns of Table 9).[42] As expected, estimates suggest that TIM's impact on entry into export markets has been stronger for smaller firms.[43]

Further along these lines, we assess the impact of improved transit procedures on the destination margin for firms' exports of given products. More specifically, we estimate a variant of Equation (2) where the dependent variable is the change in a binary indicator that takes the value of one if a firm-product-destination flow is present in a given year and zero otherwise and the main explanatory variable is the change in the TIM status indicator between two consecutive years, on the sample of all firm-product-destination triples that did not register exports in 2010 conditional on the firms exporting the products in question to at least one destination (i.e., on the respective firm-product pair being positive).[44] In addition, we estimate a variant of Equation (3) which allows for different effects for small and large firms. According to the estimates of this equation, reduced transit times associated with the TIM has had a significant positive effect on the destination extensive margin and this effect seems to have been larger for smaller companies.[45] In other worlds, TIM appears to have helped firms in general and small ones in particular reach new export markets.[46]

Second, we assess the existence of heterogeneous effects across products. In this sense, time matters for trade particularly when goods are subject to rapid depreciation. This loss of value may be driven by spoilage (e.g., fresh produce), fashion cycles (e.g., shoes and garment), and technological obsolescence (e.g., consumer electronics). It can therefore be expected that shorter transit times have stronger effects on these goods. In order to ascertain whether this is the case, we discriminate across goods according to their time-sensitiveness using the estimation results from Hummels and Schaur (2013), who identify the cost of lengthy delays based on firms' choices of air versus ocean shipment.[47] The respective estimates of

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[41] Results are similar if we use alternative thresholds to distinguish between small and large firms (i.e., 50 or 100 employees) or impose the condition that small and large firms export in the same product-destination combinations. These results are available from the authors upon request.

[42] Raw data reveal that, on average, new exporters tend to be smaller.

[43] In terms of values, the estimated effect on large firms' exports is comparable to that estimated on the product-destination level data. This is hardly surprising as these firms' flows are consistently larger than those of their smaller counterparts. This can be seen in the kernel densities presented in Figure C2 in Appendix C.

[44] Given the logic of the transit system and to be parsimonious and consistent with estimations aimed at uncovering potential heterogeneous effects across countries, singled out destinations are the individual Central American countries and the rest of the word as such.

[45] Results are identical if we instead directly estimate the respective variant of Equation (1) such that the dependent variable is a binary indicator of export status in the year in question. These results are available from the authors upon request.

[46] These estimation results are available from the authors upon request.

[47] We use the estimated effect of shipping times on the share of air relative to ocean shipments. In particular, goods are identified as time-sensitive if the estimated coefficient on shipping time (i.e., days/rate ratio) of the respective HS 2-digit is positive and significant.

Equation (3) are reported in the left panel of Table 10. These estimates confirm that the positive effects of reduced transit times are stronger on sales of time-sensitive goods.[48] When we assess how the TIM has affected sectoral exports, we observe that the impacts have been larger precisely on those sectors whose goods tend to be more time-sensitive.[49] This is particularly the case with food products (see right panel of Table 10).[50]

When we additionally allow for different effects by firm size categories, estimation results reveal that the impact is largest on small firms' exports of time-sensitive products. The second largest effect is observed on large firms' exports of the same type of goods.[51] It is worth pointing out that the effects of the TIM across product categories again works mostly through an increase in the shipping frequency. In the literature on time and trade this margins has not been examined extensively. Our results suggest that time costs are primarily captured by order processing costs. Take for example perishable food or fashion items. Before a well function transit system was in place, firms had to invest into monitoring, possible re-routing and prepare the products for lengthy transport with possible delays. With the implementation of the TIM, these costs decreased. It became easier and cheaper to ship goods on time.

In addition, we allow for different effects on differentiated and non-differentiated products based on the classification proposed by Rauch (1999) and on heavy and light products (i.e., products with weight-to-value ratios above and up to the median according to worldwide data from COMTRADE).[52] Estimates are shown in Table 10. Estimates reveal that simplification of transit procedures has particularly favored exports of differentiated products (see left panel of Table 10). Interestingly, they also indicate that these new procedures do not seem to have affected differently exports of heavy products and light products (see right panel of Table 10). While such a difference would be expected if the policy shock would have consisted for instance of improved road infrastructure (hardware), this is not necessarily here as the policy innovation primarily assumed the form of a change in processes (software).

Heterogeneous effects can also arise across destinations. In Table 12 we examine whether this holds in our data by distinguishing across groups of countries through interaction terms. Evidence presented in this table suggests that the positive response of foreign sales to shorter transit processing times does not depend on the final destination, either within the region or outside of the region (see Columns 1 and 2 of Table 12). Note that, since regional sales are mostly road-based while extra-regional sales are mostly

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[48] Alternatively, we use the frequency at which goods were shipped abroad over the period 2007-2009 to distinguish between time-sensitive goods (i.e., goods whose shipping frequency was above the median) and time-insensitive goods (i.e., goods whose shipping frequency was below or at the median) and re-estimate Equation (3), this time permitting different effects for these so-defined groups of goods (see Evan and Harrigan, 2005; and Volpe Martincus and Blyde, 2013). According to the estimation results, only time sensitive products seem to experience foreign sales gains as a consequence of reduced transit time. These results are available from the authors upon request.

[49] Exports are assigned to the different sectors based on a COMTRADE concordance table that maps HS products into BEC sectors.

[50] Estimates for more finely defined product categories are available from the authors upon request.

[51] These results are available from the authors upon request.

[52] Results presented in Table 11 are based on the liberal version of the classification. Estimates obtained when using the conservative alternative are similar and are available from the authors upon request.

multimodal –road and maritime transportation-, these results could also be seen as informing impacts according to transport modes.[53] Within Central America, effects tend to be stronger for closer destinations (see Columns 3-5 of Table 12). A possible explanation could be that time savings associated with the new transit regime are larger relative to the respective total time spent in reaching the market for these destinations.

6 Concluding Remarks

Streamlined transit procedures can play an important role in lowering the administrative burden of and expediting order processing. The same holds for the real-time information that electronically processed transits provides to firms on their shipments as such improved information allows for more effective monitoring and management of order servicing. While available anecdotal evidence seems to indicate that this is the case, our understanding of transit in general and how it affects trade in particular has been so far limited due to absence of data.

In this paper we fill this gap in the literature by exploiting the gradual adoption of a new simplified transit regime in Central America -the International Transit of Goods (TIM)- to identify the effects of improvements in transit conditions on firms' exports. In so doing, we use highly detailed export transaction-level data that inform the regime under which shipments were processed and develop a simple theoretical model that rationalize our main estimation results.

These results show that simplified border procedures within regions where trade flows often cross multiple borders lower trade costs and consequently facilitate trade. We specifically find that exports processed under the new transit system grew faster than their counterparts subject to regular transit procedures. This is evidence that, to a significant extent, border frictions are due to regulations and procedures that can be reduced through appropriate trade policies.

Our estimates also suggest that the trade increasing effect can be mainly traced back to higher shipping frequency. Consistent with a standard inventory model, firms take advantage of reductions in order processing costs by primarily shipping more frequently and not by holding higher levels of inventory. Combined, our theoretical and empirical results indicate that a significant fraction of costs associated with borders is not only due to *ad valorem* costs –as typically assumed in standard models- but also fixed per shipment costs. This implies, first, that transit regimes can only reach their full potential if public infrastructure such as roads that can handle the associated increase in shipping frequency is available. Second, reductions in border costs and the associated increase in shipping frequencies have potential impacts beyond those on trade cost in terms of the pass-through of shocks and transmission of

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[53] This is confirmed by estimating a variant of Equation (3) on data at the firm-product-destination-transport mode-year level that allows for different effects depending on the transport mode. These results are available from the authors upon request.

volatility. The interplay between border procedures and road infrastructure in shaping trade outcomes and its broader macroeconomics effects is however still an open research question.

Furthermore, not everybody gains equally from upgraded transit regimes. Streamlined transit procedures influenced export specialization. Their impact has been larger on foreign sales of time-sensitive and differentiated goods. Improved transit may therefore be particularly helpful for countries that trade intermediate inputs and products with short selling seasons (see, e.g., Evans and Harrigan, 2005), fast depreciation due to changing tastes, or products for which demand is difficult to predict and shippers want a flexible transit system that allows them to respond fast to changing market conditions (see, e.g., Hummels and Schaur, 2010). Moreover, the effects of TIM appear to be asymmetric across regional destinations.

These results, which are consistent for the two exporting countries covered in the study –i.e., El Salvador and Guatemala-, provide different peers specializing in different products according to their comparative advantage and trading with different partners with valuable insights to evaluate the potential benefits of upgrading their transit trade regimes.

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Table 1

Aggregate Export Indicators				
Indicators	**All Sample (Values)**		**Central America (Shares)**	
	2010	**2013**	**2010**	**2013**
Export Value	4,024	5,100	0.433	0.450
Number of Shipments	321,155	403,249	0.801	0.814
Number of Exporters	2,272	2,333	0.826	0.826
Number of Products	3,133	3,277	0.939	0.937
Number of Destinations	111	113	0.045	0.044
Number of Buyers	9,273	9,340	0.727	0.711
Number of Customs	25	29	0.840	0.759
Overall TIM Share				
Share of TIM on Exports	0.000	0.260	0.000	0.365
Share of TIM on Shipments	0.000	0.278	0.000	0.300
Share of TIM on Exporters	0.000	0.365	0.000	0.418
Share of TIM on Products	0.000	0.577	0.000	0.589
Share of TIM on Destinations	0.000	0.372	0.000	1.000
Share of TIM on Buyers	0.000	0.268	0.000	0.334
Share of TIM on Customs	0.000	0.172	0.000	0.227
Share of TIM on Internationally Transiting Exports				
Share of TIM on Exports	0.000	0.271	0.000	0.646
Share of TIM on Shipments	0.000	0.444	0.000	0.634
Share of TIM on Exporters	0.000	0.518	0.000	0.734
Share of TIM on Products	0.000	0.678	0.000	0.773
Share of TIM on Destinations	0.000	0.360	0.000	1.000
Share of TIM on Buyers	0.000	0.386	0.000	0.743
Share of TIM on Customs	0.000	0.143	0.000	0.176

Source: Authors' calculations based on data from DGA and TIM.

Export values are expressed in millions of US dollars. The columns corresponding to "Central America" report the respective share of the totals for all destinations for export value, number of shipments, number of exporters, number of products, number of destinations, number of buyers, and number of customs. Destinations in Central America include: Costa Rica, Guatemala, Honduras, Nicaragua, and Panama. The second and third panels of the table present the share of the respective aggregate export figures under the TIM in exports to all destinations and exports to Central America, both when considering all exports regardless of international transit occurs or not and when considering only exports that strictly involve international transit (i.e., to Costa Rica, Nicaragua, and Panama), respectively. Air-shipped exports are excluded.

Table 2

Average Exporter				
Indicators	**All Destinations**		**Central America**	
	2010	**2013**	**2010**	**2013**
Export Value	1,771.0	2,186.1	928.5	1,190.5
Number of Shipments	141.4	172.8	137.1	170.3
Exports per Shipment	14.2	19.6	8.5	9.6
Number of Products	7.2	7.5	7.1	7.5
Exports per Product	218.9	264.0	137.4	148.4
Number of Destinations	2.3	2.3	1.9	1.9
Exports per Destination	350.2	415.3	272.8	352.5
Number of Buyers	5.9	5.8	5.4	5.2
Exports per Buyer	151.0	194.8	104.8	147.6
Number of Customs	2.1	2.1	2.0	1.9
Exports per Customs	398.3	523.6	242.1	344.1
Exports per Product and Destination	102.3	117.4	75.4	80.5
Number of Shipments per Product and Destination	7.1	7.6	7.9	8.2
Number of Buyers per Product and Destination	1.4	1.4	1.5	1.4
Number of Customs per Product and Destination	1.1	1.1	1.1	1.1

Source: Authors' calculations based on data from DGA and TIM.

Export values are expressed in thousands of US dollars. Destinations in Central America include: Costa Rica, Guatemala, Honduras, Nicaragua, and Panama. Air-shipped exports are excluded.

Table 3

The Impact of TIM on Firms' Exports Baseline Specification and First TIM	Baseline	Baseline 2010 Export Flows	Weighted by 2010 Values	Mid-Point Growth Rate
TIM	0.480	0.458	0.323	1.411
Heteroscedasticity-Consistent	(0.058)***	(0.080)***	(0.114)***	(0.018)***
Cluster Main Custom-Destination	(0.084)***	(0.118)***	(0.130)**	(0.053)***
Cluster Destination	(0.117)***	(0.179)***	(0.164)*	(0.061)***
Cluster Main Custom	(0.112)***	(0.142)***	(0.144)**	(0.035)***
Cluster Firm-Product-Destination	(0.060)***	(0.083)***	(0.127)**	(0.019)***
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	39,889	29,941	29,941	122,937

Source: Authors' calculations based on data from DGA and TIM.

Columns 1 and 2 of the table report OLS estimates of Equation (2) for both the entire sample and when restricting the sample to firm-product-destination exports present in 2010, whereas Column 3 of the table presents WLS estimates of Equation (2) using the values of the firm-product-destination export flows as weights. The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year fixed and product-destination-year effects included (not reported). Columns 4 of the table shows OLS estimates of another variant of Equation (2) where the dependent variable is the mid-point growth rate and the main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year fixed and product-destination-year effects included (not reported). Robust standard errors are reported in parentheses below the estimated coefficients. Standard errors clustered at alternative levels are shown next. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. The significance indicator is presented along with the respective standard errors.

Table 4

The Impact of TIM on Firms' Exports

Alternative Specifications

Annual Changes										
TIM	0.295***	0.298***	0.297***	0.290***	0.303***	0.443***	0.480***	0.517***	0.364***	0.426***
	(0.045)	(0.055)	(0.060)	(0.065)	(0.044)	(0.051)	(0.084)	(0.085)	(0.063)	(0.122)
Firm Fixed Effect	No	Yes	No	Yes	No	No	No	No	No	No
Product-Destination Fixed Effect	No	No	Yes	Yes	No	No	No	No	No	No
Firm-Year Fixed Effect	No	No	No	No	Yes	No	Yes	No	No	Yes
Product-Destination-Year Fixed Effect	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Firm-Product-Year Fixed Effect	No	No	No	No	No	No	No	Yes	No	No
Firm-Destination-Year Fixed Effect	No	No	No	No	No	No	No	No	Yes	No
Firm-Product-Destination Fixed Effects	No	No	No	No	No	No	No	No	No	Yes
Observations	39,889	39,889	39,889	39,889	39,889	39,889	39,889	39,889	39,889	39,889
							Customs	**Transport**	**Buyer**	**Semester**
TIM							0.533**	0.683***	0.467***	0.288***
							(0.222)	(0.045)	(0.071)	(0.036)
Firm-Product-Destination-Year Fixed Effect							Yes	Yes	Yes	Yes
Customs-Year Fixed Effect							Yes	No	No	No
Transport Company-Year Fixed Effect							No	Yes	No	No
Buyer-Year Fixed Effect							No	No	Yes	No
Semester Fixed Effect							No	No	No	Yes
Observations							43,193	54,779	55,469	70,598
Lagged Effects										
TIM								0.480***	0.479***	0.630**
								(0.084)	(0.137)	(0.259)
TIM (-1)									0.109	0.349
									(0.135)	(0.226)
TIM (-2)										0.208
										(0.190)
Firm-Year Fixed Effect								Yes	Yes	Yes
Product-Destination-Year Fixed Effect								Yes	Yes	Yes
Observations								39,889	18,979	7,551

Source: Authors' calculations based on data from DGA and TIM.

The first panel of the table report OLS estimates of alternative specifications of Equation (2). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. No fixed effects are included in the first column; firm fixed effects are included in the second column; product-destination fixed effects are included in the third column; firm and product-destination fixed effects are included in the fourth column; firm-year fixed effects are included in the fifth column; product-destination-year fixed effects are included in the sixth column; firm-year and product-destination-year fixed effects included in the seventh column; firm-product-year fixed effects and product-destination-year fixed effects are included in the eighth column; firm-destination-year fixed effects and product-destination-year fixed effects are included in the ninth column; firm-product-destination fixed effects and firm-year fixed effects and product-destination-year fixed effects are included in the tenth column (not reported). The second panel shows estimates of Equation (2) based on data at the firm-product-destination-customs-year level (seventh column), at the firm-product-destination-transport company-year level (eight column), at the firm-product-destination-buyer-year level (ninth column), and at the firm-product-destination-year-semester level (tenth column)). Firm-product-destination-year fixed effects and customs-year fixed effects, buyer-year fixed effects, transport company-year fixed effects, or semester fixed effects are included (seventh, eighth, ninth, and tenth columns, respectively). The third panel of the table reports OLS a modified version of Equation (2) that incorporates up to two lags of the main explanatory variable. Firm-year and production-destination-year fixed effects are included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficients. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 5

The Impact of TIM on Firms' Exports

Placebo Exercises, Event Study, and Instrumental Variables Estimations

Placebo Exercises

	Placebo 1 2007-2010	Baseline Same Observations 2010-2013	Placebo 2 Artificial First TIM	Baseline Same Observations 2010-2013
TIM (t+3) / TIM (t+1)	0.068	0.388***	0.051	0.306***
	(0.089)	(0.071)	(0.078)	(0.059)
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	17,330	17,330	14,827	26,744

Event Study

	Weighted Sample	2010 Weights	Balanced Panel	2010 Weights
TIM (τ-1)	0.008	0.003	0.007	0.002
	(0.006)	(0.004)	(0.006)	(0.002)
TIM (τ)	0.070***	0.021***	0.068***	0.020***
	(0.023)	(0.006)	(0.026)	(0.007)
TIM (τ+1)	0.052**	0.017***	0.057**	0.017***
	(0.024)	(0.006)	(0.025)	(0.006)
Firm-Product-Destination Fixed Effect	Yes	Yes	Yes	Yes
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes	Yes
Observations	117,528	117,528	75,510	75,510

Instrumental Variables Estimations

	OLS1	IV1	OLS2	IV2
TIM	0.467***	0.483***	0.299***	0.174*
	(0.093)	(0.070)	(0.063)	(0.100)
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	No	No
Product-Year Fixed Effect	No	No	Yes	Yes
Destination Fixed Effect	No	No	Yes	Yes
First Stage Estimates				
Availability of TIM for Municipality-Customs-Product-Destination		0.631***		
		(0.051)		
Availability of TIM for according to National Implementation Schedule				0.243***
				(0.067)
Firm-Year Fixed Effect		Yes		Yes
Product-Destination-Year Fixed Effect		Yes		No
Product-Destination Fixed Effect		No		Yes
Destination Fixed Effect		No		Yes
F Test Statistic		151.0		13.7
Observations		23772		39,889

Source: Authors' calculations based on data from DGA and TIM.

The upper panel of the table reports OLS estimates of Equation (2) based on placebo exercises whereby firm-product-destinations exports using the TIM over the period 2011-2013 are assumed to have used it over the period 2008-2010 (Column 1) and whereby firm-product-destinations exports using the TIM for the first time over the period 2011-2013 are assumed to have used it the year immediately before (Column 3). Estimates in Columns 2 and 4 correspond to our baseline but when the same is restricted to those firm-product-destinations (also present in 2007-2010). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Columns 1 and 3 in the second panel present OLS estimates from an event study-type regression based on Equation (1) whereby the behavior of firm-product-destination export flows that adopted the TIM in a given year is tracked one year before and one year after that adoption year. Firm-product-destination, firm-year and product-destination-year fixed effects included (not reported). In Column 3 we restrict the sample to those firm-product-destination triples that were present in all sample years. Columns 2 and 4 show the respective WLS estimates using the values of the firm-product-destination export flows in 2010 as weights. The third panel reports OLS and instrumental variables estimates of Equation (2) along with the estimates of the first stage equation, the F test statistics. The instruments are a binary indicator that takes the value of one if at least one firm located in the same municipality can ship the same product to the same destination through the TIM and zero otherwise (Column 2) and TIM's national implementation schedule as established in Salvadoran customs' administrative decisions (Column 4). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects (Columns 1 and 2) and firm-year, product-year, and destination fixed effects (Columns 3 and 4) included (not reported). Standard errors clustered by main customs-destination (Columns 1 and 2) and destination (Columns 3 and 4) are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 6

The Impact of TIM on Firms' Exports
General Equilibrium Effects: Market Stealing

	Treated vs. Untreated			Treated vs. Residual			Untreated vs. Residual		
	Same Destination and Same			Different Destination and Different					
	HS4	**HS6**	**HS8**	**HS4**	**HS6**	**HS8**	**HS4**	**HS6**	**HS8**
TIM	0.418***	0.455***	0.493***	0.233***	0.268***	0.280**	-0.067**	-0.017	-0.105
	(0.051)	(0.064)	(0.098)	(0.052)	(0.097)	(0.115)	(0.030)	(0.040)	(0.097)
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HS2-Destination-Year Fixed Effect	Yes	No	No	Yes	No	No	Yes	No	No
HS4-Destination-Year Fixed Effect	No	Yes	No	No	Yes	No	No	Yes	No
HS6-Destination-Year Fixed Effect	No	No	Yes	No	No	Yes	No	No	Yes
Observations	15,287	11,807	11,203	21,691	27,080	28,108	29,099	29,099	29,099

Source: Authors' calculations based on data from DGA and TIM.
The table reports OLS estimates of Equation (2). The samples are defined to compare "treated" vs. "untreated", "treated" vs. "residual", and "untreated" vs. "residual". "Untreated" are defined as those firm-product-destination exports without changes in their transit procedures and consist of the same HS4, HS6, or HS8 product-destination combinations as those of counterparts using the TIM, whereas "Residual" are defined as those firm-product-destination exports without changes in their transit procedures and consist of HS4, HS6, or HS8 product-destination combinations different from those of counterparts using the TIM. The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year fixed and product-destination-year effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 7

The Impact of TIM on Firms' Exports: Guatemala

Alternative Specifications

	Annual Changes			
TIM	0.462***	0.417***	0.300***	0.377***
	(0.061)	(0.054)	(0.036)	(0.042)
Firm-Year Fixed Effect	No	Yes	No	No
Product-Destination-Year Fixed Effect	No	Yes	Yes	Yes
Firm-Product-Year Fixed Effect	No	No	Yes	No
Firm-Destination-Year Fixed Effect	No	No	No	Yes
Observations	70,146	70,146	70,146	70,146

	First TIM		**Semester Changes**	
TIM	0.368***	0.357***	0.343***	0.317***
	(0.059)	(0.058)	(0.036)	(0.044)
Firm-Year Fixed Effect	No	Yes	No	No
Product-Destination-Year Fixed Effect	No	Yes	No	No
Firm-Product-Destination-Year Fixed Effect	No	No	No	Yes
Semester Fixed Effect	No	No	No	Yes
Observations	62,543	62,543	116,475	116,475

	Lagged Effects		
TIM	0.417***	0.355***	0.309***
	(0.054)	(0.041)	(0.044)
TIM (-1)		0.058	0.044
		(0.042)	(0.070)
TIM (-2)			-0.018
			(0.064)
Firm-Year Fixed Effect	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes
Observations	70,146	36,987	20,159

The Impact of TIM on Firms' Exports in El Salvador and Guatemala

	OLS
TIM	0.374***
	(0.035)
Firm-Year Fixed Effect	Yes
Product-Year Fixed Effect	Yes
Destination Fixed Effect	Yes
Observations	101,758

Source: Authors' calculations based on data from SAT, DGA, and TIM.

The first panel of the table reports OLS estimates of alternative specifications of Equation (2). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. No fixed effects are included in the first column; firm-year fixed effects and product-destination fixed effects are included in the second column; firm-product-year fixed effects and product-destination-year fixed effects are included in the third column; and firm-country-year fixed effects and product-destination-year fixed effects are included in the fourth column (not reported). The second left panel shows estimates of Equation (2) when restricting the sample to exports that never used the TIM in the past. No fixed effects are included in the first column; and firm-year fixed effects and product-destination fixed effects are included in the second column (not reported). The second right panel presents estimates of Equation (2) based on data at the firm-product-destination-year-semester level. No fixed effects are included in the first column; and firm-product-destination-year fixed effects and semester fixed effects are included in the second column (not reported).The third panel of the table reports OLS a modified version of Equation (2) that incorporates up to two lags of the main explanatory variable. Firm-year and production-destination-year fixed effects are included (not reported). The fourth panel reports OLS estimates of variant of Equation (2) when pooling together data from El Salvador and Guatemala. The dependent variable is the change in the natural logarithm of export value at the firm-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping to the destination in question and zero otherwise. Firm-year, product-year, and destination fixed effects included (not reported). Standard errors clustered by main-customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 8

The Impact of TIM on Firms' Exports

Channels

Export Outcomes	Firm-Product-Destination Data	Product-Destination Data
Export Value	0.480***	0.373***
	(0.084)	(0.043)
Export Quantity	0.462***	0.363***
	(0.088)	(0.044)
Unit Value	0.018	0.009
	(0.024)	(0.041)
Number of Shipments	0.354***	0.255***
	(0.055)	(0.020)
Export Value per Shipment	0.126**	0.118***
	(0.049)	(0.041)
Export Quantity per Shipment	0.108**	0.109***
	(0.049)	(0.038)
Number of Buyers	0.089***	0.168***
	(0.021)	(0.012)
Export Value per Buyer	0.391***	0.204***
	(0.090)	(0.044)
Export Quantity per Buyer	0.373***	0.195***
	(0.094)	(0.042)
Number of Shipments per Buyer	0.265***	0.086***
	(0.070)	(0.014)
Number of Firms		0.151***
		(0.013)
Export Value per Firm		0.222***
		(0.052)
Export Quantity per Firm		0.212***
		(0.046)
Firm-Year Fixed Effect	Yes	No
Product-Destination-Year Fixed Effect	Yes	No
Product-Year Fixed Effect	No	Yes
Destination-Year Fixed Effect	No	Yes
Observations	39,889	23,954

Backing Out the Impact of the TIM on Order Servicing Costs and Trade Costs

	Estimates	Change in Order Servicing Cost	
		Trade with Inventories	Inventories Only
Number of Shipments per Buyer	0.265	-26.95%	-14.50%
Export Quantity per Buyer	0.373		

	Estimates	Change in Trade Costs (Trade Model with Inventories)		
		σ =4.1	σ = 5	σ = 8.2
Export Value per Buyer	0.391	-5.82%	-8.61%	-10.42%
Export Quantity per Buyer	0.373			

Source: Authors' calculations based on data from DGA and TIM and elasticity estimates from the literature (see below).

The first column of the upper panel of the table reports OLS estimates of Equation (2). The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. The second column of the upper panel of the table reports OLS estimates of a modified version of Equation (2) as obtained from data at the product-destination-year level. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer, number of exporting firms, export value per exporting firm, and export quantity per exporting firm at the product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if TIM in used in shipping the product to the destination in question and zero otherwise. Product-year and destination-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. The lower panel of the table backs out the impact of TIM on order servicing costs and trade costs. Log Change in Order Servicing Cost (Trade Model) = 2 x Estimated Coefficient on Export Quantity per Buyer – 4 x Estimated Coefficient on Number of Shipments per Buyer. Log Change in Order Servicing Cost (Inventories Model) = Estimated Coefficient on Export Quantity per Buyer – 2 x Estimated Coefficient on the Number of Shipments per Buyer. Log Change in Trade Costs (Trade Model) = (1-1/σ) x (Estimated Coefficient Export Quantity per Buyer – Estimated Coefficient on Export Values per Buyer). Elasticities are taken from Simonovska and Waugh (2014), Soderbery (2015) and Eaton and Kortum (2002) respectively. In the case of Soderbery (2015), the elasticity estimate corresponds to the mean.

Table 9

The Impact of TIM on Firms' Exports
Heterogeneous Effects by Firm Size

Export Outcomes	Firm-Product-Destination Data			Product-Destination (-Firm Size Categories) Data	
	Baseline	Effects by Firm Size Categories		Effects by Firm Size Categories	
		Large	Small	Large	Small
Export Value	0.471***	0.440***	0.501***	0.374***	0.459***
	(0.084)	(0.087)	(0.114)	(0.118)	(0.101)
Export Quantity	0.444***	0.329***	0.552***	0.290***	0.465***
	(0.097)	(0.099)	(0.136)	(0.061)	(0.090)
Unit Value	0.028	0.111	-0.050	0.084	-0.006
	(0.051)	(0.072)	(0.057)	(0.086)	(0.058)
Number of Shipments	0.317***	0.292***	0.340***	0.201***	0.217***
	(0.028)	(0.041)	(0.070)	(0.043)	(0.056)
Export Value per Shipment	0.155**	0.148	0.161**	0.173	0.243***
	(0.073)	(0.097)	(0.074)	(0.140)	(0.064)
Export Quantity per Shipment	0.127*	0.037	0.211**	0.088	0.248***
	(0.091)	(0.094)	(0.102)	(0.081)	(0.077)
Number of Buyers	0.109***	0.091***	0.126***	0.125***	0.185***
	(0.023)	(0.014)	(0.043)	(0.015)	(0.029)
Export Value per Buyer	0.362***	0.348***	0.376***	0.248**	0.274***
	(0.085)	(0.086)	(0.108)	(0.119)	(0.082)
Export Quantity per Buyer	0.335***	0.237**	0.426***	0.164***	0.280***
	(0.098)	(0.096)	(0.128)	(0.058)	(0.083)
Number of Shipments per Buyer	0.208***	0.200***	0.215***	0.076*	0.031
	(0.033)	(0.048)	(0.049)	(0.040)	(0.037)
Number of Firms				0.114***	0.151***
				(0.021)	(0.016)
Export Value per Firm				0.260**	0.308***
				(0.103)	(0.094)
Export Quantity per Firm				0.176***	0.314***
				(0.050)	(0.087)
Firm-Year Fixed Effect	Yes	Yes		No	
Product-Destination-Year Fixed Effect	Yes	Yes		No	
Product-Year Fixed Effect	No	Yes		Yes	
Destination-Year Fixed Effect	No	Yes		Yes	
Firm-Size-Year Fixed Effect	No	Yes		Yes	
Observations	23,991	23,991		23,954	

Source: Authors' calculations based on data from DGA and TIM.

The left panel of table reports OLS estimates of a specification of Equation (3) that allow for different effects on exports from small and large firms. Firms are classified as large (small) if their number of employees exceeds (does not exceed) 200. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping to the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. The right panel of the table reports OLS estimates of a modified version of Equation (3) as obtained from data at the product-destination-firm size category-year level. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer, number of exporting firms, export value per exporting firm, and export quantity per exporting firm at the product-destination-firm size category level. The main explanatory variable is the change in a binary indicator taking the value of one if the TIM is used by the firm-size category in shipping the product to the destination in question and zero otherwise. Product-year, destination-year, and firm size category-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 10

The Impact of TIM on Firms' Export Growth
Heterogeneous Effects by Product Categories: Time Sensitiveness and Sectors

Export Outcomes	Time-Sensitive Products (TS) vs. Time-Insensitive Products (TI)		Sectoral Effects					
	TS	TI	Food	Textiles	Other Industrial Supplies	Capital Goods	Transport Equipment	Other Consumer Goods
Export Value	0.484***	0.221	0.631***	0.436***	0.435***	0.553***	0.308**	0.567***
	(0.084)	(0.218)	(0.172)	(0.165)	(0.054)	(0.095)	(0.151)	(0.125)
Export Quantity	0.465***	0.262	0.671***	0.374**	0.466***	0.444***	0.316***	0.578***
	(0.088)	(0.225)	(0.157)	(0.145)	(0.091)	(0.125)	(0.105)	(0.140)
Unit Value	0.019	-0.041	-0.040	0.061*	-0.031	0.108	-0.009	-0.012
	(0.025)	(0.067)	(0.092)	(0.034)	(0.074)	(0.075)	(0.072)	(0.037)
Number of Shipments	0.354***	0.318	0.512***	0.271***	0.358***	0.367***	0.286***	0.452***
	(0.055)	(0.164)*	(0.167)	(0.081)	(0.033)	(0.041)	(0.094)	(0.159)
Export Value per Shipment	0.129***	-0.097	0.120	0.165*	0.077*	0.186**	0.021	0.114**
	(0.049)	(0.208)	(0.214)	(0.096)	(0.040)	(0.071)	(0.216)	(0.055)
Export Quantity per Shipment	0.111**	-0.056	0.159	0.103	0.108	0.077	0.030	0.126**
	(0.049)	(0.221)	(0.149)	(0.083)	(0.090)	(0.092)	(0.167)	(0.061)
Number of Buyers	0.092***	-0.136	0.066	0.110***	0.101***	0.100***	0.066	0.049
	(0.021)	(0.103)	(0.074)	(0.025)	(0.011)	(0.027)	(0.056)	(0.042)
Export Value per Buyer	0.392***	0.356	0.565***	0.326**	0.334***	0.452***	0.242	0.518***
	(0.091)	(0.230)	(0.175)	(0.163)	(0.056)	(0.090)	(0.195)	(0.151)
Export Quantity per Buyer	0.373***	0.398*	0.604***	0.265*	0.365***	0.344***	0.251*	0.53***
	(0.095)	(0.236)	(0.173)	(0.144)	(0.087)	(0.129)	(0.142)	(0.168)
Number of Shipments per Buyer	0.262***	0.454**	0.445**	0.162**	0.257***	0.267**	0.221***	0.404**
	(0.070)	(0.194)	(0.204)	(0.077)	(0.039)	(0.044)	(0.057)	(0.190)
Firm-Year Fixed Effect	Yes		Yes					
Product-Destination-Year Fixed Effect	Yes		Yes					
Observations	39,732		39,889					

Source: Authors' calculations based on data from DGA and TIM.

The left panel of table reports OLS estimates of a specification of Equation (3) that allow for different effects on exports of time-sensitive products (TS) and time-insensitive products (TI). Products are classified using estimation results reported in Hummels and Schaur (2013). We use the estimated effect of shipping times on the share of air relative to ocean shipments. In particular, products are identified as time-sensitive if the estimated coefficient on shipping time (i.e., days/rate ratio) of the respective 2 digit HS is positive and significant. The right panel of the table presents OLS estimates of Equation (3) that allow for different effects on exports of different product categories: food products, textile products, other industrial supplies, capital goods, transport equipment, and other consumer goods. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 11

The Impact of TIM on Firms' Export Growth
Heterogeneous Effects by Product Categories: Differentiation and Weight-to-Value

Export Outcomes	Differentiated Products vs. Non-Differentiated Products		Heavy Products vs. Light Products	
	D	ND	H	L
Export Value	0.511***	0.291***	0.451***	0.500***
	(0.051)	(0.108)	(0.085)	(0.098)
Export Quantity	0.494***	0.266**	0.480***	0.452***
	(0.052)	(0.113)	(0.079)	(0.108)
Unit Value	0.017	0.026	-0.029	0.048*
	(0.028)	(0.059)	(0.030)	(0.027)
Number of Shipments	0.366***	0.279***	0.402***	0.325***
	(0.030)	(0.055)	(0.063)	(0.058)
Export Value per Shipment	0.145***	0.012	0.049	0.175***
	(0.039)	(0.085)	(0.047)	(0.060)
Export Quantity per Shipment	0.128***	-0.013	0.078*	0.128**
	(0.040)	(0.089)	(0.041)	(0.064)
Number of Buyers	0.096***	0.049	0.090***	0.089***
	(0.015)	(0.032)	(0.023)	(0.024)
Export Value per Buyer	0.415***	0.242**	0.361***	0.411***
	(0.048)	(0.105)	(0.098)	(0.102)
Export Quantity per Buyer	0.398***	0.216**	0.389***	0.363***
	(0.050)	(0.109)	(0.091)	(0.113)
Number of Shipments per Buyer	0.270***	0.230***	0.312***	0.235***
	(0.028)	(0.050)	(0.078)	(0.072)
Firm-Year Fixed Effect	Yes		Yes	
Product-Destination-Year Fixed Effect	Yes		Yes	
Observations	39,889		39,396	

Source: Authors' calculations based on data from DGA and TIM.

The left panel of table reports OLS estimates of a specification of Equation (3) that allow for different effects on exports of differentiated products (D) and non-differentiated products (ND). Products are categorized using the liberal version of the classification proposed by Rauch (1999). The right panel of table reports OLS estimates of a specification of Equation (3) that allow for different effects on exports of heavy products (H) and light products (L). Products are categorized as heavy (light) is their weight-to-value ratio exceeds (does not exceed the median) as computed using worldwide data from COMTRADE. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 12

The Impact of TIM on Firms' Exports
Heterogeneous Effects by Destinations

	All Products					Common Products across Destination				
Export Outcomes	**CA and ROW**		**Contiguous CA Countries, Non-Contiguous CA Countries, and ROW**			**CA and ROW**		**Contiguous CA Countries, Non-Contiguous CA Countries, and ROW**		
	CA	**ROW**	**CCA**	**NCCA**	**ROW**	**CA**	**ROW**	**CCA**	**NCCA**	**ROW**
Export Value	0.469***	0.557***	0.626***	0.290***	0.565***	0.476***	0.577***	0.657***	0.289***	0.531***
	(0.084)	(0.159)	(0.076)	(0.037)	(0.158)	(0.087)	(0.163)	(0.079)	(0.025)	(0.185)
Export Quantity	0.462***	0.463***	0.626***	0.274***	0.472***	0.465***	0.479***	0.650***	0.266***	0.410***
	(0.098)	(0.121)	(0.081)	(0.028)	(0.119)	(0.102)	(0.122)	(0.080)	(0.035)	(0.146)
Unit Value	0.007	0.094	0.000	0.016	0.093	0.012	0.098	0.007	0.024	0.121**
	(0.026)	(0.059)	(0.026)	(0.029)	(0.059)	(0.030)	(0.060)	(0.025)	(0.039)	(0.055)
Number of Shipments	0.364***	0.283***	0.468***	0.245***	0.288***	0.373***	0.288***	0.485***	0.252***	0.264***
	(0.062)	(0.048)	(0.084)	(0.024)	(0.048)	(0.065)	(0.050)	(0.094)	(0.021)	(0.058)
Export Value per Shipment	0.106***	0.274**	0.158***	0.045	0.277*	0.103**	0.29**	0.172***	0.037**	0.267*
	(0.037)	(0.126)	(0.042)	(0.026)	(0.097)	(0.043)	(0.128)	(0.051)	(0.019)	(0.137)
Export Quantity per Shipment	0.098**	0.180*	0.158**	0.030***	0.183*	0.092	0.192*	0.165***	0.013	0.146
	(0.050)	(0.097)	(0.035)	(0.020)	(0.052)	(0.058)	(0.097)	(0.051)	(0.043)	(0.106)
Number of Buyers	0.088***	0.095*	0.088**	0.088***	0.095*	0.097***	0.097*	0.103***	0.092***	0.078*
	(0.023)	(0.052)	(0.035)	(0.020)	(0.052)	(0.022)	(0.049)	(0.033)	(0.020)	(0.046)
Export Value per Buyer	0.381***	0.462***	0.538***	0.202***	0.47***	0.379***	0.481***	0.553***	0.198***	0.453**
	(0.091)	(0.173)	(0.092)	(0.052)	(0.172)	(0.091)	(0.174)	(0.091)	(0.039)	(0.192)
Export Quantity per Buyer	0.374***	0.368***	0.538***	0.186***	0.377***	0.367***	0.382***	0.547***	0.174***	0.332**
	(0.104)	(0.125)	(0.098)	(0.039)	(0.123)	(0.104)	(0.125)	(0.092)	(0.033)	(0.147)
Number of Shipments per Buyer	0.276***	0.188**	0.380***	0.156***	0.193**	0.276***	0.191**	0.381***	0.161***	0.186**
	(0.076)	(0.078)	(0.110)	(0.039)	(0.079)	(0.077)	(0.078)	(0.117)	(0.034)	(0.080)
Firm-Year Fixed Effect	Yes		Yes			Yes		Yes		
Product-Destination-Year Fixed Effect	Yes		Yes			Yes		Yes		
Observations	39,889		39,889			32,231		30,559		

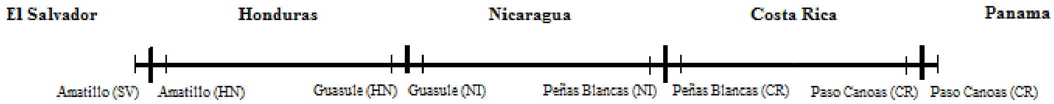
Source: Authors' calculations based on data from DGA and TIM.

The table reports OLS estimates of a specification of Equation (3) that allow for different effects across destinations (CA: Central America – CCAC: Contiguous Central American Countries: Honduras and Guatemala; Non-Contiguous Central American Countries: Costa Rica, Nicaragua, and Panama; and ROW: Rest of the world) for both the entire sample and a subsample consisting exclusively of products exported to the different destinations. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year and product-destination-year fixed effects included (not reported). Standard errors clustered by main customs-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

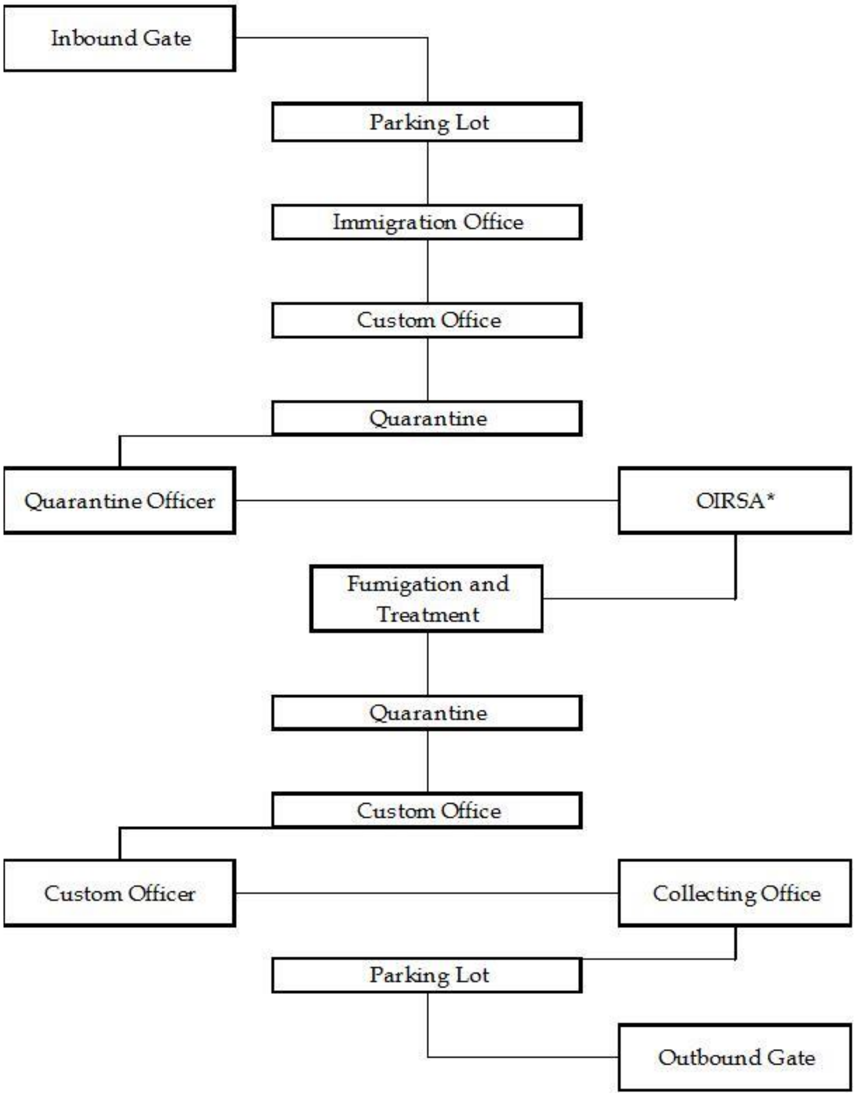
Figure 1
Typical Export Route from El Salvador to Panama

Source: Authors’ preparation based on data from DGA and TIM.

Figure 2
Stylized Processing of an Export Shipment from El Salvador to Panama: Pre-TIM

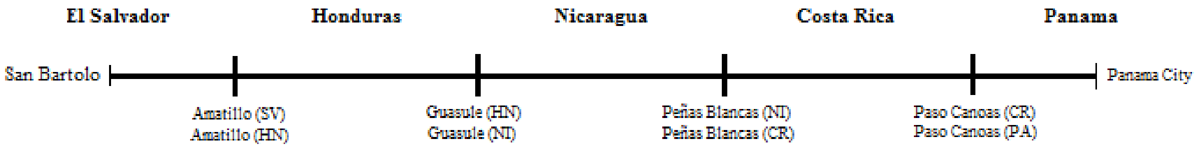


At each of the eight border posts, an export shipment had to go through the following process:

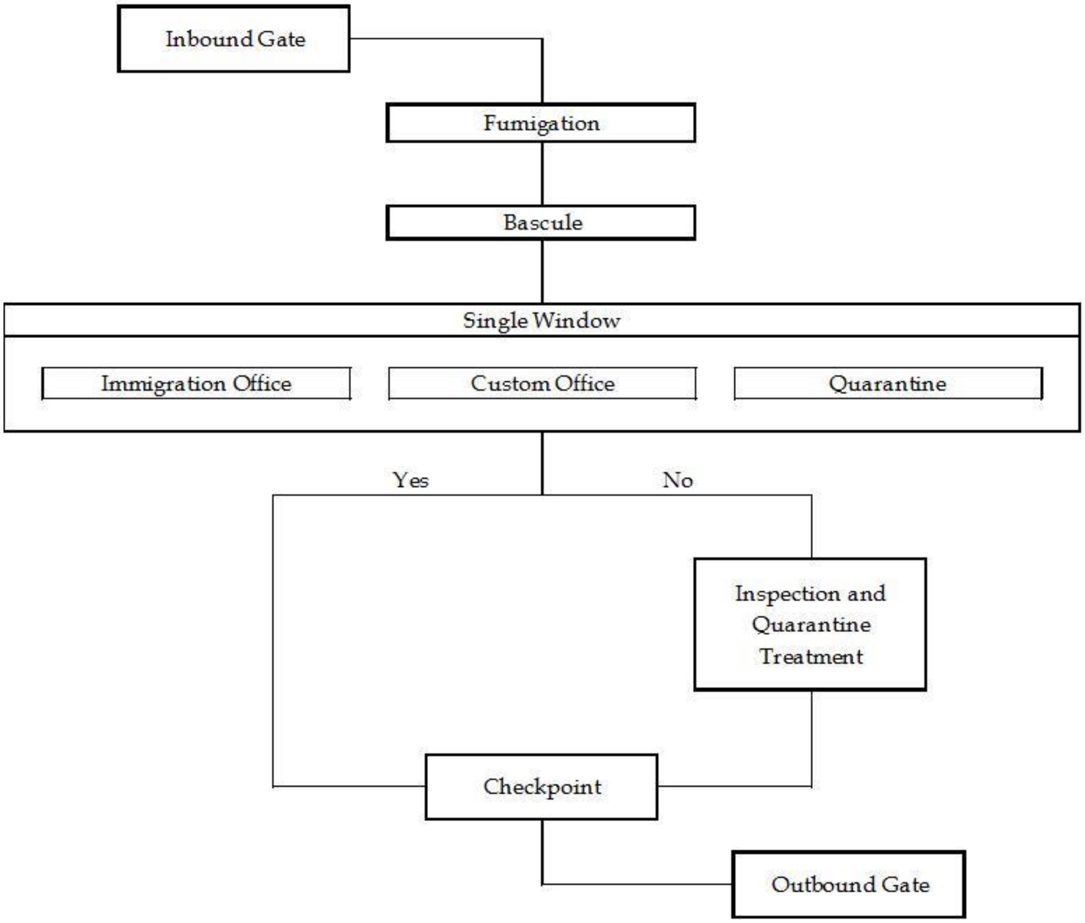


OIRSA: Regional Organization for Animal and Plant Health.
Source: Authors' preparation based on Sarmiento (2013).

Figure 3
Stylized Processing of an Export Shipment from El Salvador to Panama: Post-TIM



At each of the four border posts, an export shipment has now to go through the following process:



Source: Authors' preparation based on Sarmiento (2013).

Figure 4
Gradual Phase-In of TIM across Trade Corridors and One Specific Example

Source: Authors' preparation based on DGA.

Trade corridors that started to operate with the TIM in 2011 are colored in black, whereas trade corridors that started to operate with the TIM in 2012 and 2013 are colored in red.

Appendix A

Table A1

The Impact of TIM on Firms' Exports
Baseline Specification with Alternative Standard Errors

	All Observations	**Observations with Origin Data**
TIM	0.480	0.467
Heteroscedasticity-Consistent	(0.046)***	(0.067)***
Cluster Main Custom-Destination	(0.084)***	(0.093)***
Cluster Main Customs	(0.112)***	(0.116)***
Cluster Destination	(0.079)***	(0.094)***
Cluster Firm-Product-Destination	(0.048)***	(0.069)***
Cluster Firm	(0.053)***	(0.072)***
Cluster Product	(0.046)***	(0.066)***
Cluster Product-Destination	(0.047)***	(0.069)***
Cluster Chapter HS2-Destination	(0.052)***	(0.069)***
Cluster Firm-Product	(0.049)***	(0.069)***
Cluster Firm-Chapter HS2	(0.050)***	(0.069)***
Cluster Firm-Destination	(0.058)***	(0.074)***
Cluster Municipality-Main Customs-Destination		(0.073)***
Firm-Year Fixed Effect	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes
Observations	39,889	23,772

Source: Authors' calculations based on data from DGA and TIM.

The table reports OLS estimates of Equation (2) for both the entire sample and when restricting the sample to firm-product-destination export for which data on firms' location (i.e., municipality of origin) is available. The dependent variable is the change in the natural logarithm of export value at the firm-product-destination-year level. The main explanatory variable is the change in a binary indicator taking the value of one if the firm uses the TIM in shipping the product to the destination in question and zero otherwise. Firm-year fixed and product-destination-year effects included (not reported). Robust standard errors are reported in parentheses below the estimated coefficients. Standard errors clustered at alternative levels are shown next. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. The significance indicator is presented along with the respective standard errors.

Appendix B

In this section we provide a simple model that guides the predictions we discuss in the empirical section. The model highlights how transit trade policy affects transaction, trade and inventory management costs for exporting firms. The model emphasizes the effects of the new policy on the intensive and extensive margins via variable and fixed trade costs.

Import Demand

As is standard in the literature we assume that the importers preferences are CES such that every exporter supplying a variety of product on the foreign market faces the import demand $q = Ep^{-\sigma}$. In monopolistic competition the constant E captures aggregate expenditure. Here we focus on partial equilibrium and treat it as a constant.

Supply Chain, Logistics and Inventory Management Costs

We apply the inventory and production costs derived in Subsection 5.6 such that we obtain the linear cost function $q2\sqrt{mf/3} + cq + F$ with associated optimal shipping frequency $N = \sqrt{q}(m/3f)^{(1/4)}$.

Profit Maximization

Export revenues net of ad-valorem trade costs are$r = Eq^{1-1/\sigma}(1+\tau)^{-1}$ and the exporter supplies output to maximizes profits $\pi(q) = Eq^{1-\frac{1}{\sigma}}(1/\tau) - q2\sqrt{mf/3} - cq - F$. The profit maximizing quantity is then:

$$\mathrm{q}^* = 3^{\sigma}\left[\frac{\tau\sigma\left(2\sqrt{mf3} + 3c\right)}{E(\sigma-1)}\right]^{-\sigma}$$

with fob export revenues:

$$\mathrm{r}^* = \frac{E}{\tau}\left[3^{\sigma}\left[\frac{\tau\sigma\left(2\sqrt{mf3} + 3c\right)}{E(\sigma-1)}\right]^{-\sigma}\right]^{1-\frac{1}{\sigma}}$$

and optimal order frequency:

$$\mathrm{N}^* = \left(\frac{m}{3f}\right)^{1/4}\sqrt{q^*}$$

We now derive and sign the elasticity of the quantity and revenue with respect to order servicing costs and delivery costs. Let $\varepsilon_{q|\tau,}\varepsilon_{q|f}$, $\varepsilon_{r|\tau,}\varepsilon_{r|f,}$ denote the elasticities of the quantity and sales with respect to tau and f. Similarly, let, $\varepsilon_{q/_{N}|\tau}, \varepsilon_{q/_{N}|f}$, $\varepsilon_{r/_{N}|\tau}, \varepsilon_{r/_{N}|f},$denote the elasticities of the quantity and sales per shipment with respect to the same parameters. We then obtain:

$$\varepsilon_{q|\tau} \ = -\sigma < 0$$

$$\varepsilon_{q|f} = -\frac{\sigma\sqrt{fm3}}{2\sqrt{fm3}+3c} < 0$$

$$\varepsilon_{r|\tau} = -\sigma < 0$$

$$\varepsilon_{r|f} \ = -\frac{\sqrt{3mf}(\sigma-1)}{2\sqrt{fm3}+3c} < 0$$

$$\varepsilon_{N|\tau} = -\frac{\sigma}{2} < 0$$

$$\varepsilon_{N|f} = -\frac{1}{4}\frac{2\sigma\sqrt{fm3}+2\sqrt{fm3}+3c}{2\sqrt{fm3}+3c} < 0$$

These elasticities predict that if the TIM decreases order servicing and variable trade costs, then we should see an increase in the export quantities, revenues and shipping frequencies. Next we derive the elasticities on the per shipment measures.

$$\varepsilon_{q/_{N}|\tau} \ = -\frac{\sigma}{2} < 0$$

$$\varepsilon_{q/_{N}|f} = -\frac{1}{4}\frac{2\sqrt{fm3}(\sigma-1)-3c}{2\sqrt{fm3}+3c}$$

$$\varepsilon_{r/_{N}|\tau} \ = -\frac{\sigma}{2} < 0$$

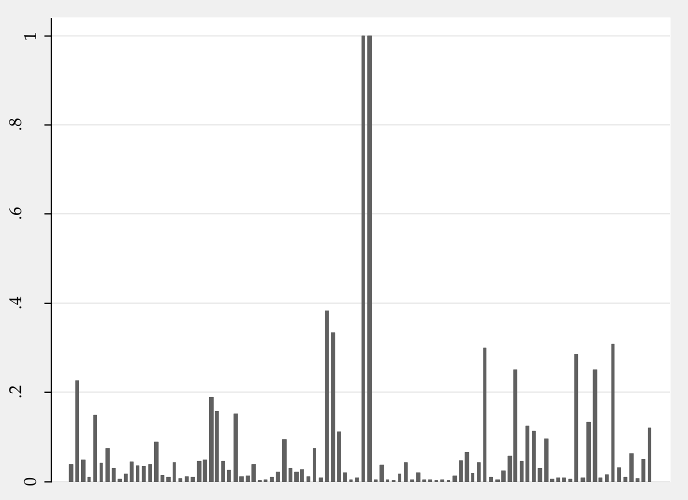
$$\varepsilon_{r/_{N}|f} \ = -\frac{1}{4}\frac{2\sigma\sqrt{fm3}-6\sqrt{fm3}-3c}{2\sqrt{fm3}+3c}$$

The sign of the elasticity of revenue and quantity per shipment depends on the demand elasticity and cost parameters. If the unit production costs are very high and the demand elasticity is low, then an increase in *f* will have little effect on revenues and quantities. However, the number of shipments will decrease. Therefore, in this case, the revenues and quantity per shipment would increase if *f* increases. On the other hand, if demand is sufficiently elastic, then a decrease in *f* will increase quantities and revenues such that the per shipment measures increase. The bottom line is that the prediction of the effect of the TIM on these dependent variables depends on parameter values. Our results in Table 8 suggest that demand elasticities are sufficiently large such that the combined impact of a decrease in τ and *f* increases the revenues and quantities per shipment.

Appendix C

Figure C1

Share of the Modal Shipment Size in Terms of Weight across HS 2-Digit Products, 2013

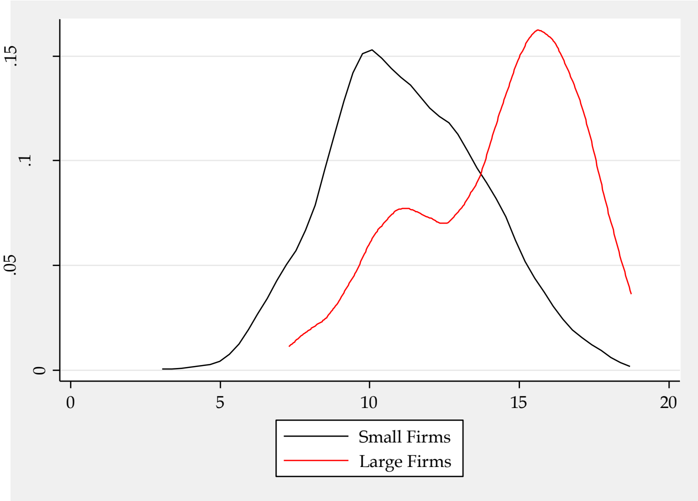


Source: Authors' calculations based on data from DGA.

The figure shows the share of the total number of shipments that the modal shipment based on weight accounts for. Each bar corresponds to a HS 2 digit product. Data corresponds to 2013.

Figure C2

Distribution of the Value of Product-Destination Exports for Small and Large Firms, 2013



Source: Authors' calculations based on data from DGA.
The figure shows kernel densities of product-destination export flows for small and large firms. Data corresponds to 2013.