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Transportation and Trade Interactions: A Trade Facilitation Perspective♦

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Abstract

Trade facilitation policies intend to simplify administrative processes and accelerate the handling of shipments across borders. Recent research shows that these policies have substantial effects on trade flows. In this chapter, we discuss what the existing evidence for trade implies for the provision of transportation services. In addition, we make use of a particular policy change, an upgrade to a new transit trade regime, to illustrate the many direct and indirect linkages between trade facilitation and transportation. These multiple connections imply that a well-functioning transportation sector is important to realize the full potential of trade facilitation policies. Our conceptual and empirical analyses show that, despite an increase in demand for transportation services, the effect of trade facilitation on freight rates and the underlying transportation sector is far from obvious. This calls for future research to examine equilibrium adjustment channels to trade facilitation policies in the transportation sector.

Keyword: Transportation, Trade Facilitation, Trade Costs, Trade Policy
JEL-Code: F10, F13, F14

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1 Introduction

In international trade, the seamless transportation of cargo between importers and exporters across borders plays a key role in managing supply chains. This is naturally reflected in the recent trade policy focus on secure and timely processing of shipments, which materialized in the World Trade Organization (WTO) Trade Facilitations Agreement (TFA) reached in Bali in 2013. Policymakers have high hopes that, by streamlining the administrative processes for shipments to enter and exit countries, trade facilitating policies will lead to deeper international integration. Hence, these policies can directly affect firms engaged with the logistics of international transactions. Therefore, the full impact of trade facilitation will depend at least to some extent on the transportation services sector.

Trade facilitation policies encompass several measures that directly affect official administrative procedures related to cross-border transactions. These measures range from the design of forms that firms have to submit, to the processing of these forms and shipments by all border agencies within and across trading partners. This chapter examines the interrelationships between these policies, international trade and the transportation services sector. We start by reviewing the recent evidence on the effects of trade facilitation policies on international trade, emphasizing the associated effect on the demand for transportation services. Next, we make use of a specific trade facilitation policy, the introduction of a new transit trade regime, to highlight the richness of interactions between trade facilitation, trade and transportation.

Improved transit trade is part of the WTO Trade Facilitation Agreement. Properly designed transit trade allows for shipments to be inspected and sealed at the start and opened and confirmed at the destination while substantially simplifying the intermediate border controls between origin and destination. These procedures reduce cumbersome document management along trade routes, wait times and idle equipment.

Central America recently implemented a new transit trade system known as TIM (*Tránsito Internacional de Mercancías*/International Transit of Goods) that 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). This transit regime was gradually introduced across trade corridors within the region. The use of this new transit trade system is mandatory on these specific trade corridors. As a result, the use of TIM varies at the exporting firm-product-destination-year level depending on which routes exporting firms use to deliver certain products to certain destinations. We draw on this rich source of variation combined with detailed export data from one specific Central American country, El Salvador, to examine the effect of this new transit trade regime on the transportation sector by

exploring the impact on freight charges, insurance charges, and, the associated value, unit and per-shipment rates.

The adoption of an enhanced transit trade regime is instructive to discuss the interactions between trade facilitation policies, trade, and transportation for several reasons. First, seamless transit trade systems have been the common rule of the road in many developed economies, but are rather the exception in the developing world. Thus, it is difficult to assess the implications of changes in transit policies for developing countries based on the experience of developed economies due to the many other co-existing differences in regulations that affect trade and other characteristics related to the different stages of development. Therefore, the introduction of a new transit trade regime in Central America is a unique opportunity to discuss its impact on trade and the transportation sector. Second, it reveals a fundamental problem of measurement of trade facilitation policies. Better, streamlined transit procedures, as well as many other trade facilitation policies, are at best only partially captured by standard aggregated border time measures such as those from the World Bank's Trading across Borders Doing Business Indicators or the Enterprise Surveys.[2] They also simultaneously affect several useful individual, specific, trade facilitation indicators such as those developed by the OECD, thus making it difficult to determine the relevance of each of these individual indicators and to establish how they should be aggregated to evaluate policy effectiveness. Third, for a trade facilitation policy in general, and a transit policy in particular, to work as expected, the underlying transportation infrastructure should be able to adopt and take advantage of the improved regulatory environment to raise efficiency and lower trade costs. While the cost-reducing effects of better transit trade conditions due to streamlined border crossings, lower wait times, and more predictable deliveries should drive down operational costs of carriers and reduce freight rates, the increase in demand may drive prices up.

The main goal of our empirical evidence is not to identify all possible interactions between trade policy and the transportation sector, but to show what is possible in terms of combining trade facilitation policies with trade and transportation data. Keeping this in mind, our results provide evidence that total freight charges and total insurance charges to deliver exports increase as a consequence of the implementation of a streamlined transit trade system such as the TIM. Perhaps this is not surprising. Focusing on exports and using detailed transaction level trade data, Carballo et al. (2016a) find that TIM raises El Salvador's exports.[3] Given this increase in exports and the associated increase in the demand for freight services, the natural next step is to examine how TIM affects freight and insurance rates per value, weight and shipment. While our estimates and their significance vary across specifications and chosen clustering levels, they seem to suggest that the effect of TIM on freight and insurance rates is closer to zero.

[2] www.enterprisesruveys.org and www.doingbusiness.org/data/exploretopics/trading-across-borders.

[3] Having said that, the alternative is theoretically possible if freight rates decrease sufficiently to lower total freight charges as exports increase.

Our discussion of the results highlights two challenges for the identification of the impact of trade facilitation policies on transportation. First, multiple interacting channels make it difficult to identify unambiguous effects of trade facilitation policies, even with very good micro level data. Second, a null estimated impact on freight rates does not imply that TIM has no effect on the transportation sector. Depending on the market structure, a positive demand effect may offset initial negative cost reducing effects of TIM. More generally, these findings indicate that the interaction of international trade, trade facilitation policies, and transportation is fruitful open ground for empirical work. Contrary to standard tariff policy, these new types of trade policies directly affect the operations of firms engaged in the logistics and transportation sector.

The rest of this paper proceeds as follows. Section 2 provides background on recent research in trade facilitation and the link between trade facilitation and transportation. Section 3 discusses how trade facilitation policies can affect transport costs using the Central American international transit policy TIM as an illustration. Section 4 introduces data and presents descriptive evidence. Section 5 discusses the empirical results, and Section 6 concludes.

2 Background on trade facilitation

2.1 Trade-related regulations and procedures create significant trade costs

Research shows that slower international supply chains are more costly (Djankov et al., 2010; Hummels and Schaur, 2013). Aside from production and arrangement of transportation services, international shipments have to clear several hurdles between the placement of an order and delivery. Documents must be completed and filed, shipments must be loaded potentially multiple times at different points in the supply chain and their contents must pass several inspections. In the case of mis-alignment among these individual steps shipments have to be stored, information has to be processed regarding the status of shipments and expected delivery dates. These procedural and often regulated steps in the management of cross-border transactions impose costs in addition to the time it takes to physically move the shipments from the shipper to the consignee. According to Hornok and Koren (2015a) these administrative steps represent a significant part of the $3,000 per shipment cost that they estimate using administrative barriers from the World Bank's doing Business data. Fixed costs per shipment including these administrative barriers significantly affect shipping patterns in terms of their frequency and load (Hornok and Koren, 2015b; Kropf and Sauré, 2014; Alesandria et al. 2010; Alessandria et al., 2011).

2.2 What is trade facilitation?

Trade facilitation comprehends all policies that lower costly administrative barriers to trade by primarily streamlining administrative processes, thus reducing the burdens of managing international supply chains and thereby helping increase trade. In short, "removing obstacles to the movement of goods across borders."[4] In essence, while it is customary to associate trade and transportation costs with the hardware of physically moving goods (Harley 1980, Harley1989; Hummels, 2007; North, 1958, North 1968; Mohammed and Williamson, 2004; Bernhofen et al., 2016; Micco and Serebrisky 2004; Blonigen and Wilson, 2008; Wilmsmeier 2006), trade facilitation operates on the software that regulates the administrative processing within the physical constraints of transportation networks.

The 2013 WTO TFA contains several provisions that precisely aim to expedite the processing and release of shipments to accelerate the movements of goods. These provisions include a number of specific trade facilitation measures such as the adoption of risk management systems, the introduction of authorized economic operator programs for trustworthy firms, the implementation of trade single windows interconnecting all relevant border agencies, and improvements to transit trade regimes. Table 1 discusses these measures along with variants thereof, such as the simplification of export procedures for low-value shipments through postal offices.

<Table 1 about here>

2.3 Trade facilitation policies and international trade

Trade facilitation policies have only recently received attention in the academic literature. Many questions related to trade facilitation are empirical. Does trade facilitation affect trade flows, why does it affect trade patterns, how large are the effects, and ultimately, do the benefits justify the costs?[5] Contrary to tariff policy, there are no existing databases for trade facilitation policies that directly report variation in the associated costs of importing at the product level. This makes the empirical evaluation of these policies interesting, but also more challenging.

2.3.1 Assessment and measurement of trade facilitation policies

[4] https://www.wto.org/english/thewto_e/glossary_e/trade_facilitation_e.htm. These costs are contrary to trade and transportation costs related to the physical movement of goods. Trade and transportation costs are often associated with changes in technology, regulatory issues related to market power and the efficiency of ports in handling shipments (Harley 1980, Harley1989; Hummels, 2007; North, 1958, North 1968; Mohammed and Williamson, 2004; Bernhofen et al., 2016 Micco and Serebrisky 2004; Blonigen and Wilson, 2008; Wilmsmeier 2006; Cristea et al. 2014, Cristea and Danila, 2016, Cristea et al., 2015; Clyde and Reitzes, 1995; Fink et al. 2000; Sjostrom 1992). A few exceptions even examine the cost of cross border trucking and regulation in the trucking industry related to cross border traffic (Brown, 2015; Brown and Anderson, 2012; Jones 1999; Lafontaine and Valeri, 2009; Bottasso and Conti, 2010, Haralambides and Londono-Kent, 2004).

[5] Existing theory and extensions are useful to understand why trade facilitation affects trade flows and to provide systematic guidance to identification problems, magnitudes and potential distributional consequences.

Empirical analyses of trade facilitation policies are confronted with two major challenges: identification and measurement. Adequate identification of the effects of interest requires one to account for firm heterogeneity and self-selection into trade and facilitation. A recent small literature in international trade turns to randomized control trials (RCTs) to account for firm heterogeneity and self-selection into trade opportunities, and thus properly identifies the impact of engaging in these opportunities on firms' performance (Atkin et al., 2016). RCTs, as opposed to natural policy experiments, have many advantages in terms of establishing causality and cleanly testing underlying mechanisms, but unfortunately they are not a natural alternative to examine the impact of trade facilitation policies. While treatment can be specifically designed to operate within a narrow, dedicated environment in RCTs to abstract from relevant sources of heterogeneity, trade facilitation policies are written and rolled out at a much more general level that cannot take into account the specifics of each possible firm, product, sector, or trading partner. This is why the literature has typically used quasi-experimental approaches based on panel data, differencing, matching techniques, and instrumental variables to address identification concerns in examining the effects of implementing actual policies.

Inherent to these natural policy experiments is the challenge of how to measure trade facilitation. While traditional trade policy instruments (such as tariffs) are observable at the level at which they operate and are directly suitable for empirical work, this is not the case for trade facilitation policy. As a consequence, the literature contains various approaches to measure trade facilitation policies, quantify their effects, and examine micro channels.

2.3.2 The standard approach

A popular approach is to rely on indicators compiled by international institutions and augment gravity-type estimation equations.[6] This approach relates trade performance measures on facilitation indicators plus a number of standard covariates, such as distance, GDP, remoteness, and other trade frictions. For instance, a number of papers have used aggregate, country-level data from the World Bank's Doing Business Indicators to examine the effects of total time to trade and customs and technical control times on aggregate bilateral trade (e.g., Djankov et al., 2010; Freund and Rocha, 2011), sectoral bilateral trade (e.g., Martínez-Zarzoso and Márquez-Ramos, 2008; Bourdet and Persson, 2010; and Zaki, 2010), the product extensive margin (e.g., Persson, 2010), the destination extensive margin (e.g., Nordas, 2006), and the frequency and size of shipments (Hornok and Koren, 2015ab) for various samples of countries and product categories. These papers conclude that delays and trade related administrative procedures have a significant negative impact on export outcomes, especially for time-sensitive products.

[6] See Head and Mayer, 2016 for a detailed discussion on gravity estimation in international trade.

While certainly helpful and covering a wide range of countries, the applied indicators are perception-based and depend on the assumptions of the surveys administered to collect the underlying information. Therefore, aggregate indicators may face some challenges. For example, Carballo et al. (2016b) show that the time to clear port-of-entry procedures in Peru varies systematically across importers, products and exporters. In addition, estimates of time cost reductions need to be reinterpreted in the presence of clearance time uncertainty. Firms optimally choose buffer time based on firm-specific cost parameters to absorb random delays in port-of-entry procedures to meet agreed upon delivery windows. If these endogenously-chosen storage times are included in aggregated country-level time-to-import indicators, then country rankings based on these measures can be difficult to interpret. Longer average times to import may not necessarily imply greater costs, but may reflect endogenously-chosen longer storage times based on lower underlying cost parameters.

Similarly, the useful OECD's trade facilitation indicators capture a country's performance in terms of clarity of border procedures, rules, fees, electronic document management, customs functions, information management, and involvement of the trade community, as measured in three levels from best to worst.[7] Evidence based on these indicators suggests that improvements in so-measured border performance raises trade flows and lowers trade costs at the aggregate level (Moïsé et al., 2011; Moïsé and Sorescu, 2012) and results in expansion along the firm and the product intensive/extensive margins. Small firms in particular seem to gain from information availability (Fontagné et al. 2016; Beverelli et al., 2015). The advantages of the OECD data include that the indicators are specific and, like the Doing Business Indicators, are easily available. Furthermore, they cover a large number of economies. This is a benefit in terms of understanding how broad measures of trade frictions and improvements in reducing these frictions affect trade from a cross-country perspective. On the downside, the limited availability of time variation precludes the use of standard panel data approaches, which help to account for unobserved heterogeneity for identification purposes. In addition, it is not clear which exact trade policy action generates cross-section variation in these indicators. For example, Moïsé et al. (2011) point out that transit trade policies are not included in the OECD indicators, in part because it is likely a change in several indicators at the same time. Hence, in order to assess a particular policy one first has to establish the relevant subset of indicators and how to add up and weigh these indicators based on various policies.

This can be clearly seen in Table 2. The left hand column reports the Agreement on Trade Facilitation Article.[8] The remaining columns provide a short description of the purpose, an indication of which trade facilitation policies as discussed above touch on these articles and the assigned OECD indicators according to Fontagné (2016). The main take away is that actual trade facilitation measures as

[7] http://www.oecd.org/trade/facilitation/indicators.htm#About-TFI. Also see Moïsé et al. (2011).
[8] https://www.wto.org/english/tratop_e/tradfa_e/tradfa_e.htm

reported in the third column of Table 2 potentially stretch across multiple facilitation articles and indicators. In short, these useful trade facilitation indicators may map one-to-one to WTO TFA articles, but are not likely to map one-to-one to actual trade facilitation policies. This misalignment leads to non-trivial correspondence and aggregation issues. From a research point of view, it is clear that new trade policy focusing on the facilitation of trade is more difficult to understand, measure, and evaluate than traditional policy such as a change in tariffs.

<Table 2 about here>

Hilberry and Zhang (2015) help us better understand why the OECD indicators affect trade flows and what mechanisms they capture.[9] They find that good performance on the OECD indicators in terms of governance and impartiality and formalities regarding automation, lowers the time required to clear customs.[10] This helps closing a knowledge gap: given a movement in the trade facilitation indicators, the resulting reduction in clearance times can be translated into cost savings. However, several questions still need to be answered to actually understand the effects of trade facilitation. Leaving aside the measurement and identification challenges referred to above, this approach does not explain how specific policies, such as for instance new transit systems, move the dial in terms of the trade facilitation indicators. Also, reduced border times may not be the only cost reducing effect of a facilitation policy. For example, transit trade also provides benefits in terms of reduced document administration costs. It is difficult to know all sources of cost that can be affected by trade facilitation and have to be aggregated. This creates a further issue if distributional consequences matter. For instance, while a reduction in border times may be of particular importance to fashion products with short lifecycles, streamlining documents may be more important for products that require careful documentation due to security reasons.

In summary, an extensive amount of helpful literature based on aggregate data discusses the effects of how trade facilitation may affect trade costs and trade. The challenge is that aggregate indicators are somewhat disconnected from the implementation of actual trade facilitation policies. Rigorous identification approaches making use of more granular data to investigate how actual policy does affect trade costs and trade performance are rare, but a few such approaches exist.

2.3.3 Evidence from transaction-level trade and trade facilitation data

Volpe Martincus et al. (2015) examine a customs risk management system using detailed export data from Uruguay. The main identification challenge is that shipment size and characteristics are systematically related to the clearance times. To solve this issue they construct instruments mimicking

[9] Similarly Hoekman and Shepherd (2015) evaluate trade facilitation in terms of reduced delivery lags.
[10] Related to the time it takes to import and export Feenstra and Ma (2013) apply port efficiency measures developed by Blonigen and Wilson (2008) to examine the effect of port efficiency on the extensive margin of trade.

customs' risk management model that, conditional on exporting firms and product-destination combination, randomly allocate shipments to inspection channels that vary in their intensity of procedures and therefore the time it takes to clear shipments (see Table 1). The conclusion is that long clearance times to export are costly and reduce exports primarily along the shipping extensive margin. Following this approach, Fernandes et al. (2015) examine the effects of customs risk management on importing in Albania.

Customs agencies' risk management systems can be used to reduce the administrative burden and accordingly facilitate trade by trusted and safe firms. The Authorized Economic Operator (AEO) program is an example in this regard (see Table 1). Firms certified under this program enjoy trade facilitation privileges such as reduced physical inspection frequency and faster release of shipments. To examine this program, Carballo et al (2016c) use transaction-level export and import data from Mexico that include customs clearance information and firms' engagement with the AEO program. Their estimation results based on a difference-in-difference strategy that accounts for time-varying firm and product-destination unobserved heterogeneity reveals that AEO certification of firms' raises exports. Compared to the mean product-firm-destination level annual growth rate of exports of 3.8 percent, AEO firms have a growth rate 2.8 percentage points higher than comparable non-AEO firms. From a supply chain point of view, two findings are particularly interesting. First, such an export expansion is mainly driven by an increase in shipping frequencies. Second, certification raises the variability of shipments. This suggests that facilitated clearance allows firms to more flexibly respond to demand shocks.[11]

AEO programs appear to effectively address border issues for large firms running complex supply chains. Given their specific capabilities and needs, small firms may require different trade facilitation solutions. As such, the *Exporta Fácil* or Easy Export program common in South America targets small firms. It allows small producers of specialized products that do not have easy port access to export shipments under certain size (as established in terms of both value and weight) directly through post offices and take advantage of simplified documentation and procedural requirements (see Table 1).[12] Carballo et al (2016d) use data for Peruvian exporters to show that *Exporta Fácil* increases municipalities' exports where post offices are available to handle international shipments. The effects are to a large extent driven by an increase in the number of exporters and the number of destinations.

Traditionally, in the absence of any special programs, firms engaged in international trade must submit information related to shipments on paper forms not only to customs, but also to other multiple border agencies along the international supply chain. Even today, traders must submit the same information to multiple agencies, multiple times through processes that are largely paper-based and

[11] For issues on demand volatility, the pass through of shocks and their consequences see Bergin et al. (2009).
[12] For a discussion on how trade costs affect the production and economic geography of specialized products see Holmes and Stevens (2014).

manual.[13] Foreign Trade Single Windows are arrangements that streamline these administrative processes (see Table 1). In their most efficient form, they allow firms to submit all information online and responsible government agencies to share the information and update the processing status simultaneously, thus lowering administrative and information management costs. Costa Rica recently gradually introduced one such electronic single window system. Carballo et al. (2016e) take advantage of this policy change to explore the impact on trade. They merge transaction-level Costa Rican export data from 2007 to 2013 with information on the product-specific export permits and distinguish shipments that were processed through the electronic single window. Controlling for time-varying, unobserved firm and product-destination specific factors, their difference-in-difference estimates indicate that reducing administrative burdens by switching from paper to modern information technology leads to an expansion of exports. More precisely, according to the baseline estimate, the export growth rate increases by about 1.4 percentage points for the average exporter growing exports at an average of 2 percent. This increase in exports is due to an increase in new buyers and an increase in export quantities and sales. Again, notably from a supply chain management perspective, the expansion is almost entirely due to an increase in the number of shipments. If anything, quantities per shipment slightly decrease, showing that firms take advantage of the cheaper and faster processing by switching to more flexible production schedules.

Trade can be facilitated not only by connecting and coordinating border agencies and streamlining their procedures on one side of the border, but also doing so across borders. Properly designed transit trade regimes allow traders to seal shipments at their origin, pass through multiple border controls with minimal procedural requirements, and clear customs at the final destination, thus substantially lowering administrative costs. Carballo et al (2016a) use transaction-level data for El Salvador and take advantage of the stepwise introduction of a transit trade regime across trade corridors in Central America to provide evidence. As with the previous studies, an advantage of this approach is that the policy indicator is not at the country level, but varies across shipments depending on the route and time. This additional variation delivers a control group that allows for rigorous sets of fixed effects and robustness checks. For aggregate policy indicators this is a challenge because not all firms exporting to the same destination are affected by the policy at the same time. The main finding is that the introduction of the TIM raised export growth by about 62 percent, which implies that the export growth rate increased by about 2.7 percentage points for firms that use TIM. This export expansion is driven to a large extent by an increase in shipping frequency.

In summary, available evidence suggests that policies that facilitate trade by streamlining trade procedures and simplifying information management are associated with an expansion in trade, and that

[13] United States' Department of Homeland Security introducing the Executive Order on Streamlining the Export/Import Process for America's Businesses signed on February 19, 2014

the main channel through which this positive effect arises is an increase in the shipping frequency. We expect that the effect of trade facilitation on trade also affects the demand for transportation services.

2.3.4 Trade facilitation, trade, and the transportation sector

Combined, the findings from the literature summarized in the previous sub-section suggest that there is a great opportunity to understand the relationship between trade and transportation for a number of reasons. First, it is possible to collect detailed transportation data in combination with highly disaggregated trade data. We illustrate this for the example of a new transit trade system in the empirical section.

Second, in the absence of RCTs, trade facilitation provides a proper policy experiment to examine the relationship between trade and transportation. From a conceptual point of view, while standard trade policies (such as tariff reductions) are expected to lower trade costs, increase trade, and raise the demand for transportation services, trade facilitation policy can influence transportation directly in additional ways. Based on the results of the studies surveyed above, it is clear that trade facilitation policies affect integration with international markets by improving the management of shipments in the global supply chain by sellers, buyers, and the transportation service providers.

To be more concrete, trade facilitation policies generally lead to an increase in the number of shipments and expansion of the number of buyers. The effects vary across product types. Light, time-sensitive and differentiated products tend to be more affected. Effects also vary across geography in the origin and destination markets. The Costa Rican Electronic Single Window raised exports more for firms that are far from brick and mortar border agencies' facilities where documents used to be processed. For close-by export destinations, the trade expansion is mostly on the value-per-buyer margin. For distant locations the expansion is mostly on the number-of-buyer margin. The implied changes in the level and profile of the demand for transportation services and, notably, those likely occurring in the sector's operational costs, can result in changes in freight and insurance charges or rates. And this may take place through multiple channels. For example, across all modes and transportation markets, the aforementioned results imply that transporters and logistics providers have to become more flexible in terms of scheduling, equipment utilization, and shipping. New carriers and new technologies may enter to respond to these demands, and out of date and inefficient service providers may exit. This raises the question of market consolidation and concentration effects, especially in developing countries. Case studies and anecdotal evidence of regions and policies confirm that the success of trade facilitation is tied to technology, regulation and operation of transportation and logistics (Lakshmanan et al., 2001; Gonzalez et al., 2008).

From an estimation point of view, the trade facilitation literature uses precise information on the introduction of the policy instruments to make it possible to address standard identification concerns and

isolate the policy effect. This helps identify adjustment margins in the transportation sector in a clean way. The next section will illustrate this point using the TIM in Central America.[14]

3 How trade facilitation policies can affect transportation costs: an illustration based on international transit

Direct and indirect linkages between trade facilitation and transportation regulation provide motivation for our empirical exercise. We have data to examine the effect of TIM in El Salvador on freight and insurance charges as well as per-unit, per-value and per-shipment charges. Before diving into this rich data source, we provide background on the trucking sector in Central America, details related to the implementation of TIM and a discussion of the expected effects of TIM on the transportation sector.

3.1 Some background on trucking and transport in Central America

Road-freight is an important mode of transport in hauling shipments to international destinations in Central America, within the region and to ports or border posts for extra-regional trade. Recent survey evidence shows that at 17 U.S. cents per ton-kilometer on main international trade corridors, road freight transport in Central America is more expensive than in developed countries and developing regions in Africa (Osborne et. al. 2014). Given the high demand for road freight transport, there are several potential explanations for these high prices in Central American trucking. The World Bank's survey on the trucking industry raises concerns that routes are segmented and highly concentrated. Additionally, the survey data reveals relatively low average annual truck utilization as a source of high cost. Osborne et al (2014) name several factors that drive low truck utilization, including low travel speed, seasonality in demand, lags between trips, short travel distances, wait time, limits on cabotage, and trade imbalances resulting in empty return trips. Interestingly, their results show that wait time significantly affects costs. This is important from a trade policy point of view because the goal of trade facilitation is often to streamline and speed up border and customs processing to reduce wait times.

Several factors explain why wait times and border crossings are costly to transporters. Idle equipment and drivers in line at congested bottlenecks at borders is the most obvious reason. In addition, cargo security is an important cost factor. An Inter-American Development Bank report suggests that the cost of security may be up to 22 percent of the freight value, with risks being greater in areas that require

[14] We should mention that not all trade facilitation policy works the same. For example, while upgrading the transit trade regime has greater effects on small firms, the Electronic Single Window has greater effects on larger but less experienced firms. The AEO program has positive effects on trade, but underlying regulation on trucking across the border complicate empirical work. When using trade facilitation to understand the interaction between trade and transportation, then it is advisable to use detailed policy information and trade/transportation data.

trucks to reduce speed (Guerrero and Abad, 2013). Furthermore, at some borders the driver is in charge of managing the customs clearance process. To avoid the chance of robbery and damage the drivers hire costly intermediaries to complete necessary procedures.[15]

3.2 The implementation of TIM

In El Salvador, the TIM was rolled out gradually between 2011 and 2013 for road-based exports. Specific trade corridors were sequentially incorporated into the regime. Figure 1 illustrates the implementation of the new transit trade system on the various trade routes.

<Figure 1 about here>

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. 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. This addition of corridors was determined by the decision of other Central American countries to take part of the new transit regime (i.e., Costa Rica and Panama) or to incorporate new fiscal routes to it (i.e., Guatemala, Honduras, and Nicaragua). In the third phase, new corridors joined through 2013 as the TIM was further phased-in with neighboring countries.

The stepwise implementation of TIM generated variation in regime usage status both across shipments in a given point in time and over time. In particular, within exporter-product-destinations usage of TIM may begin after the policy implementation. However, not all export-product-destination combinations use TIM. Therefore, after the implementation of the policy, usage of TIM varies across different exporter-product-destination combinations. As a consequence, a specific exporter in a given time period may use TIM for sales related to certain product-destination combinations if TIM is operational on the specific trade corridor, but not use TIM for sales on other products or destinations. It is unusual to

[15] Crossing borders is not just costly in developing countries. Anderson and Brown (2012, 2015) focus on the cost of transporting shipments from Canada to the U.S. They provide evidence that trucking across the border is more expensive than within Canada. Again using Canadian data on trucking prices Brown (2015) provides evidence that border compliance costs are reflected in prices. Avetisyan et. al (2015) examine the cost reducing effects of adding customs personnel at twelve major land crossing of the U.S. Due to the reduction in wait times and associated savings in costs of transportation they predict an increase in GDP and jobs. Goodchild et al (2007) examine the effects of variability of border crossing times. They conclude that service variability is not a significant factor for regional carriers. However, they also conclude that some of their interviewees build expected border clearance times into their prices.

observe such a high dimensional policy variable. Most often they are collapsed into an indicator for the country as a whole (e.g., Doing Business Indicators). To examine the effects of trade facilitation policy this is optimal because this is the level at which these policies operate. From an identification point of view, the advantage of the various sources of variation is that we can account for firm and (product-)destination characteristics with fixed effects.

Furthermore, in the first phase, El Salvador imposed a mandatory use of the TIM on all possible trade corridors, as determined by the regime implementation status at the regional level. In other words, there was no endogenous selection of routes either by the Salvadorian authorities or the firms. In the second and third phases, decisions to add trade corridors to the TIM were made by countries other than El Salvador. As such, these decisions can also be considered exogenous to El Salvador's firms.

3.3 The TIM, its trade effects, and implications for the transportation sector

Before the TIM, shipments in Central America had to clear customs on each side of the border and present documents to various agencies, including sanitary and phytosanitary certificates, migration arrival and departure cards, in addition to documents related to the clearing of the shipment at customs.

The TIM substantially simplified both documentation and procedures. Multiple paper-based processes were combined into one single electronic document, which firms can complete at their nearest customs office. Instead of presenting and checking documents on each side of each border, a single customs office at each border simply bar-code scans the shipment to document its passage. As a result, this new transit regime significantly affects the speed of border crossings and provides trading firms with information related to the location of their shipments (Sarmiento et al., 2010).

A trade facilitation policy such as the TIM can have various direct and indirect effects on the trucking industry. On one hand, as mentioned above, the TIM has been associated with an expansion in trade, which has been primarily driven by a higher shipping frequency (Carballo et al. 2016a). This has resulted in an increase in the demand for transportation services. Under perfect competition such an upward shift in demand would imply prices that are at least equally high if marginal costs are constant or increasing. On the other hand, if this high demand makes it more difficult to maintain collusive agreements, it may lead carriers to charge lower prices (Rotemberg and Saloner, 1986).

On the other hand, the TIM can have a negative effect on transport costs. Shorter wait times at borders and faster supply chains mean less idle equipment and driver time. Predictable planning of delivery times allows for better fleet management. Less waiting in congested areas also lowers the possibility of theft and potentially reduces the chance of accidents. The consequent downward shift in marginal costs of providing transportation services could imply lower freight rates.

Given that all of these effects happen simultaneously, there is no clear prediction on the effect of a trade facilitation policy, such as transit trade, on freight rates. Whether trade facilitation reduces freight rates or increases freight rates is therefore an empirical question. Given that unfortunately we do not have all the micro data to separate the various margins referred to above, we follow the literature and estimate a reduced-form pricing equation that captures the net effect of enhanced transit trade on freight charges and rates to show what kind of approaches are possible with the data. Identifying the mechanisms and margins at which trade facilitation policies operate has great potential for future empirical work.

4 Data and descriptive evidence

Our data is similar to Carballo et al. (2016a) in terms of the information regarding the transit regime. Here we add information on freight and insurance charges to their detailed export data. More specifically, we combine exporter-specific information regarding freight charges, insurance charges, number of shipments, export value and export weight at the product-destination-year level for 2007 to 2013, kindly provided by the Salvadoran customs DGA (by its name in Spanish *Dirección General de Aduanas*). The data also have transaction-level information on whether a certain shipment was processed under the regional transit regime. Therefore, for any exporting firm engaged in international transactions in a given year, we observe the export value in US$, the quantity (weight) in kilograms, and, the number of shipments of a given product (8-digit HS) to a particular destination and associated freight and insurance charges. In addition, based on underlying transaction level trade data, we can keep track of the main customs office that firms use to clear exports.

In 2010 and 2013, El Salvador reports about 4.5 and 5.5 billion U.S. dollars' worth of exports. Of these exports, about 1.8 and 2.3 billion are exported within Central America. Table 3 provides summary statistics for the years 2010 and 2013 for shipments that were transported over land. Based on the export shares in Table 3, about 1.6 and 2.2 billion are exported within Central America over land in 2010 and 2013, respectively. Therefore, for trade within Central America, truck transport is the dominant mode of transportation, and trucks are mostly used for trade within Central America.

<Table 3 about here>

At the same time, the numbers in Table 3 indicate that freight charges are worth about 2.8 percent of the total export value in 2010, but increased 40 percent by 2013.[16] Combined with the change in export values this implies that freight rates per dollar of exports increased by about 5 percent as a whole, and, applying the trade shares for Central America, by about 8 percent within Central America. The bottom panel shows the uptake in TIM. About 38 percent of exports and about 30 percent of shipments and freight

[16] The annual average and median ad-valorem freight related charges equal about 9 and 4 percent in all years.

charges were delivered under TIM by 2013.[17] If the entire change was due to TIM, then this would imply that due to the trade facilitation measures, carriers serving El Salvadorian exporters captured about 21.9 million extra dollars in revenues

Table 4 reports summary statistics related to exporters that use transportation services. From 2010 to 2013, the average exporter saw an increase of international sales of about 29 percent. Along this export expansion, the average exporter increased the shipping frequency by about 24 percent. In the same period of time, the average freight rate increased by about 44 percent. Other characteristics such as the number of destinations, buyers, products, and transportation companies used by the average exporter remained remarkably stable. The bottom panel reports the characteristics of the average exporter using TIM. The average TIM exporter is larger along all dimensions of export performance.

<Table 4 about here>

The literature discussed in the background section argues that transportation markets are concentrated. Table 5 explores this concentration for the case of El Salvador. This table reports a Herfindahl index and a 5-firm concentration ratio for carriers that are active under transit trade serving Central American markets.[18] The Herfindhal indexes are low and do not show much concentration. The 5-firm concentration ratio shows that depending on the measure of interest, the top 5 firms control between 18 to 28 percent of the market. Something to keep in mind is that these concentration ratios are computed across all shipping markets within TIM. A concern in the literature is that markets are segmented, potentially in terms of geography, products, and, exporters and importers. In summary, while the Herfindhal indexes and 5 firm concentration ratios do not immediately raise concerns of market power, it is possible that markets are segmented.

<Table 5 about here>

Table 6 reports some performance statistics for TIM. We do not observe border-processing times for the part of our sample that is not processed under TIM. However, we compare the performance statistics to the World Bank's Doing Business Indicators. For 2013, Doing Business clocks the time to export in El Salvador at 14 days. However, this is not limited to the time at the border. The new methodology reports that border procedures take about 38 hours of time in 2015.[19] Compared to this, TIM looks fast, with a processing time cut almost in half. Accumulated over multiple borders, this could make a difference of 4 days. Of course, the caveat is that the Doing Business data is not limited to truck transport at land borders. The World Bank's enterprise survey lists the average time to clear customs to direct export at 3.7 days. Compared to this performance measure, TIM is a huge improvement. Under TIM in 2013, the median time

[17] The shares of TIM use are even higher for non-neighboring countries.

[18] Unfortunately we do not have carrier information available for the whole sample of exports. The carrier information we use here is specific to the information we obtained related to TIM.

[19] For a detailed discussion on the current methodology visit http://www.doingbusiness.org/Methodology/Trading-Across-Borders.

to clear a border is about a day (between 20 and 26 hours). This is fairly consistent. Table 6 shows that whether shipments cross one or multiple borders, each border crossing takes about 20 hours.

<Table 6 about here>

The descriptive evidence suggests that within Central America, TIM is an important trade facilitation policy that can potentially affect the trucking sector. The next section examines more formally whether this is the case and, if so, how.

5 Regression Evidence

This section provides evidence regarding the effects of the implementation of TIM on transportation related performance measures.

5.1 Empirical model

Let TIM_{fpdt} equal one if shipments by firm f of product p to destination d in year t involved the use of the new transit trade system. Our empirical model relates the log of total freight charges, total insurance charges, and rates computed as charges per export value, export weight and number of export shipments to the TIM indicator. Let y_{ctpd} stand for any of these dependent variables. Our most rigorous empirical model

$$\ln(y_{fpdt}) = \alpha TIM_{fpdt} + \delta_{fpd} + \delta_{ft} + u_{fpdt} \quad (1)$$

accounts for time varying specific information such as fuel costs. It also accounts for carrier characteristics that interact with firm productivity. For example, if more productive firms sort with carriers that have a better fleet and management ability, for example in scheduling, then this could affect freight charges and insurance premiums across exporters. We capture this with firm and firm-year fixed effects. In addition, exporter-product-destination fixed effects control for exporter specific demand and cost of delivering certain products to particular destinations. For example, these fixed effects account for the distance to the border and destination relative to the firms' actual locations.

The estimate of interest is $\hat{\alpha}\times 100$, the reduced form impact of the transit trade system on the dependent variable. As discussed above, the coefficient α subsumes the effects of TIM on demand, supply and market structure. As a consequence, we can't predict the sign of α.[20]

We do not have much guidance from the literature on the effects of TIM on freight insurance. An export expansion due to TIM raises the demand for insurance services, putting upward pressure on prices.

[20] Similar models related to freight charges and transportation services have been estimated in the literature (Blonigen and Wilson, 2008; Clark et al., 2004; Hummels et al., 2009).

However, streamlined border services and transportation may lower the risks of accidents, mishandling, and theft. Again, the coefficient of interest measures the combination of all of these effects.

Our baseline specification, Equation (1), is demanding on the sources of variation. It identifies the effects of TIM within firm-product-destination triplets accounting for firm-year specific information. This requires that firms complete shipments before and after TIM, and, only a subset of all its product-destination combinations use trade routes under TIM. We also estimate several specifications with less rigorous sets of fixed effects. They do not absorb as many unobserved variables and are more likely subject to omitted variable bias, but are easier in terms of interpretation and avoid sweeping potentially useful information for identification into fixed effects.

While the empirical model (1) is intuitive, there are some challenges. Destination-by-year changes that account for local policy differences that change over time are not controlled for. However, given our focus on a small region and one particular mode of transport, one might argue that these changes are less severe. It is difficult to account for this information with fixed effects because of the limited variation across destinations and years. Expanding the empirical application to more countries and years could help with this. The tradeoff is that in this case we introduce multiple modes of transportation and destinations with additional sources of heterogeneity.

Given that trade corridors across which the TIM was implemented are defined as routes connecting with specific destinations through particular customs offices, we clustered standard errors at destination-custom level to control for potential correlations. As robustness checks, we also report standard errors clustered by firm and firm-product-destination combinations.

5.2 Results

Table 7 presents the regression results. The left hand column reports the dependent variable of interest. For each dependent variable we report the estimated effect of TIM and three types of standard errors. Across the columns we report estimates from specifications, including varying sets of fixed effects.

<Table 7 about here>

Without any fixed effects, we find that the introduction of transit trade is associated with a positive, but insignificant effect on freight charges. There are several possible reasons for this null effect. Exports on TIM routes may simply be different because of the destination-specific demand for the products shipped on these routes. It could also be that carriers servicing exporters on these routes are different. To account for these sources of heterogeneity, we sequentially include product, destination, customs-office, year, and exporting-firm fixed effects. Accounting for these sources of heterogeneity, we now find that TIM tends to be associated with higher total freight charges. This pattern persists as we include exporter-by-destination-

by-product effects and account for time varying unobserved exporter-specific information with exporter-year effects.

We conclude that, once we account for relevant unobserved heterogeneity with various sets of fixed effects in general, and for potential unobserved sorting of exporters with carriers of differing level of productivity across trade routes and destinations with exporting firm-year fixed effects in particular, the introduction of TIM raised total freight charges that exporters pay their carriers operating on TIM-eligible trade corridors relative to the pre-TIM regime and trade flows that do not clear under TIM. This result is consistent with an increase in demand for transportation services due to an increase in exports at the firm-destination-product level (Carballo et al., 2016a).[21]

Next, we examine the effect of TIM on freight rates per value and weight. The results in Table 7 show that the signs and significance levels of the estimates are variable across the different specifications. In our most rigorous specifications there is a small positive, and mostly insignificant, effect on value rates. There is no effect on rates per weight, with standard errors greater than coefficient estimates.

Two insights are important. First, from these results we conclude that potential positive effects on freight rates, such as increasing markups and entry of new and potentially less efficient carriers, are marginally greater than the negative cost-reducing effects. This is important to keep in mind, because the marginal increases in freight rates are with respect to a null hypothesis of no change, when in fact marginal cost curves may be decreasing. In this sense, freight transportation may have a limiting effect on the success of trade facilitation policy. Second, the effects of trade facilitation on freight rates are small and difficult to identify, likely because there are multiple channels that affect freight rates in potentially heterogeneous ways that are all subsumed in the average effects.

Despite the small coefficient values and high standard errors, it is useful to put the magnitudes of estimates from a model like ours in perspective. Total trade costs subsume transportation, reliability, timeliness, and many other measure that influence trade. Let the transportation costs be denoted by T and all other trade costs as O. For the sake of illustration, Novy (2013) provides evidence that between the U.S. and Canada, total trade costs as a fraction of the trade value equal about 30 percent. If we suppose that the various trade costs are additive, then we obtain $\tau = \frac{T+O}{Export\ Value} \approx 0.3$. Our data shows that $\frac{T}{Export\ Value} \approx 0.1$. The largest effect from Table 6 says that TIM raises ad valorem freight rates by about 6 percent such that $\frac{T}{Export\ Value} \approx 0.106$. Assume that all other ad valorem trade costs are not affected. The total change in τ is then equal to about 0.006 percentage points. How much is this worth in exports? The increase in ad valorem charges at $\tau \approx 0.3$ to $\tau \approx 0.306$ represent about 2 percent of increase in trade costs. Applying standard elasticity estimates (Soderbery 2015), a 2 percent increase in trade costs reduces trade by about 4 percent.

[21] An alternative explanation is that at given trade flows, freight rates increase because carriers are able to extract greater rents due to faster and more reliable delivery.

Also interesting is the effect of TIM on freight charges per-shipment. To our knowledge, this is the first direct evidence that examines the trade policy effects on transportation costs at the per shipment level. The most common assumption is to capture transportation and all other related trade costs in per-unit, ad-valorem or fixed export costs. Similar as with the ad-valorem and per-unit rates, Table 7 shows that the signs and significance levels of the estimates for per-shipment rates vary across the specifications. If anything, TIM seems to have a positive effect on per-shipment charges, albeit only under the less demanding clustering strategy. Carballo et al. (2016a) provides evidence that the average export value per shipment increased to some extent as a consequence of TIM. Thus, the increase in freight charges per shipment may simply reflect larger shipment sizes in terms of value. In any case, again, it is important to interpret this result knowing that TIM likely reduced some costs at the shipment level due to management of shipments at the border. Therefore, the null result on freight charges per shipment should be evaluated with the understanding that the per-shipment costs of providing the transportation services likely decreased as a result of TIM.

Next we explore the impact of TIM on insurance charges, since they are an important part in understanding the effects of TIM on transportation-related services. Across most specifications we find that TIM increases insurances charges. While its impacts on rates per value and weight and per shipment charges depend on the specification of fixed effects and standard errors, these are predominantly insignificant, especially in our preferred specifications. It is worth pointing out that in terms of magnitudes, the insurance component is the small component of the freight related charges. For the average exporter characterized in Table 3, they account for about 15 percent of the total freight related charges.[22]

We conclude from this preliminary empirical evidence that trade facilitation policy has significant effects on the demand for transportation services. Our review of transit trade and the transportation section predict cost reducing effects on the provision of transportation services. Our regressions show that TIM did increase total freight charges, but the evidence on freight rates is subtler. While some estimated impacts are positive, it is difficult to achieve precision. Based on these pooled regressions and taking the most severe increases in freight charges as a base case, our back-of-the-envelope calculations show that this could potentially have some small limiting effects on trade.

When combined with data from other sources such as tax agencies and statistical offices, customs trade data provide some opportunity to dig deeper and examine micro channels. For example, we augmented our trade dataset with data on the location of the exporting firms from the national economic census conducted by the national statistical office. This information allows for separating potentially segmented markets based on their characteristics. We performed two exercises related to this. First, we

[22] We also examined lagged effects of TIM on insurance and freight charges. This is challenging because we do not have much time series information after the implementation of TIM. The results were similar as what we report here, although over a much smaller sample due to requiring a lag.

split municipalities by size according to population. Second, we split municipalities in terms of the percentage of the population that lives in urban areas. An interesting, but preliminary, result is that per weight charges decrease as a result of TIM in smaller more urbanized areas. If these markets are less competitive as they are initially more difficult to enter, then a decrease in freight rates suggests that as demand for transportation services increases market power is more difficult to sustain and new carriers potentially enter to drive down shipping rates. Admittedly, a caveat applies. Firm addresses are often mistyped or simply missing. Nevertheless, our preliminary evidence indicates that solving these data problems to take advantage of these additional sources of variation may go some way in understanding the various interactions between trade facilitation and trade policy.[23]

6 Conclusions

The WTO TFA signed in Bali emphasizes trade facilitation as a means to increase international trade. Several countries including those in Central and Latin America have recently moved towards implementing trade facilitation measures featured in this agreement to affect the flow of shipments and to reduce the associated trade costs.

Our literature review shows that there is a small, but growing, number of studies examining the effects of trade facilitation on trade and exports. This is a challenging task, as broad country-level indicators complicate identification and interpretation, while micro level datasets with particular policy changes are difficult to come by. Contrary to standard trade policy instruments like tariffs, trade facilitation often directly affects transportation and shipments of products, a part of the international supply chain that is typically very simplified in the existing literature.

We provide evidence that examining these links is important. The introduction of a new transit trade policy in El Salvador suggests that an expansion in trade demand also increases the demand for transportation and freight insurance services. The literature argues that freight rates in the Central American trucking sector are relatively high. While the transit trade policy has transportation cost-reducing components, such as faster delivery times and more reliable border crossing which should result in less idle equipment, shorter driver hours and improved scheduling, we do not find evidence for systematic cost-reducing effects for the trade sector in terms of lower freight rates. In most cases, the effects of TIM on ad valorem rates and per shipment charges are null, or if anything at all, slightly positive, although the effects are not precisely estimated with available data.

[23] We also examined effects related to different product categories. While some of the results seem intuitive, for example transportation of food related products see a large and positive increase due to trade facilitation, across the product groups it is difficult to identify revealing significant differences.

References

Alessandria, G., J.P. Kaboski and V. Midrigan, (2010), 'Inventories, lumpy trade and large devaluations', *American Economic Review*, 100(5), 2304-2339.

Alessandria, G., J.P. Kaboski and V. Midrigan, (2011), 'US trade and inventory dynamics', *American Economic Review*, 101(3) 303-307.

Anderson, W. P. and W.M. Brown, (2015), 'How thick is the border: the relative cost of Canadian domestic and cross-border truck-borne trade, 2004–2009', *Journal of Transport Geography*, 42, 10-21.

Anderson, W. P. and W.M. Brown, (2012), 'Trucking across the border: the relative cost of cross-border and domestic trucking, 2004 to 2009', Economic Analysis Research Paper Series, ISSN 1703-0404.

Atkin, D., A. Khandelwal and A. Osman, (2016), 'Exporting and firm performance: evidence from a randomized Trial', *Quarterly Journal of Economics*, accepted.

Avetisyan, M., N Heatwole, A. Rose and B. Roberts, (2015), 'Competitiveness and macroeconomics impacts of reduced wait times at U.S. land freight border crossings', *Transportation Research Part A*, 78, 84-101.

Bernhofen, D., Z. El-Zahli and R. Kneller, (2016), 'Estimating the effects of the container revolution on world trade', *Journal of International Economics*, 98, 36-50.

Beverelli, C., S. Neumueller and Teh R., (2015), 'Export diversification effects of the WTO trade facilitation agreement', *World Development*, 76, 293-310.

Bergin, P., R. Feenstra and G. Hanson, (2009), 'Offshoring and volatility: evidence from Mexico's maquiladora industry', *American Economic Review*, 99(4), 1664-1671.

Blonigen, B. and W. Wilson, (2008), 'Port efficiency and trade flows', *Review of International Economics*, 16(1), 21-36.

Bottasso, A. and M. Conti, (2010), 'The productive effect of transport infrastructures: does road transport liberalization matter?', *Journal of Regulatory Economics*, 38(1), 27-48.

Brown, W.M., (2015), 'How much thicker is the Canda-U.S. border? The cost of crossing the border by truck in the pre- and post 9/11 eras', EA Research Paper Series Nr. 99.

Carballo, J., A. Graziano, G. Schaur and C. Volpe Martincus, (2016a), 'Transit trade', IDB Working Paper 704.

Carballo, J, A. Graziano, G. Schaur and C. Volpe Martincus, (2016b), 'Endogenous border times', IDB Working Paper 702.

Carballo. J, G. Schaur and C. Volpe Martincus, (2016c), 'Trust no one? Security and international trade', IDB Working Paper 703.

Carballo, J., G. Schaur and C. Volpe Martincus, (2016d), 'Posts as trade facilitators', IDB Working Paper 705.

Carballo, J., A. Graziano, G. Schaur and C. Volpe Martincus, (2016d), 'The border labyrinth: Information technologies and trade in the presence of multiple agencies', IDB Working Paper 706.

Clark, X., D. Dollar and A. Micco, (2004), 'Port efficiency, maritime transport costs and bilateral trade', *Journal of Development Economics*, 75(2), 417-450.

Clyde, P. and J. Reitzes, (1995), 'The effectiveness of collusion under anti-trust immunity, the case of liner shipping conferences', Federal Trade Commission Policy Report.

Cristea, A., D. Hummels and B. Roberson, (2014), 'Estimating the gains from liberalizing services trade: The case of passenger aviation', working paper.

Cristea, A. and D. Liliana, (2016), 'The extensive margin of aviation networks: Implications for urban development', working paper.

Cristea, A., R. Hilberry and A. Mattoo, (2015), 'Open skies over the middle east', *The World Economy*, 38(11), 1650-1681.

Djankov, S., C. Freund and C. Pham, (2010), 'Trading on time', *Review of Economics and Statistics*, 92(1), 166-173.

Evans, C. and J. Harrigan (2005), 'Distance, time, and specialization: Lean retailing in general equilibrium', *American Economic Review*, 95(1), 292-313.

Feenstra, R. and H.T. Ma, (2014), 'Trade facilitation and the extensive margin of exports', *Japanese Economic Review*, 65(2), 158-177.
Fernandes A.M., R. Hillberry and A. Mendoza, (2015), 'Trade effects of customs reform: Evidence from Albania', Policy Research Working Paper 7210.
Fink, C., A. Mattoo and I.C. Neagu, (2000), 'Trade in international maritime services: How much does policy matter?', *World Bank Economic Review*, 16(1), pp. 81-108.
Fontagné, L., G. Orefice and R. Piermartini, (2016), 'Making (small) firms happy, the heterogeneous effects of trade facilitation measures', CESIfo Working Paper 5899.
Gonzalez, A. J., J.L. Guasch and T. Serebrisky, (2008), 'Improving logistics costs for transportation and trade facilitation', Policy Research Working Paper 4558.
Goodchild, A., S. Globerman and S. Albrecht, (2007), 'Service time variability at the Blaine, Washington, international border crossing and the impact on regional supply chains', Border Policy Research Institute, http://www.ac.wwu.edu/~bpri/resources.html.
Guerrero, P. and J. Abad, (2013), 'Trucking in Belize, Central America, and the Dominican Republic: Performance analysis and policy recommendations', IDB-TN-511.
Haralambides, H.E. and M.P. Londono-Kent, (2004), 'Supply chain bottlenecks: Border crossing inefficiencies between Mexico and the United States', *International Journal of Transport Economics*, 31(2), 171-183.
Harrigan, J., (2010), 'Airplanes and comparative advantage', *Journal of International Economics*, 82(2), 181-194.
Harley, C. K., (1988), 'Ocean freight rates and productivity, 1740-1913: The primacy of mechanical invention reaffirmed', *Journal of Economic History*, 48(12), 851-76.
Harley, C. K., (1989), 'Coal exports and British shipping, 1850-1913', *Explorations in Economic History*, 26(3), 311-38.
Hilberry, R. and X. Zhang, (2015), 'Policy and performance in customs', Policy Research Working Paper 7211, The World Bank.
Hoekman, B. and B. Shepherd, (2015), 'Who profits from trade facilitation initiatives? Implications for African countries', *Journal of African Trade*, 2, 51-57.
Holmes, T. and J. Stevens, (2014), 'An alternative theory of the plant size distribution, with geography and intra- and international trade', *Journal of Political Economy*, 122(2), 369-421.
Hornok, C. and M. Koren, (2015a), 'Administrative barriers to trade', *Journal of International Economics*, 96, S110-S122.
Hornok, C. and M. Koren, (2015b), 'Per-shipment costs and the lumpiness of international trade', *Review of Economics and Statistics*, 97(2), 525-530.
Hummels, D., (2007), 'Transportation costs and international trade in the second era of globalization', *Journal of Economic Perspectives*, 21(3), 131-154.
Hummels, D. and G. Schaur, (2013), 'Time as a trade barrier', *American Economic Review*, 103(7), 2935-2959.
Hummels, D., V. Lugovskyy and A. Skiba, (2009), 'The trade reducing effects of market power in international shipping', *Journal of Development Economics*, 89(1), 84-97.
Jones, T.J., (1999), 'The effects of trans border trucking regulations on inbound trucks and the trucking infrastructure', *Journal of Transport Economics and Policy*, 33(2), 173-183.
Kropf, A. and P. Sauré, (2014), 'Fixed cost per shipment', *Journal of International Economics*, 92(1), 166-184.
Lakshmanan, T.R., U.R. Subramanian, W.P. Anderson and F.A. Leautier, (2001), 'Integration of transport and trade facilitation selected regional case studies,' The International Bank for Reconstruction and Development, The World Bank.
Lafontaine, F. and L.M. Valeri, (2009), 'The deregulation of international trucking in the European Union: Form and effect,' *Journal of Regulatory Economics*, 35(1), 19-44.
Mohammed, S.I. and J.G. Williamson, (2004), 'Freight rates and productivity gains in British tramp shipping 1869-1950', *Explorations in Economic History*, 41(2), 172-203.
Moïsé, E., T. Orliac and P. Minor, (2011), 'Trade facilitation indicators the impact on trade costs', OECD Trade Policy Working Papers Nr. 118.

North, D., (1958), 'Ocean freight rates and economic development 1750-1913', *Journal of Economic History*, 18(4), 537-55.
North, D., (1968), 'Sources of productivity change in ocean shipping, 1600-1850', *Journal of Political Economy*, 76(5), 953-970.
Osborne, T., M.C. Pachon and E.A. Gonzalo, (2014), 'What drives the high price of road freight transport in Central America', Policy Research Working Paper Nr. 6844, The World Bank.
Rotemberg, J.J. and G. Saloner, (1986), 'A supergame-theoretic model of price wars during booms', *American Economic Review*, 76(3), 390-407.
Sjostrom, W., (1992), 'Price discrimination by shipping conferences,' *Logistics and Transportation Review,* 28(2), 207-216.
Soderbery, A., (2015), 'Estimating import supply and demand elasticities: Analysis and implications', *Journal of International Economics*, 96(1), 1-17.
Volpe Martincus, C., J. Carballo and A. Graziano, (2015), 'Customs', *Journal of International Economics*, 96, 119-137.
Wilmsmeier, G., J. Hoffmann and R. Sanchez, (2006), 'The impact of port characteristics on international maritime transport costs', Port Economics, Research in Transportation Economics, Volume 16, edited by Kevin Cullinane and Wayne Talley, Elsevier.

Table 1: Trade Facilitation Policies

Trade Facilitation Policy	Description
Risk Management Systems (RMS)	All shipments leaving or entering countries must be processed by their respective customs agencies. Under a risk management system inspection intensities vary across shipments. Some shipments are not inspected (green channel), some shipments are only subject to documentary inspection (yellow orange channel), and some shipments undergo both documentary and intrusive examination (red channel) RMS make it possible to move from inspecting 100% of shipments, as was common in several developing countries a few years ago to focusing attention on a substantially smaller subset of those shipments that are considered riskier.
Authorized Economic Operator Programs (AEO)	AEO programs are voluntary cooperative arrangements between customs agencies, other public border entities and private sector firms. Firms that have a record of compliance with customs requirements, a satisfactory system of managing commercial records, proven financial solvency, and, crucially, adequate security and safety standards are considered reliable and eligible to become AEOs. Firms certified as AEO by their respective national customs agency are entitled to trade facilitation advantages, which include less frequent physical and documentary customs inspections, expedited processing and release of shipments, and, streamlined administrative compliance procedures.
Simplified Export Regime for Postal (Low Value) Exports (*Exporta Fácil*-EF)	Post offices can provide trade intermediation services. Instead of having to go to the nearest customs branch, fill out a full export declaration, and hire customs brokers and freight forwarders, firms can export their low value shipments via the local post office accompanied by a simplified export customs declaration (and other relevant documents). This provides at least three advantages for firms. First, the program simplifies document management. Second, given that postal services have a broader geographical coverage than the standard entry points associated with regular customs branches, the program reduces the costs that firms have to incur to reach the country's borders. Third, the program streamlines the administrative export process and firms using it also benefit from assistance from the postal offices in completing these customs procedures.
Trade Single Windows (SW)	SW are arrangements that streamline the administrative process related to international trade. They allow all involved parties to file and review standardized information with a single entry point. Information technology and interoperability enabling methods have made it possible to develop and implement electronic SW. Instead of filling out and physically moving paper-based documents consecutively, these single windows allow online applications, digital document exchange among agencies dealing with trade regulations, and issuance of trade-related permits and certificates. Electronic single windows are associated with an increase in the speed, timeliness, and accuracy of information submission and processing, and a reduction in response times. Firms can interact with a single virtual agency instead of having to pay physical visits to obtain paper forms, fill them out, and present them at the various regulatory agencies involved. Further, submitted data can be reused multiple times, errors from re-keying identical data are eliminated, and data consistency is enhanced. Moreover, systems generally allow better tracking of the progress toward completing the procedures and more predictable decisions.
Streamlined Transit Trade (TT) Systems	Goods frequently have to be transported through intermediate countries when shipped over land. This is technically known as "international transit". Without explicit special provisions for international transit, deliveries need to undergo a succession of import and export border clearance procedures including filling out paper-based documents and in some cases even loading and unloading trucks. These repetitive procedures create substantial congestion at borders and lead to transaction costs. Under well-functioning transit regimes, 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. 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.

Table 2: Trade Facilitation Agreements, Policy Implementation and Indicators

WTO TFA Article	Description	Policies	OECD Indicators according to Fontagné et al. (2016)
1, 3, 4, 5, 6	Communication of information between firms and customs to facilitate processing, transparency and non-discrimination		Information availability, advance rulings, appeals, fees and charges
7	Simplify and expedite the administrative process of shipments at the border	Single Windows, Transit Trade Regimes, Authorized Economic Operators, Risk Management, Postal Exports	Formalities and document automation, procedures
8, 12	Cooperation of customs and border agencies within and across countries to share information and streamline procedures	Single Windows, International Transit Regimes	Cooperation, internal and external
9	Customs clearance of shipments at inland customs	Transit Trade Regimes	
10	Reduction of complexity of documents and formalities	Single Windows, Transit Trade Regimes, Authorized Economic Operators, Postal Exports	Formalities, document, automation, procedures
11	Countries should allow for transit regimes	Transit Trade Regimes	

Note: We drop article 2 because it regulates how traders can influence the shaping of policy, but how trade actually works.

Table 3: Export Indicators for all Overland Exports in El Salvador

Indicators	All Sample (Values)		Central America (Shares)	
	2010	2013	2010	2013
Export Value	1,868.34	2,475.22	0.90	0.90
Number of Shipments	264,087.00	333,675.00	0.95	0.96
Number of Exporters	1,947.00	2,003.00	0.95	0.95
Number of Products	2,970.00	3,095.00	0.98	0.99
Number of Destinations	19.00	19.00	0.26	0.26
Number of Buyers	7,228.00	7,075.00	0.92	0.92
Number of Customs	24.00	34.00	0.88	0.94
Freight Charge	53.91	75.29	0.95	0.97
Freight and Insurance Charge	63.03	89.65	0.95	0.97
Overall TIM Share				
Share of TIM on Exports		0.36		0.38
Share of TIM on Shipments		0.30		0.31
Share of TIM on Freight Charge		0.31		0.32
Share of TIM on Freight and Insurance Charge		0.30		0.31

Table 4: Characteristics of the Average Exporter using Land Transport

Indicators	Average Exporter Land			
	All Sample		Central America	
	2010	2013	2010	2013
Export Value	959.60	1,235.75	906.56	1,172.04
Number of Shipments	135.64	166.59	135.61	168.51
Number of Exporters	1,947.00	2,003.00	1,859.00	1,898.00
Number of Products	7.19	7.43	7.10	7.50
Number of Destinations	2.01	1.97	1.92	1.88
Number of Buyers	5.49	5.28	5.38	5.22
Number of Customs	2.06	2.20	2.01	2.18
Freight Charge	27.69	37.59	27.61	38.57
Freight Rate	0.09	0.13	0.09	0.13
Freight and Insurance Charge	32.37	44.76	32.31	45.95
	TIM			
Export Value	2,679.34		2,410.98	
Number of Shipments	360.52		349.68	
Number of Exporters	808.00		804.00	
Number of Products	10.90		10.64	
Number of Destinations	2.93		2.67	
Number of Buyers	10.12		9.64	
Number of Customs	3.33		3.18	
Freight Charge	32.05		30.64	
Freight Rate	74.95		73.15	
Freight and Insurance Charge	0.10		0.10	

Table 5: Concentration Indexes on TIM Routes

Indicator	Variable	Concentration Index	Concentration Index Land
Herfindhal Index	**Export Value**	0.014	0.014
	Number of Shipments	0.027	0.027
	Freight Charge	0.014	0.014
Top 5 Concentration Index	**Export Value**	0.178	0.179
	Number of Shipments	0.284	0.284
	Freight Charge	0.198	0.199

Table 6: Border Performance of TIM

Border Crossings	TIM Performance Measures		
	Indicators	**2011**	**2013**
1	**Median Time in Days**	1.44	1.10
	Median Time in Hours	34.44	26.43
2	**Median Time in Days**	0.89	0.83
	Median Time in Hours	21.26	19.95
3	**Median Time in Days**	0.93	0.87
	Median Time in Hours	22.36	20.97
4	**Median Time in Days**	0.90	0.85
	Median Time in Hours	21.63	20.32

Table 7: The Effects of TIM on Freight Charges, Insurance Charges and Rates

Dependent Variable	The Impact of TIM on Freight and Insurance Charges					
	Coefficient Estimates and Standard Errors					
Freight Charge	0.306	0.309	0.220	0.127	0.135	0.166
Cluster Custom-Destination	(0.209)	(0.148)**	(0.068)***	(0.055)**	(0.080)	(0.059)***
Cluster Firm	(0.185)*	(0.099)***	(0.114)*	(0.066)*	(0.076)*	(0.053)***
Cluster Firm-Product-Destination	(0.040)***	(0.034)***	(0.037)***	(0.036)***	(0.035)***	(0.041)***
Freight Charge per Value	0.021	0.051	-0.091	0.008	0.060	0.039
Cluster Custom-Destination	(0.121)	(0.110)	(0.082)	(0.040)	(0.036)	(0.021)*
Cluster Firm	(0.076)	(0.059)	(0.056)	(0.042)	(0.050)	(0.041)
Cluster Firm-Product-Destination	(0.016)	(0.015)***	(0.017)***	(0.016)	(0.019)***	(0.022)*
Freight Charge per Weight	-0.006	-0.002	-0.175	-0.039	0.027	0.029
Cluster Custom-Destination	(0.183)	(0.141)	(0.067)**	(0.031)	(0.068)	(0.047)
Cluster Firm	(0.136)	(0.102)	(0.113)	(0.048)	(0.056)	(0.043)
Cluster Firm-Product-Destination	(0.023)	(0.021)	(0.025)***	(0.022)*	(0.024)	(0.027)
Freight Charge per Shipment	0.036	0.106	-0.076	0.126	0.050	0.077
Cluster Custom-Destination	(0.271)	(0.198)	(0.147)	(0.047)***	(0.077)	(0.053)
Cluster Firm	(0.290)	(0.183)	-0.202	(0.056)**	(0.041)	(0.053)
Cluster Firm-Product-Destination	(0.034)	(0.028)***	(0.031)**	(0.028)***	(0.027)*	(0.032)**
Insurance Charge	0.156	0.182	0.313	0.156	0.093	0.116
Cluster Custom-Destination	(0.123)	(0.072)**	(0.038)***	(0.042)***	(0.074)	(0.055)**
Cluster Firm	(0.143)	(0.103)*	(0.109)***	(0.070)**	(0.069)	(0.064)*
Cluster Firm-Product-Destination	(0.040)***	(0.034)***	(0.038)***	(0.037)***	(0.037)**	(0.044)***
Insurance Charge per Value	-0.129	-0.075	0.002	0.037	0.018	-0.011
Cluster Custom-Destination	(0.064)**	(0.048)	(0.038)	(0.015)**	(0.032)	(0.030)
Cluster Firm	(0.073)*	(0.053)	(0.061)	(0.032)	(0.035)	(0.030)
Cluster Firm-Product-Destination	(0.013)***	(0.012)***	(0.014)	(0.013)***	(0.017)	(0.018)
Insurance Charge per Weight	-0.156	-0.128	-0.083	-0.011	-0.015	-0.020
Cluster Custom-Destination	(0.132)	(0.067)*	(0.031)**	(0.021)	(0.049)	(0.051)
Cluster Firm	(0.095)*	(0.065)**	(0.073)	(0.048)	(0.051)	(0.053)
Cluster Firm-Product-Destination	(0.024)***	(0.021)***	(0.024)***	(0.022)	(0.025)	(0.027)
Insurance Charge per Shipment	-0.114	-0.020	0.017	0.154	0.008	0.028
Cluster Custom-Destination	(0.162)	(0.104)	(0.106)	(0.031)***	(0.065)	(0.059)
Cluster Firm	(0.222)	(0.138)	(0.161)	(0.062)**	(0.052)	(0.062)
Cluster Firm-Product-Destination	(0.032)***	(0.028)	(0.031)	(0.029)***	(0.029)	(0.035)
Product Fixed Effect	No	Yes	Yes	Yes	No	No
Destination Fixed Effect	No	No	Yes	Yes	No	No
Custom Fixed Effect	No	No	Yes	Yes	Yes	No
Year Fixed Effect	No	No	Yes	Yes	Yes	No
Firm Fixed Effect	No	No	No	Yes	No	No
Firm-Year Fixed Effect	No	No	No	No	No	Yes
Firm-Product-Destination Fixed Effect	No	No	No	No	Yes	Yes
Observations	65,811	65,811	65,811	65,811	65,811	65,811

Notes: The unit of observation is carrier-destination-year-product. Standard errors are clustered at the destination and main custom office level. Stars ***, **, * indicate significance at the the 1, 5 and 10 percent significant levels. The estimator for all coefficient estimates is OLS. The sample is limited to shipments within Central America.

Figure 1: The TIM Implementation

Source: Authors' elaboration based on Carballo et al. (2016a).