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Jerónimo Carballo
Alejandro Graziano
Georg Schaur
Christian Volpe Martincus

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Endogenous Border Times[♦]

Jerónimo Carballo
University of Colorado

Alejandro Graziano
University of Maryland

Georg Schaur
University of Tennessee

Christian Volpe Martincus[*]
Inter-American Development Bank

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Abstract

We examine transaction-level Peruvian import data to show that firms are subject to significant costs of port-of-entry delays. At the transaction level, we observe the time it takes a shipment to clear each step in the entry process. Our theory shows conditions under which observed entry times are endogenous. As a result, total entry delays potentially lead to biased policy conclusions and non-informative efficiency rankings of countries' entry procedures. We make three empirical contributions that help unbundle sources for time costs in trade and border effects. First, we provide evidence that at least part of the total port-entry-time is endogenous. Second, we identify the effect of entry delays on imports based on exogenous necessary entry processing. Third, we provide evidence that trade costs due to entry delays are heterogeneous across firm types. New and large importers are more elastic with respect to entry delays. This information allows researchers and policymakers to interpret aggregate port of entry delay data and their costs across different types of firms.

Keyword: Trade Costs, Borders, Trade Facilitation, Peru
JEL-Code: F10, F13, F14

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[*]Correspondence Address: Inter-American Development Bank, Stop W0610, 1300 New York Avenue, NW, Washington, DC 20577, United States of America. E-mail: christianv@iadb.org. Tel.: +1 202 623 3199. Fax: +1 202 623 2995.

Endogenous Border Times

1 Introduction

Supply chains in international trade are complex processes that involve multiple steps. After leaving the origin country, imports have to be internationally shipped, arrive at the destination port, unloaded, moved to customs, inspected, cleared and finally picked up. Because these procedures take time and their duration is uncertain, they can affect inventory and financing costs, a firm's ability to plan production runs and to respond to market fluctuations. In short, long and uncertain delivery times create significant costs. As a consequence, policies that aim to simplify port-of-entry procedures such as those covered in the 2013 WTO Agreement on Trade Facilitation could have large effects.

If this worldwide initiative is to make a difference, two key issues need to be addressed: how to measure and keep track of countries' actual progress towards facilitating trade and how to assess its economic implications. This requires both an appropriate theoretical framework to think about the economics of border times and specifically to guide the evaluation of the policies that affect these times and appropriate data to implement these evaluations. On the theoretical side, so far we lack a model that explains how firms optimally schedule time in their supply chains. On the empirical side, measurement of countries' performance at their borders has been typically limited to aggregate, survey-based indicators of the time it takes to complete trade procedures (e.g., Doing Business Indicators).[1]

More generally, the absence of a theoretical model on time scheduling in supply chains and data aggregation result in several fundamental questions related to time delays in international trade, which have not been examined. These questions include where policy-driven trade processes delay trade flows, how delays are distributed across different procedures and importers to generate heterogeneous costs, how firms respond to policy-driven trade procedures, and how their management of the international supply chain affects the interpretation of elasticity estimates. Answer to these questions are relevant to understand the sources of costs of long delivery times and their economic implications for comparative advantage, trade costs, border effects, uncertainty, and precisely policy effectiveness.

Opening the black box of international trade processing reveals several challenges that evaluations of trade facilitation policies have to deal with if their success is to be measured in terms processing times. First, firms may optimally choose the amount of time they allocate to port of entry processing. Hence, observed port-of-entry delays may be determined in equilibrium and differ from actual processing times raising concerns of systematic measurement bias. Second, the costs of actual processing delays are potentially heterogeneous across products and firms depending on supply chain management strategies

[1] These measures have been widely used to estimate the costs of delays derived from administrative barriers (e.g., Djankov et al., 2010; Hornok and Koren, 2015).

and firm types. Third, the processing speed of shipments in the port of entry is endogenous if it is correlated with shipment-specific shocks that cannot be absorbed with fixed effects. Combined, these challenges imply that it is not clear what information survey data on time delays contain, how to identify their costs, and how these costs vary across importers. With these challenges in mind, we develop a model of port-of-entry delays and employ a novel dataset including detailed transaction-level import and port-of-entry processing information to uncover the micro channels that explain time costs and identify the benefits of trade policy that streamline border procedures.

Our model allows firms to optimally allocate time to their supply chains to clear the port-of-entry if actual processing times are uncertain and firms' objective is to meet a delivery date. Allocating more time to entry reduces the risk of missing the delivery date, but raises container rental, financing and depreciation costs. For a given distribution of actual processing times, a decrease in the costs of scheduling long supply chains and late arrival increases the time that firms allocate for port-of-entry clearance.

This mechanism has two important consequences for the interpretation of observed clearance times and elasticity estimates. First, if total observed delivery times are based on the firm's optimal lead time, then they overstate actual processing times. As a consequence, country rankings based on aggregate or average survey-based delay information potentially mix policy-driven processing times due to inspections and other border procedures with firms' optimal allocation of lead time to the supply chain. This complicates the interpretation of country rankings if they are supposed to reflect port and customs efficiency and can even make them misleading. This is of policy importance because international organizations spend resources to collect the underlying data, multinational firms declaredly consider these measures when deciding where to invest and establish their affiliates, and policymakers set goals in terms of these indicators and have to answer for a slipping performance compared to competitors. Second, the model shows that the trade cost elasticity with respect to a firms' optimal lead time has a structurally different interpretation than the elasticity based on actual processing times. Hence, elasticities based on firms' optimal lead times are not directly informative about the effect of a policy that reduces actual processing times and identifies different model parameters than the elasticity based on processing times. Understanding this difference is crucial when evaluating the trade effects and ultimately welfare implications of public investments into trade facilitation.

We operationalize this model using a unique dataset. Our data covers all import transactions entering into Peru through the country's main port over several years and includes information on the date of ship arrival, the date of unloading, the date of arrival at customs, the date of custom's clearance, and the date of actual exit from port facilities. We find that longer median delays at the port of entry reduce trade. Pooled over the whole sample, a one percent increase in the median entry delay reduces trade by about

0.03%. Going from the 25th to the 75th percentile of the distribution increases costs by 3.45% of the total value of the shipment.

Detailed firm-level information allows us to address several identification concerns. First, aggregating data by countries or products makes the interpretation of estimation results difficult. They capture intensive and extensive margins and place restrictions on the elasticity parameters across firms within the unit of aggregation. This is important if entry requirements are especially costly for new firms and therefore affect the extensive margin or if large firms are especially sensitive to delays because they manage highly fine-tuned and rigid production processes. Second, our model highlights the importance not just of the central tendency, but the shape of the entry delay distribution. Shipment level data allows us to examine the importance of both characteristics of the entry processing distribution. Third, entry times can be endogenous to firm behavior due to a measurement problem. If firms optimally allocate storage time, then observed entry delays including storage time systematically overstate actual processing times. We observe total clearance times as well as broken down by necessary processing time –i.e., port and customs handling- and potentially endogenously chosen storage time. Consistent with our model, we provide evidence for each of these steps and total entry delays.

The standard identification concerns are that importers may have means that are not observable to speed up small emergency shipments or that larger shipments may take longer to clear due to longer handling and inspection times. In this case we would see long delays associated with large shipment and small shipments associated with short delays. Both channels bias our coefficients against the prediction from the theory. Solving these identification problems would allow for a better interpretation of available statistics and for a robust anticipation of the benefits associated with streamlined port-of-entry procedures.

In order to address these identification issues we pursue multiple strategies. We directly account for unobserved time-varying firm-level heterogeneity such as productivity differences, quality variation, and supply chain infrastructure through firm-year fixed effects and, in robustness check exercises, through firm-product-year and firm-origin-year fixed effects. Our baseline specification also includes product-exporting country-year fixed effects that account for time-varying product-exporting heterogeneity such as that associated with preferential tariffs and transport costs. As a result, we neutralize a set of confounding factors that could be shipment specific and correlated with processing delays that is much more extensive than what exists in the literature.

On top of this, we apply an instrumental variable estimator based on port congestion and the customs clearance mechanism. More precisely, we instrument observed delays first with the median number of other ships that arrive on the same date as the vessel carrying the firm-product-export country import flow in question. The intuition is that given the port's limited storage, customs and processing abilities, the greater is the level of congestions, the longer will be the port-of-entry delays. Two considerations are worth being made here. First, this instrument is logically similar to those of changes based on initial levels (i.e., initial tariffs as an instrument for subsequent changes in tariffs). As with those peers, this initial level instrument is less prone to endogenous decisions. In particular, strategic choices regarding arrival date are less of an issue, especially given the use of a narrow time window for port arrivals and Peru's trade share that is small and unlikely to determine maritime routes. Second, the exclusion restriction can be expected to hold because the median number of ships arriving in given days likely affects imports only through its impact on delays but not directly. Second, we exploit customs' use of risk management systems in handling shipments to generate an additional instrument for observed port-of-entry processing times (see Volpe Martincus et al., 2015). In particular, we utilize the median assignment to (documentary or physical) inspection channels. Conditional on importing firm, product-origin, and seller combinations, shipments can be considered to be randomly allocated to inspection. Depending on whether shipments have to go through this verification or not, processing times increase for some imports while those for others remain the same. This instrument also fulfills the exclusion restriction is fulfilled because assignment to control cannot affect foreign purchases through channels other than delays themselves. Consistent with the intuition, the instrumental variable estimate is significant, negative and smaller than the OLS estimate.

In addition, we make use of information on a regime adopted by Peru's tax agency according to which importers can register for express clearance prior to arrival of the vessel to control for firms' incentives to speed up shipments at the border. More specifically, we differentiate import flows in those channeled through express processing and those subject to standard procedures. Remarkably, the elasticity of imports with respect to an increase in the median delay is similar under both regimes. Therefore, while total entry times are shorter in the express regime, an increase in the median delay has a similar effect in both regimes. This implies that our identification strategy in the overall sample appropriately controls for incentives to speed up shipments as exhibited by firms that utilize express channels.

Time is an important factor for international business and firms take this into account when making export and import decisions. A number of papers have identified the elasticity of trade costs with respect to an increase in lead time by focusing on their central tendency (see Evans and Harrigan, 2005; Hummels and Schaur, 2010; Hummels and Schaur 2013). This literature shows that long lead times in international supply chains are costly. Our results reveal that the lead time elasticity of trade costs typically estimated in the literature is a combination of two parameters, namely, the shape of the delay distribution and the cost elasticity if allowing for longer delivery times in the supply chain. This informs the academic literature on what is driving the costs with respect to long delays. Furthermore, as a consequence, long average (or median) clearance times are not enough to derive appropriate policy recommendations because the combined elasticity does not reveal why trade costs for a given exporter or importer are particularly elastic with respect to delays.

Fueling this debate, Hallward-Driemeier and Pritchett (2015) argue that Doing Business time indicators may be over-estimated, because they are based on *de jure* times. *De facto*, the time it actually takes, may be lower due to enforcement issues. They apply this argument to explain differences between Doing Business indicators and data collected on Enterprise Surveys also by the World Bank. In the manufacturing sector, the Enterprise Business Survey reports an average duration of 21 days to direct import to Peru in 2010. Also in 2010, Doing Business reported an average duration of 24 days.[2] This seems consistent with Hallward-Driemeier and Pritchett's argument. However, in 2011 the Doing Business number drops to 17 days, which is comparable to our observed average delay in 2013 of about 16.5 days, but earlier in our sample, in 2007, the average delay is even lower at 15.9.

We provide an additional explanation for why it is difficult to obtain estimates of average port-of-entry delays. Instead of answering how long it actually takes to clear the official part of the import process, firms may answer how much time they schedule to clear the port of entry. Our data show that in 2013, the average time for unloading, document preparation and storage and customs delay are 2, 11, and 5. The longest part of the total delay, document preparation and storage, primarily depends on importing firms' decisions.

Exploiting firm and product level heterogeneity, our empirical evidence provides insight in where and why supply chain delays are costly. This helps policy makers understand what firms and what part of the economy are affected the most by streamlining port-of-entry procedures. This also provides evidence if firms actively manage the entry process and the length of their supply chains and explains why long average delays are an important cost in international trade. This is a step towards understanding the micro channels that explain the large times costs in international trade identified in the existing literature.

Our results also add to a number of papers that identify trade costs (see, e.g., Hummels, 2007; Anderson and Neary, 2005; Anderson and Yotov, 2008; and Jacks et al., 2008), but especially with respect to frictions related to crossing borders (see, e.g., McCallum, 1995; Helliwell, 1996; and Anderson and van Wincoop, 2003). The advantage of our dataset is that instead of estimating a catch all border effect, we can quantify the impact of detailed border procedures. In this specific regard, we contribute to and combine two so far largely disconnected literatures that examine ports and airports, their efficiency, and their implications for economic outcomes such as population growth, employment composition, and trade (see, e.g., Wilson et al., 2003; Brueckner, 2003; Clark et al., 2004; Blonigen and Wilson, 2008; Sheard, 2014; and Blonigen and Cristea, 2015) and how customs processing affect exports and imports (see, e.g.,., Volpe

[2] http://www.doingbusiness.org/Custom-Query/peru.

Martincus et al., 2015; Fernandes et al., 2015).[3] In particular, we distinguish actual processing delays that can be affected by policy due to a streamlining or elimination of import procedures from endogenously determined delays.

This makes a substantial difference in the case of imports. While there is interdependence among import stages, the correlation is far from perfect, so that focusing on just one component of the port-of-entry delays can lead to biased estimates. On the other hand, pooling them together does not make it possible to establish the source of delays, what governments can do to facilitate trade or to properly measure the impact of policy on efficiency. This is important because imports affect productivity (see, e.g., Pavnick, 2002; Shor, 2004; Fernandes, 2007; Amiti and Konings, 2007; Kashara and Rodrigue, 2008; Topalova and Khandelwal, 2011); exports (see, e.g., Kasahara and Lapham, 2013; Bas and Strauss-Kahn, 2014); product scope (see, e.g, Goldberg et al., 2010; Colantone and Crino, 2014); and product quality (see, e.g., Fernandes and Paunov, 2013; and Bas and Strauss-Kahn, 2015).

The remainder of the paper is organized as follows. Section 2 develops a model that will guide our empirical approach and help interpret the coefficient estimates. Section 3 presents our dataset. Section 4 describes the import process in Peru. Section 5 explains our empirical approach. Section 6 reports and discusses our estimation results, and Section 7 concludes.

2 Importing into Peru

Importing involves various steps and diverse actors (see Figure 1). In this section we describe the processing of imports at Peru's main seaport, Callao. We employ highly disaggregated data taken from customs import declarations and load manifests over the period 2007-2013 kindly provided by Peru's National Tax Agency (Superintendencia Nacional de Administración Tributaria -SUNAT). These data allow us to know the exact date associated with the various port-of-entry procedures that shipments have to complete. Thus, for each of these shipments clearing through the port of Callao, we observe the date when the ship arrived, the date the shipment was unloaded, the date the customs import declaration was created and registered, the date the physical inspection took place, the customs channel, and the date the shipment was released by customs. Shipments must clear several port of entry procedures associated with these dates. Some of the steps are due to the actual processing of the imports by port workers, shipping agents, customs brokers and government officials, while others are due to storage between steps.

[3] There is a large number of studies that utilize aggregate time to trade measures from the World Bank Doing Business Indicators and thereby pool together ports, storage, and customs delays (e.g., Djankov et al., 2010; Freund and Rocha, 2011; Hornok and Koren, 2015).

Upon arrival in Callao, the ship has to be unloaded by the port operators. Unloaded shipments can then be held in shipyards or warehouses while firms revise them and prepare customs documents. Once ready, an electronic Single Customs Document (*Declaración Unica de Aduanas*-DUA) is completed and sent to the customs -SUNAT-, which validates the DUA, sends back a message containing the number assigned to the DUA and the date, and informs the associated tax and customs payments that are due.

Upon payment (or warranty of it) of duties and fees, the shipments are assigned to a verification channel based on the customs' risk management system. In particular, the system randomly allocates these shipments to no inspection (green channel), documentary inspection (orange channel), or documentary and physical inspection (red channel) conditional on administrative, fiscal and security risk factors.[4] In the case of imports, these factors are multiple and include the seller in the origin country, the transport mode, the transport company, the countries where intermediate stops (if any) took place, the customs broker, the customs branch, the product, and the buyer in Peru.[5] This clearly contrasts with how the system works on the export side where the number of risk sources before arrival at the customs is very limited and primarily consists of the exporting company and the product-destination combination (see Volpe Martincus et al., 2015).[6] No more than 15% of the DUAs numbered in a given month in Callao can be subject to material control (see SUNAT, 2015).[7] In addition to potentially causing additional delays, there are direct additional costs to the importer associated with the orange and red customs channels due to the need to move, open, unload, reload, and close containers. At the Callao port, these basic operations cost on average 40 US dollars each. After the verification, if any has taken place, customs releases the DUA and clears the shipment. At this stage, goods can be immediately picked up, or, sit for some time if firms decide to take advantage of port storage facilities.

Table 1 presents percentiles of the distribution of the total number of days from ship arrival to customs' exit (Total Entry Delay) as well as those for each of the main segments of the import process for transactions processed in the port of Callao in 2007 and 2013, overall and broken down by customs verification channel.[8] Based on these figures, we state the following fact.

[4] Documents to be presented when assigned to the orange or red channels include authenticated copies of the transport document, the invoice, and origin certificate if applicable. Among others, the inspector verifies the risk of the good; consistency between the documentation and the DUA; description, nature, tariff classification, and value of the goods as well as tax and customs payments (see SUNAT, 2015).

[5] Unfortunately, we do not have data on the transport companies and the customs brokers. Aggregate information provided by SUNAT indicates that most importing firms work with just one customs broker and one maritime transport company, particularly when importing from a given origin country. Hence, the incidence of these actors in the trade process and specifically their consideration in the risk management scheme is most likely to be subsumed by the Peruvian buyers operating with them. More precisely, firm-year (or firm-origin-year) fixed effects will account for the roles of both customs brokers and shipping companies.

[6] Customs generally do not have information on the domestic transport company that carries the shipment to the customs' facilities.

[7] When a shipment is allocated to the red channel, the customs agent chooses randomly and inspects no less than 5% of the packs. In particular, the agent checks the consistency between the documents -including transport document, invoice, and DUA- and the actual shipment. In so doing, the official can take samples and pictures (see SUNAT, 2010b).

[8] We count 1 day for stages cleared within the same day.

Fact 1: Total entry delays are due to the official and necessary processing of shipments –i.e., port and customs handling- and storage time after and between necessary processing steps.

In both years, about 50 percent of the shipments are cleared in 12 days or less, but clearance can take over 40 days at the high end of the distribution. Average clearance times are between 16 and 17 days. For comparison, the ocean voyage from Rotterdam to Callao takes about 18 days.[9] Based on existing estimates, this suggests that port of entry clearance is about as expensive as the time costs due to shipping.

For all import stages, the mean clearance time is greater than the median clearance time. This is consistent with the fact emerging from Figure 2, which shows the distribution of the delays for the unloading, storage and preparation, and customs steps of the import processing. This suggests the following fact:

Fact 2: Border delays are highly skewed to fast clearances times with a long tail of slow clearances.[10]

Unloading is the smallest part of the total clearance time taking between one and four days with a relatively tight distribution. Not surprisingly, there is no variation across customs channels in this stage. Document preparation, shipment review, and storage account for the majority of the total delay with a wide distribution ranging from two to over 30 days. Note that, unconditionally, shipments that must clear customs under the red channel rest for slightly longer in this intermediate stage. This could be due for two main reasons. Customs may take longer to start processing red-channel shipments resulting in longer storage time, shipments that tend to fall in the red channel allocate more time for preparation.

At the median, actual customs clearance times are low, but with a wide distribution taking from one to 14 days. Not surprisingly, much of this variation is explained by the assigned customs channels. Shipments subject to documentary and especially physical inspection (orange and red channels, respectively) take significantly longer. It is worth mentioning that customs delays only account for less than 20% of the total delays for the median shipment and not more than 50% of the total delay for those physically inspected. Hence, in the case of imports and unlike exports, customs is certainly a component in the process that adds transit time between origins and destinations but is definitely not the only one and may not even be the most important.

Table 2 shows a significant amount of heterogeneity across different firms. Measuring firm size by number of employees such that firms with more than 200 employees are considered large (Volpe Martincus and Carballo, 2008), the data show that for large firms mean and median delays are about

[9] Data comes from searates.com.
[10] Several distributions will characterize this feature of processing times. For example, queuing models with Poisson arrival rates and exponential processing times with multiple processors result in an exponential wait time distribution. In the theoretical model, we will focus instead on a Pareto distribution because it results in closed form solutions that are easy to interpret and can be implemented with log linear empirical models.

three days shorter.[11] This heterogeneity is primarily due to differences at the customs stage (see the upper panel of Figure 2). Differences are even more pronounced when we compare new and incumbent importers (see the lower panel of Figure 2). Table 3 reveals that there is also heterogeneity across products depending on their degree of time sensitiveness and across origins depending on how far they are.

To examine systematically how delays relate to exporting countries and firms, products, and importing firms we take the median entry delay over all shipments for each importer, i, purchasing product, h, from origin country, x, (exporting firm, s), in year, y, and generate the log median, $ln(MedianDelay_{ihx(s)y})$. Next we regress the log median delay on various sets of fixed effects. Table 4 reports the R^2 from these regressions for 2007 and 2013. In both years and for all stages of the entry process, country of origin explains a relatively small portion of observed delays. Augmenting the regression with product fixed effects shows that product specific information explains preparation and storage as well as customs clearance delays. This is likely due to importers providing buffer time for long delays and customs focusing control efforts on particular products. Afterwards, we include importer fixed effects. This additional set of fixed effects explains by far the largest portion of the variation across all stages of the entry process. This suggests that heterogeneity across importers is directly related to observed delays. Finally, we incorporate exporting firm fixed effects. While they also account for a substantial portion of these delays, the explanatory power of these fixed effects is generally lower than those capturing importing firms.

Fact 3: Entry delays are heterogeneous across origin countries, products, exporting firms, and particularly importing firms.

In the bottom panel of Table 4 we report the correlation between the delays at consecutive border stages after conditioning by firm-year and product-origin-year fixed effects. Estimates reveal a significant negative relationship between the time spent at storage facilities and in preparing the documentation and port delays, which would be consistent with firms' endogenously adjusting border times for specific import flows. In contrast, no conditional correlation seems to exist between customs delays and time spent in the previous step.

The descriptive statistics presented in this section have several implications for the interpretation of aggregate delay information such as in the Doing Business Indicators and World Enterprise Surveys both maintained by the World Bank as well as for estimating the impacts of port-of-entry delays. Given the wide distribution of delays we observe in the data, the question arises of how to interpret aggregate statistics and to what extent these statistics are useful. As shown above, there is substantial heterogeneity across products and importers. Thus, country-level measures and their comparisons can be strongly

[11] The same pattern prevails when we group firms based on their total imports. A table with these data is available from the authors upon request.

influenced by countries' portfolios of traded goods and specific characteristics of their populations of trading firms and may not necessarily reflect differences in port or customs efficiency.[12] In other words, without distributional information, these aggregate measures can hardly be considered an appropriate reference for economic analysis and, importantly, for firms or policymakers to decide on trade or trade policy, respectively.

From an identification point of view, there are three implications. First, even after accounting for a set of high-dimensional fixed effects, the residual amount of variation in observed entry delays is significant and useful for identification purposes. Second, the variation of import delays across importing firms supports the conjecture that parties engaged in importing may affect observed delays during entry processing. In this case, delays are endogenously determined in equilibrium, thus creating identification concerns. Third, the wide distribution of observed entry delays raises the question of how the shape, in addition to the central tendency, of the delay distribution affect costs of importing, which also generates identification problems. The following sections address both theoretically and empirically these challenges to properly identify the costs of port of entry delays by taking advantage of the high dimensionality of our data.

3 A Model of Endogenous Port-of-Entry Delays and Imports

This section develops a model to interpret port-of-entry processing delays and to derive an import demand equation that can be estimated to identify the cost of these delays. The model captures the three main facts discussed in the previous section. The main premise of the model is that missing the scheduled delivery time due to a late clearance at the port of entry is not desirable.

3.1 Expected Costs to Clear the Port-of-Entry

It takes time to clear the port of entry. Processing times are random due to congestion, conditional randomization over customs allocation channels, and other factor such as equipment failure. The importers' problem is to determine how much lead time to allocate to port-of-entry clearance taking as given a desired/contracted delivery date. Practices of firms participating in global value chains are revealing of how important this is. Take, for instance, the case of Basso an Argentine producer and exporter of combustion valve engines. This firm keeps a permanent stock of these goods in warehouses or on ships to avoid adverse eventualities such as strikes at the port (González et al., 2012).

[12] The most recent edition of the Doing Business Indicators makes a first step in this direction by identifying the main export/import product and the respective main destination/origin the reported times refer to.

Figure 3 illustrates the problem. Along the horizontal line we denote the date when the shipment arrives. The minimum clearance time, $t_{min} > 1$, is the duration of port of entry procedures under the best circumstances. By choosing when the product arrives at the port, the importer chooses the time allowed for entry processing, t_c, without missing the delivery date.[13] But, actual processing times, t_p, are random. If the actual processing time is longer than the allocated time, $t_p > t_c$, then the shipment clears after the planned delivery date and is therefore late. In contrast, if the actual processing time is shorter than the allocated time, then the clearance is early and before the delivery date.

By choosing an earlier arrival date, the importer reduces the chance of a late delivery, but scheduling additional lead time is expensive. Let the cost of time scheduled to clear the port, $t_c^{\vartheta} v$, be proportional to the import value v and increasing in the allocated port of entry time. The elasticity $\vartheta > 0$ translates an increase in lead time into additional costs. This elasticity may vary across products. For example, lead time costs are likely to be more sensitive for perishable goods. Figure 3 depicts this cost by the solid line for any clearance date before the contracted delivery date. This cost is the same for any early clearance date between the arrival date and the delivery date for two reasons. First, importers have to rent containers and obtain financing for the scheduled supply chain time before they know what the actual clearance date is. For example, if the importer contracts a container for 10 days but only needs it for five days, then the shipper still has to pay the full cost according to the contract. A second reason is that early deliveries are not possible due to inventory management and storage constraints. In that case, even if the shipment clears early, the shipment will remain in the port's storage facility for the entire scheduled lead time.

On the other hand, because time in the supply chain is expensive, importers want to shorten lead times. However, shorter windows increase the chance of missing the delivery date. Late deliveries accrue additional costs due to late fees, container demurrage and product depreciation. Let the extra costs of a late clearance, $\left(\frac{t_p}{t_c}\right)^{\omega} rv$, be increasing in the deviation of the actual from the scheduled processing time as a factor of the import value, $rv > 0$. The cost elasticity $\omega > 0$ and the cost factor r may be heterogeneous across importers and products. Thus, for instance, importers with highly fine-tuned supply chain and inventory management may experience greater cost from missing scheduled arrival dates. Figure 3 illustrates the importer's total cost and extra costs due to late deliveries for and processing time after the scheduled delivery date.

The importer's problem is to choose how much time to allow for entry processing, taking into account the costs of scheduling additional clearance time and the benefits –cost avoidance- of reducing

[13] By increasing t_c the importer allows for more time between the arrival date and the preferred delivery date. Because the importers choose t_c our set up encompasses the possibility that maritime services are limited such that the importer has little flexibility in choosing the arrival date. In this case, the arrival date can be taken as fixed and the importer can increase t_c to allow for more time between this arrival date and the preferred delivery date by pushing the latter back relative to the former.

the chance of a late delivery. Let the actual processing time t^p be distributed Pareto-type with density $\frac{\varphi t_{min}^{\varphi}}{t_p^{\varphi+1}}$ and support $[t_{min}, \infty]$. The cumulative distribution function of this distribution is $1 - \frac{t_{min}^{\varphi}}{t_p^{\varphi}}$, with median $t_{min}\sqrt[\varphi]{2}$. This distribution has intuitive interpretation for the random process we approximate. When processing is seamless, border clearances are efficient, but take some minimum time t_{min} to make it through the port. Due to factors such as port congestion, customs inspection, and unexpected equipment failure or human error, clearances are random and may be longer. The distribution of delays relative to the minimum clearance time is determined by the shape parameterφ. A lower φ flattens the distribution of actual processing times and reduces the probability that the clearances time is less than t_p. Policy actions such as investment into ports or customs inspection technologies may affect both parameters of the probability distribution, t_{min} and φ.

Taking the distribution for delays in to account, the shipper schedules optimal port of entry time to minimize the expected costs of importing:

$$t^* = \min_{t_c} \int_{t_c}^{\infty} \left(\frac{t_p}{t_c}\right)^{\omega} rv \frac{\varphi t_{min}^{\varphi}}{t_p^{\varphi+1}} dt_p + t_c^{\vartheta} v = t_{min}^{\frac{\varphi}{\varphi+\vartheta}} \left(\frac{(\varphi-\omega)\vartheta}{r\varphi^2}\right)^{-\frac{1}{\varphi+\vartheta}} \tag{1}$$

The optimally scheduled clearance time increases with the cost elasticity with respect to missing the delivery date ω and the cost of such late delivery relative to the import value as proxied by the factor r and decreases with the cost of additional lead time.

We require that $t^* \geq t_{min} \geq 1$, because it does not make sense for the importer to schedule a clearing window that is smaller than the minimum clearance time. This implies the parameter restriction $\varphi > \omega$, i.e., the shape parameter of the distribution of actual processing times is greater than the cost elasticity of deviations from scheduled processing times. If it doesn't hold, then the expected costs of delays are infinite and the importer does not purchase foreign products.[14] Now, if the cost of late deliveries is sufficiently high, $r > \frac{(\varphi-\omega)\vartheta t_{min}^{\vartheta}}{\varphi^2}$, then importers schedule a clearance window that is longer than the minimum processing time, $t^* > t_{min}$.[15]

The elasticity of the optimal clearance time with respect to the minimum clearance time is determined by the shape of the density and the cost elasticity of the clearance time. The underlying intuition can be best understood by looking at the first order condition of the expected cost of clearing the port -the middle expression in equation (1)- with respect to the optimal clearance window. Set the marginal benefit of increasing the clearance window equal to its marginal cost:

[14] This restriction is due to the Pareto distribution. We need $\varphi > 0$. If not, then the integral over the pdf over the entire support is infinite. In the expected cost, the cost elastic and shape parameter combine to the restriction that $\omega - \varphi - 1 < -1$ for the integral to exist. This result in the parameter restriction $\varphi > \omega$.

[15] Taking second order conditions and substituting t^* shows that the optimal clearance window minimizes the costs of importing.

$$\frac{t_c^{-\varphi} r\varphi^2}{\varphi-\omega}\left(\frac{t_{min}}{t_c}\right)^{\varphi} = t_c^{\vartheta}\vartheta \tag{2}$$

This expression reveals that the marginal benefit of allowing more time for port of entry processing is directly proportional to the probability of a late delivery $\left(\frac{t_{min}}{t_c}\right)^{\varphi}$. Holding t_c fixed, a one percent increase in the minimum clearance time raises the probability of a late delivery and the marginal benefit of increasing the clearance time by φ percent. A one percent increase in the scheduled clearance time lowers the probability to clear late by φ percent, but also increases the marginal cost by ϑ percent. As a consequence, the optimal clearance time raises by only $\frac{\varphi}{\varphi+\vartheta}$ percent in response to a one percent increase in the minimum clearance time.

Substituting the optimal clearance time –the right hand expression in Equation (1)- into the expected cost function –the middle expression in Equation (1)- we obtain the minimum expected cost:

$$CC(q) = t_{min}^{\frac{\varphi\vartheta}{\varphi+\vartheta}} v r^{\frac{\vartheta}{\varphi+\vartheta}} (\varphi-\omega)^{-\frac{\vartheta}{\vartheta+\varphi}} \left(\vartheta^{\frac{\varphi}{\varphi+\vartheta}} \varphi^{-\frac{\varphi-\vartheta}{\varphi+\vartheta}} + \vartheta^{-\frac{\vartheta}{\varphi+\vartheta}} \varphi^{\frac{2\vartheta}{\varphi+\vartheta}}\right) > 0 \tag{3}$$

Products that have a high cost elasticity of lead time $\vartheta$are are more elastic with respect to an increases in the minimum clearance time. This is for instance the case with a perishable product for which each additional day in the supply chain raises the chance that the shipment is rotten. The same holds for products and firms that face a tight clearance distribution associated with a high value of φ. In addition, this would apply to products and firms that follow more expedite procedures, so that the distribution of actual processing times has smaller mean, median, and variance.

Taking into account that the median of the distribution of actual processing times is $t_{min}\sqrt[\varphi]{2}$, we can substitute the minimum clearance time in Equation (3) for $t_{median} = t_{min}\sqrt[\varphi]{2}$ to obtain:

$$CC(q) = (t_{median})^{\frac{\varphi\vartheta}{\varphi+\vartheta}} v\lambda > 0 \tag{4}$$

where $\lambda = r^{\frac{\vartheta}{\varphi+\vartheta}} (\varphi-\omega)^{-\frac{\vartheta}{\vartheta+\varphi}} \left(\vartheta^{\frac{\varphi}{\varphi+\vartheta}} \varphi^{-\frac{\varphi-\vartheta}{\varphi+\vartheta}} + \vartheta^{-\frac{\vartheta}{\varphi+\vartheta}} \varphi^{\frac{2\vartheta}{\varphi+\vartheta}}\right) / 2^{\vartheta/(\vartheta+\varphi)}$.

This version of the cost function is empirically convenient because it expresses costs as a measure of the central tendency of the delay. Such measures are reported by the Doing Business and Enterprise Surveys and other similar data sources.

Equation (4) highlights an empirical challenge. Policy actions that seek to reduce median delays by lowering minimum clearance times are most effective when both the shape parameter of the distribution of actual processing times φ and the cost elasticity of lead time ϑ are high. However, streamlining of border procedures may affect not only the median delays but also the shape of the distribution. Hence, if we treat φ as a constant, then we are missing part of the impact of the policy on entry costs and, also importantly, we cannot assess what policy is most effective either affecting the distribution of entry delays φ or providing resources to influence the cost of scheduled entry time through ϑ. In short, without distributional information on border delays, it is difficult to interpret elasticity estimates with respect to the median delays.

The endogenous scheduling of clearance time may also introduce a measurement problem. The question is what firms do when shipments clear early. There are two cases to consider. In the first case, early deliveries are easily manageable and the importer moves the shipment through the port and picks the shipment up for delivery as the entry procedures advance and conclude. This means that observed entry delays are primarily driven by necessary processing and associated random shocks. The median clearance time we observe in this case is $t_{median} = t_{min}\sqrt[\varphi]{2}$, based on the Pareto distribution.

In the second case, importers are not prepared to accept early deliveries. Then, if entry procedures move quickly for a given shipment, importers slow down the progress of shipments with storage time to meet the scheduled pick-up and delivery date. This is for example the case when pick up by trucks is scheduled in advance and hard to reschedule. If the shipment clears early, the shipment does not leave the port until the desired pick-up date and the observed time in the port is t^*. This is plausible because storage within ports between stages is subject to storage costs below market prices and sometimes even free, at least up to a certain number of days.

The measurement problem is that in this case we can't be sure what we observe. If $t^* > t_{min}\sqrt[\varphi]{2}$, then the observed median entry time is greater than the median random processing time. In this case, median (and average) entry times are overstated compared to actual processing delays.

To see how this affects the elasticities solve t^* for the minimum clearance time and substitute for t_{min} in Equation (3) to obtain:

$$CC(q) = (t^*)^{\vartheta} v \frac{\varphi + \vartheta}{\varphi} > 0 \tag{5}$$

From an empirical point of view, Equation (5) implies that based on endogenous clearance windows we would overestimate the cost elasticity compared to the median of the actual processing time because $\frac{\varphi\vartheta}{\varphi+\vartheta} < \vartheta$ if $\vartheta > 0$ and $\varphi > 0$. As a consequence, both cases imply that we can't be sure what cost elasticity we identify when we employ average or median delay data. If importers manage early clearances according to the first case, then we observe median delays according to exogenous processing delays and cost elasticities are specified as in Equation (4), $\frac{\varphi\vartheta}{\varphi+\vartheta}$. If importers manage early clearances as in the second case, then observed clearance delays measure the endogenously chosen entry time. In that case, the cost elasticity of delays is as in Equation (5), ϑ. In the worst case, if some importers manage early clearances as in the first case and others as in the second case and data is pooled over importers and products that differ in how they manage early clearances then regressions that specify costs in log-linear models neither identify $\frac{\varphi\vartheta}{\varphi+\vartheta}$ nor ϑ.

Equations (4) and (5) have several implications in terms of how to rank countries in terms of efficiency and costs of port of entry procedures. Because firms endogenously choose how much time to allocate to the port of entry when planning their supply chain, observed port times may be longer than what it usually takes to process a shipment. If importers respond to survey questions based on the time they schedule instead of the processing times, then this leads to an overestimation of port of entry times. Given that this may vary across countries, unconditional comparisons could be misleading.

From the point of view of a cost benefit analysis, it is important to understand whether we talk about delays in actual processing versus endogenously chosen entry times, and, if we observe a decrease in delays that we apply the appropriate elasticity. For example, many countries around the world will streamline entry procedures to reduce border delays following the WTO Agreement on Trade Facilitation. Suppose that a given policy reduces the median delay by one day. If the median delays measure t_{median} as in the first case, then the policy reduces costs of entry by $\frac{\varphi\vartheta}{\varphi+\vartheta} * 100$ percent. If, on the other hand, the observed median measures t^* as in the second case, then the policy reduces costs by $\vartheta * 100$ percent. Therefore, to evaluate policy, it is important to know what elasticity must be applied. If the policy effect is a reduction in actual processing delays as often presented in custom performance reports, then we must apply $\frac{\varphi\vartheta}{\varphi+\vartheta}$. However, if the elasticities are identified by data that potentially includes endogenous storage time as in Doing Business' total time to trade measure, then the elasticity we estimate is likely between ϑ and $\frac{\varphi\vartheta}{\varphi+\vartheta}$ and we would overestimate the benefit of reducing the processing time.

3.2 *Optimal Import Demand*

A Peruvian importer purchases inputs, q, from a foreign upstream exporter at price m,. The importer faces ad-valorem transportation costs τ. The total costs of purchasing and shipping are then $v = mq\tau$. Substitute this expression in Equation (2) and the total expected cost of importing inclusive of port of entry clearance is $t_{median}^{\chi} m\tau q\lambda$, where $\chi = \frac{\varphi\vartheta}{\varphi+\vartheta}$.

The Peruvian firm combines the import with a domestic input L hired at wages w to produce a differentiated output for the domestic market according to the Cobb-Douglas production function $d = \alpha q^{\beta} L^{1-\beta}$.[16] Let $p = Ed^{-1/\sigma}$ be the demand for the importer's output where p denotes the price, d

[16] Given the constant returns production structure it is easy to extend the problem to a multi-product or exporting firm. Let total output across products and markets be y. The cost function can then be written as $c\left(w, t_{median}^{\chi} m\tau\lambda, y\right) = c\left(w, t_{median}^{\chi} m\tau\lambda, 1\right)y$. In other words the firm hires the same input bundle to produce any unit of output for any market. The factor demand for the imported product is then, $q = \left(\frac{1-\beta}{\beta}\frac{w}{m}\right)^{\beta}\frac{y}{a}$, where the aggregate quantity is determined by demand functions for the respective products and markets. The other extreme is that the firm applies an independent production process for each product and market. In that case (6)

denotes quantity, E is a demand shifter and $\sigma > 1$ determines the elasticity of substitution. In standard monopolistic competition the demand shifter captures aggregate real expenditure. We solve for partial equilibrium and treat it as constant[17]. To simplify notation we suppress exporter and product subscripts but will reintroduce them later when necessary.

The importer maximizes expected profits

$$\max_{q,L} \left[E \left(a \quad q^{\beta} \quad L^{1-\beta} \quad \right)^{1-1/\sigma} - wL - t^{\chi}_{median} m\tau q\lambda \right] \tag{6}$$

by choosing the optimal import quantity

$$q = K \quad w^{(\sigma-1)(-1+\beta \quad)} \left(t^{\chi}_{median} m\tau\lambda \right)^{-\sigma \beta+\beta-1} = K \quad w^{-\sigma+\rho} \left[t^{\chi}_{median} m\tau\lambda \right]^{-\rho} \tag{7}$$

where $K \quad = \frac{\sigma^{-\sigma}(\sigma-1)^{\sigma}E^{\sigma}\left((1-\beta \quad)^{-1}\right)^{\sigma\beta \quad -\beta \quad -\sigma} \beta^{\quad \sigma\beta \quad -\beta \quad +1} a^{\sigma-1}}{1-\beta} > 0, -\sigma + \rho \quad < 0$ and $\rho \quad > 1$.

An increase in the median border delay lowers the demand for the foreign input. The same happens in response to higher prices of foreign and domestic inputs and transportation costs. The elasticity of demand with respect to the import cost inclusive port-of-entry charges, ρ, is determined by the factor intensity of the foreign input β and the elasticity of demand on the domestic product market, σ. The factor intensity translates an increase in the cost of importing the input into a cost increase of supplying the domestic market. The consumer's demand elasticity determines how much of this cost increase is passed to consumer prices and the corresponding drop in demand.

Firms that produce with greater imported input intensity are more elastic with respect to the cost of importing, $\frac{\partial\rho}{\partial\beta} > 0$. A given shock to the cost of importing has a greater effect on the costs of firms that use imports intensively. Therefore, for import intensive firms a given cost shock translates into a greater demand response.

Multiply Equation (7) by the factory gate price to obtain the value of imports (or, the value of exports from the point of view of the foreign supplier):

$$v = K \quad w^{-\sigma+\rho} (m)^{1-\rho} \tau^{-\rho} \left(t^{\chi}_{median} \lambda \right)^{-\rho} \tag{8}$$

Equation (8) highlights several implications of firm-level and distribution information on processing times related to the existing literature. First, if firms combine multiple inputs, then the demand elasticity is not simply σ but a combination of σ and the imported factor intensity. If $\sigma > 1$, then a greater imported input intensity result in a greater elasticity of import values with respect to an increase in the median clearance time. Hence, examining heterogeneity across firms that may vary in intermediate input intensities has import implications for elasticity estimates. For example, if large firms produce with

applies for each product and market with potentially varying elasticities. In theory we do not consider firms that import the same product from multiple exporters. The data will show that most firms in Peru import a given product from one source.

[17] Our goal is to identify the cost elasticities with respect to delays. In the empirical specification we account for general equilibrium variables such as the price indices with fixed effects. This approach is reasonable, because once we know the elasticities, then they can be employed in any standard general equilibrium trade model to evaluate welfare effects. This is beyond the reach of the current paper.

higher imported input intensity, then we expect that their import demands are more elastic with respect to. lead times, all else equal. Second, the elasticity of import values with respect to clearance times is a combination of the shape parameter and the elasticity of trade costs with respect to scheduling lead time. This implies that the combined elasticity usually estimated in the literature combines two sources of information, the shape of the distribution and the elasticity of lead time costs. In addition, even if lead time cost elasticities are homogenous across firms and products, the combined elasticity estimates vary if the clearance distribution differs across these dimensions.

Section 4 describes the data and derives the empirical model that we take to the data based on Equation (8).

3.3 *Express Shipments and Endogenous Processing Times*

Peruvian importers have the option to speed up the clearance of imports by choosing and express channel. Express clearances reduce variable costs of importing because they result in lower entry times. Express clearance raises the cost of a shipment because firms have to file extra documentation and potentially pay additional fees to use express channels. This intuition results in the standard tradeoff where firms can lower variable costs at the extra expense of higher fixed costs. Firms that import a large quantity of imports to sell a large amount of output especially benefit from variable cost reductions. To formalize this tradeoff, substitute the optimal import quantity and employment into the profit function to obtain:

$$\pi^* = K_1 w^{(\sigma-1)(\beta-1)} \left(t_{median}^{\chi} m\tau\lambda\right)^{-\beta(\sigma-1)} a^{\sigma-1}$$

where K_1 is a constant that includes elasticity, production and demand parameters. Operational profits decrease in the clearance time. An increase in the clearance time raises the cost of the imported input, raises costs and lowers profits. let F^x, be the fixed cost of using the express channel and let F denote a fixed cost of importing. Let $t_{express} < t_{median}$ be the clearance time in the express channel. The importer uses the express channel if the profits with the express channel are greater than using the regular entry channel:

$$\pi_{express}^* - F^x > \pi_{regular}^* \Leftrightarrow K_1 w^{(\sigma-1)(\beta-1)} (m\tau\lambda)^{-\beta(\sigma-1)} \left(t_{express}^{\chi(-\beta(\sigma-1))} - t_{median}^{\chi(-\beta(\sigma-1))}\right) > F^x \quad (9)$$

Note that the left hand side is positive because $t_{express} < t_{median}$ and $\chi(-\beta(\sigma-1)) < 0$. Thus, large, highly productive firms that import at lower cost are more likely to employ the express channels as the advantage of lower variable costs dominates the additional fixed cost. From an empirical point of view this means that within the express or regular channels the demand elasticities with respect to processing times are the same, if the choice between the two channels is determined only by scaling factors like productivity differences. The benefits of the express channel increases in the amount of time the express channel saves relative to regular clearance channels. As a consequence, large, highly productivity firms that import a large quantity and gain significant time savings from using the express channel are more likely to incur the additional fixed cost to express their shipments. The alternative is that faster, and possibly more reliable processing of imports allows firms to switch to technologies that complement fast and reliable supply chains. For example, they may switch to leaner inventories and potentially more flexible production technologies. In that case, the parameters of the production function change and elasticity estimates in the express channel differ from elasticity estimates in the regular channel. It may also be the case that the shape of the clearance distribution varies. This is the case if express shipments are not only faster, but also more reliable. In summary, whether and, if so, to what extent utilization of the express channel makes a difference is an empirical question. We will address this question below.

3.4 Fixed Costs and the Extensive Margin

Our discussion above is mute on the fixed costs of importing and the extensive margin. If there are fixed costs to importing, then we expect that only firms with a sufficient level of productivity are able to recover the fixed cost by sourcing cheaper inputs from abroad, because the variable costs are linear in the imported quantity (see Footnote 13). Equation (4) shows that the cost of importing from foreign markets decreases when processing times are short. Hence, as highlighted in Section 3.3, shorter processing times raise profits of firms that import from foreign markets. Based on standard intuition in heterogeneous firm models, we therefore expect more firms import more products from markets with short processing times.

4 Trade Data and Empirical Specification

4.1 Trade Data

To identify the effect of port-of-entry delays on trade, we augment the detailed port-of-entry processing information described in Section 2 with highly detailed transaction level import data and firm characteristics. In particular, we have transaction level import data for the period 2007-2013 from Peru's National Tax Agency (Superintendencia Nacional de Administración Tributaria -SUNAT). These data cover all transactions entering Peru. For each record we observe the ID of each importing firm, the origin country of the flow, the selling firm, the product code (10-digit HS), the import value in US dollars, and the import weight in kilograms.

Table 5 compares the universe of import transactions for Peru with the sample of imports that arrive at the seaport of Callao where we also have complete detailed delay information. Imports that clear at the seaport of Callao account for approximately three quarters of the total import value and the total weight, two third of the total number of importers, 60% of all import transactions, and 90% or more of all imported products and countries of origin. Therefore, we capture most of Peru's imports. An advantage of focusing on the seaport at Callao is that the concentration of business activity around Lima mitigates concerns that heterogeneity in inland transportation costs impact the results, or, that imports clearing through other ports are destined for Lima (see Volpe Martincus et al., 2014).

Table 6 characterizes the overall average importer and the average Callao importer along several relevant dimensions over our sample period. The average Callao importer has 65 employees, is eight years old, and buys 12.4 products from 2.8 countries through 180 shipments with a total weight of 261 tons for approximately 650,000 US dollars, whereas the national average importer has 52 employees, is seven years old, and buys 14 products from 3.1 countries in 271 shipments with a total weight of 500 tons for roughly one million US dollars. Hence, as expected based on the relative weight of Callao as an entering customs in total Peru's imports, the average Callao importer is very similar to the overall one except that imports less in terms of value and particularly of weight through a smaller number of shipments. The difference in values and weights are primarily due to the fact that heavy goods tend to be imported through other ports which are located closer to the production facilities these goods are actually used, whereas that in shipments is related to imports through airports which typically consists of larger number of smaller transactions. This can be seen in the lower panel of Table 5 which reports the averages when minerals and metals and air-shipped imports are excluded from the sample.

Importantly, Peruvian importers use 22 customs offices, but the average firm uses only 1.03 customs offices and does not use multiple ports of entry in response to long queues at customs, port congestion or other delays.

For our econometric analysis we slightly aggregate the data such that we obtain the annual f.o.b. import values v_{ihxy}, of importer i purchasing product h (10-digit) from exporting country x in year y. We then merge this information with the median delays examined in Section 2 and firm-level employment, sector of activity, and establishment date data which were also generously provided by SUNAT. Firms are also identified by thesame ID in this case, so that the two datasets could be easily merged. As a result, we have an estimation sample at the *i-h-x-y* level including information on import values, total and stage-specific delays and several firm level characteristics for all transactions that cleared through the seaport of Callao.

4.2 *Empirical Model*

Introducing subscripts to Equation (7) we obtain the baseline model:

$$v_{ihxy} = K_{ihx} w_{iy}^{-\sigma+\rho} \left(m_{hxy}\right)^{1-\rho} \tau_{hxy}^{-\rho} \left(\left(MedianDelay_{ihxy}\right)^{\chi} \lambda_{ihx}\right)^{-\rho} \tag{10}$$

where firm-level demand and productivity differences with respect to products K_{ihx} vary across exporting countries ; prices m, freight and tariff charges τ vary across exporting countries, product and year; the price a firm pays for the local input w varies across importers and year. An increase in the median delay raises the expected costs of clearing the product in the port of entry. The elasticity χ translates this increase in the delay into a cost increase. The elasticity $-\rho$ translates the cost increase into a demand response.

To take advantage of the high dimensionality of our data and fixed effects we work with the log-log model

$$lnv_{ihxy} = \delta_{ihx} + \delta_{iy} + \delta_{hxy} + \theta ln(MedianDelay_{ihxy}) + u_{ihxy}, \tag{11}$$

where $\theta = -\rho\chi$; δ_{ihx} is a set of importer-product-exporting country fixed effects, δ_{iy} is a set of importer-year fixed effects, and δ_{hxy} is a set of product-exporting country-year fixed effects that account for all variables listed in the previous paragraph (i.e., K, w, m, and τ) as well as other sources of unobserved heterogeneity at the respective level; and u_{ihxy} is the regression disturbance that captures all remaining importer-product-exporting country-year preferences and supply shocks that affect the import volume but not the distribution of port of entry delays. The theory predicts $\theta < 0$.

Given the importer-product-exporting country fixed effects, the identifying variation is driven by changes in firms' demand for a product imported from a given exporting country due to changes in the median delays. According to our probability distribution, holding the elasticity θ fixed, this variation is driven by variation in the minimum time it takes to clear the port of entry and is due to several sources. For instance, some products may take longer to unload. Similarly, shipments of some firms may be more likely to be assigned to customs physical inspection and thus, on average, spend more time at the customs. Moreover, processing of some shipments may be affected by port congestion.[18] These sources of variation may even interact. Thus, firms may be more efficient at clearing core products, but take longer with other products, or use different companies to ship given goods from their different origin countries.

The importer-year fixed effects and the product-exporting country fixed effects perfectly explain imports for firms that only import a single product from a single location and imports of given products from given countrys that only involve one importer, respectively. This limits the identifying variation to firms that import from multiple origins or import multiple products and to product-exporting country combinations in which multiple importers are active.

Given the high dimensionality of the fixed effects, we apply the first difference operator Δ to our baseline specifications to obtain the estimation model that is operationalized with our data:

$$\Delta lnv_{ihxy} = \delta'_{iy} + \delta'_{hxy} + \theta\Delta ln(MedianDelay_{ihxy}) + \Delta u_{ihxy} \tag{12}$$

where $\Delta lnv_{ihxy} = lnv_{ihxy} - lnv_{ihxy}$; $\delta'_{iy} = \delta_{iy} - \delta_{iy-1}$; $\delta'_{hxy} = \delta_{hxy} - \delta_{hxy-1}$; and $u'_{ihxy} = u_{ihxy} - u_{ihxy-1}$

[18] The same holds for port strikes. Regrettably, we do not have information on these episodes.

4.3 *Identification Assumptions*

We first estimate Equation (12) with pooled OLS. Our main parameter of interest is θ, the elasticity of port-of-entry processing costs with respect to median entry delays. Using this central measure has clear advantages. Thus, the median is founded in our model and more generally in economic theory. For example, the median is the optimal forecast when the objective is to minimize absolute deviations from forecasted costs (see, e.g., Granger and Machina, 2006). Moreover, the median is more robust with respect to outliers than for example the mean delay.

In this regard, it should be noted that, consistent with our theory, if importers know the median of the distribution, then the elasticity can be simply estimated based on the observed median delay. If instead firms guess the median, then the median in Equation (10) should be replaced with the estimate, $ln(\widehat{MedianDelay}_{ihxy})$. Let the difference between the observed and estimated medians be random in the disturbance e_{ihxy},:

$$ln(MedianDelay_{ihxy}) - e_{ihxy} = ln(\widehat{MedianDelay}_{ihxy}), \tag{13}$$

In this case, if the error term e_{ihxy} is not systematically related to the observed median delay, then substituting for the estimated median with $ln(MedianDelay_{ihxy}) - e_{ihxy}$ will raise the variance, but not affect the consistency of OLS estimates. In contrast, if e_{ihxy} is systematically related to the observed median, then estimates would be affected by classical measurement error and would accordingly be attenuated, so that the estimated elasticities would be a lower bound.

Such an attenuation bias would also be the consequence of other sources of endogeneity. Thus, if, as pointed out by Hallward-Driemeier and Pritchett (2015), *de jure* processes deviate from *de facto* application, then observed delays may be endogenous to a firm's management of shipments while they move through the port. More specifically, large shipments may take a longer time to clear or firms may have an incentive to speed up small emergency shipments that are required in a production process.

We address these endogeneity concerns, first, by exploiting our detailed port of entry information to split total delays in portions associated with each stage of the import process. As shown above, these are likely to differ in the extent to which they are endogenous to firms' behavior, i.e., port and customs handlings, which involve necessary processing and storage and preparation, which can be seen as potentially more determined by the importers. More precisely, unloading is based on the location of the container and port equipment. Customs delays are primarily determined by a risk management model, which, conditional on product-exporting country (firm) and importing firm characteristics, randomly assigns shipments to inspection channels. Second, we use an IV estimator whereby observed processing (port and customs) delays are instrumented with port congestion (as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the import in question does in a given year) and the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively). This along with the splitting of the import process in stages and thus with the proper measurement of the border delays allows us to identify the parameter of interest.

In addition, we also take advantage of information available on the use of a formal regime that allows for express clearance to distinguish between expedited flows and regular flows and thus neutralize the concern that firms may speed up certain shipments.

Under standard assumptions, our fixed effects account for several sources of unobserved heterogeneity. Thus, processing delays may depend on firm characteristics. Less experienced exporters may be subject to longer delays because they do not have the experience with the necessary documents and procedures and may be more likely to be assigned to more stringent inspection channels. Large firms, in turn, may have less flexible production processes and manage complicated supply chains importing many products from many locations. These firms' characteristics systematically related to delays are all accounted for by our firm-year fixed effects.

According to our model, prices are determined in equilibrium. However, the descriptive statistics show that Peruvian importing firms are relatively small. Hence, we assume that exporters do not price discriminate across importers and these take their f.o.b. prices as exogenous. More specifically, a positive demand shock from a Peruvian importer does not affect the equilibrium price which is determined based on aggregate demand across many importers. Aggregate changes in demand for a foreign product that may impact pricing are then absorbed by our product-exporting country-year fixed effects. Similarly, freight charges are determined by container pricing and liner pricing of grid space on vessels. The assumption is that a Peruvian firms' import demand does not affect world-wide container pricing and that the price of a container is the same across all importers who purchase a given product from a given location. Any deviation from this pricing is considered random and relegated to the error term. Given Peru's economic size, this appears as reasonable assumption. Moreover, lengthy ocean transit times between Peru and trade partners, variation in economic size and infrastructure quality across trade partners and quality heterogeneity of a given product across origins do not affect our estimates as long as they are separable in our import specification and can therefore be absorbed with our product-exporting country-year fixed effect.

Further along these lines, the descriptive statistics show that most Peruvian importers select one foreign exporting country to supply a given product. In this case, discrete-continuous choice models are the appropriate framework to consider selection of export partners: each importer selects the exporter for a given product that, based on the continuous optimal import demand, maximizes the importer's profit (see Train, 1993). Admittedly, selection of suppliers may not be completely random but based on information that impacts the level of imports and specified variables in the import demand. For example, if importers producing high quality products select sellers with efficient supply chain management strategies, then the value of imports will be high when delays are relatively low. The same could be true if the importer produces at a large scale for an export market. On the other hand, inexperienced firms may be cautious and therefore allow for more time to clear the port of entry and at the same time rely less on foreign markets. In order to control for such endogenous selection of suppliers, we estimate alternative specifications that include sets of importer-exporting country-year fixed effects and importer-product-exporting country fixed effects in our first differenced equation.

While these rich sets of fixed effects account for level differences associated with factors operating along various dimensions, these factors can also result in asymmetric effects thereby invalidating pooling restrictions. Thus, it may be the case that inexperienced firms face greater costs of delay because they don't have developed the means to absorb them, or, that larger firms are less flexible and suffer more from delays. In these cases, an additional delay will have a different effect on costs across these firms. Similar consideration can be made along the product dimension. Thus, the cost of delay can be higher for time-sensitive products. We therefore also explore heterogeneous effects through sample splits. This also helps address potential asymmetric effects associated with endogenous selection of suppliers as discussed above.

In closing this section, we should mention that these identification assumptions are comparable to those used in any identification approach that is based on firms importing multiple products. For example, if firms import varieties to minimize the cost of production based on a CES production function, then within firms, the elasticity with respect to the input price and trade costs captures substitutability between varieties in the production process and K_i absorbs the CES price index over imported varieties.

5 Estimation Results

5.1 Baseline Results

Table 7 presents OLS and IV estimates of Equation (12). In all cases, we use standard errors clustered by firm-product-origin for inference purposes. In this regard, it should mention that all results are robust to cluster by firm, product (2 or 10 digit), origin country, and their alternative combinations (see Table A1 in the Appendix).

In the first cell –first column, first row- OLS estimates are for total border times, which would correspond to the typical estimation using data such those from the Doing Business. According to these estimates, total border delays have a significant negative impact on firms' imports. In particular, imports decline by 0.6% in response to a 10% increase in these border delays.[19] Assuming an import elasticity of substitution of 2 (see Soderbery, 2015) and applying our coefficient estimate for θ, we can back out $\hat{\chi} = -\frac{\hat{\theta}}{-2} = 0.03$. Thus, a one percent increase in the scheduled port of entry time increases costs by about 0.03 percent. Starting at the mean of 16 days, cutting the entry time by half is then worth about 1.5%. Going from the 25th percentile of the delay distribution to the 75th percentile equals an increase of about 138%. The associated increase in costs is therefore about 4%.

As discussed above, given that firms can endogenously choose how much time allocate to port-of-entry and specifically the time spent at storage facilities and paperwork preparation, relevant border delays are better measured through those associated with the processing stages, namely, port and customs. The second row accordingly reports the estimated impact of these processing delays on imports. Based on this estimate, a 10% increase in such delays would result in a 0.5% reduction in foreign purchases. Consistent with the theory, this impact is 20% smaller than that obtained when considering total time spent at the border. Applying the same elasticity estimate as above for the sake of compare, we can back out a cost elasticity of $\hat{\chi} = -\frac{\hat{\theta}}{-2} = 0.025$. In this case, cutting the mean delay in half is worth about 1.25%. Moving from the 25th percentile to the 75th percentile increases the cost by about 3.45%. Thus, estimated cost elasticities based on the processing delays are smaller than those based on total delays. While the difference might seem modest, applied to a total annual import value of 40 billion US dollars, 25 basis points are worth 1 billion US dollars per year in cost differences. This example illustrates a difficulty when evaluating a trade facilitation policy. If policymakers focus on cutting actual processing times in half, then applying cost elasticities based on total delays over-estimates the benefits.

Rows three and four of Column 1 show the estimated effects of delays on imports when instead these are measured using only information from one of the two processing stages, either port or customs. The import effect of border delays when captured through time in customs is similar to that estimated using total time but larger than that based on processing times, and is substantially smaller than both of them when the border delay measure is limited to that occurring at the port. This highlight the importance of distinguishing where delays and reductions in delays occur.

[19] We have also estimated an alternative specification where the main explanatory variable is the change in the level of delays instead of the log changes. According to this specification, one additional day of delay is associated with a 0.4% decrease in firms' imports. The estimates based on the two specifications are comparable. A 10% increase in delays amounts to 1.6 more days at the median (see Table 1). The semi-log specification would indicate that, in this case, foreign purchases would fall by 0.6%. Further, this alternative specification is comparable to what has been estimated in the literature. Thus, Hummels and Schaur (2013) estimate that reducing ocean transit time by one day raises imports at seaports by 0.9% relative to imports that arrive by air. Translating this in to a cost estimate they find that an additional day of transport time is worth about 0.6% of the value of the shipment. Applying their elasticity estimates of about 1.5 and Khandelwal's (2010) average own price elasticity of 1.28, we find that an additional day of median delay at the port of entry raises expected clearance cost by about 0.3%. Therefore, our estimates are of the same order of magnitude as what is identified by the literature, but smaller. There are several potential reasons. Our main advantage compared to the literature is that we observe firm-level data.

To understand these differences across the elasticities it is helpful to remember that the elasticity of the imports with respect to delay shocks are determined by $\rho\frac{\varphi\vartheta}{\varphi+\vartheta}$. We assume that the demand elasticity ρ does not vary across stages of the import procedure because the set of products and importers remain the same across all stages.

There are two remaining reasons why the elasticity may differ between total and stage-specific delays as well as across them. First, the shape of the clearance distribution, φ, and the cost elasticity, ϑ, may vary across the stages the combined elasticity may vary across the stages. Based on the summary statistics in Table 1 the shape parameter φ is the highest for unloading and lower for customs. The second source of heterogeneity is due to potentially estimating based on endogenously chosen port of entry delays. The theory shows that if the delays including endogenously chosen buffer time, then we directly identify $\rho\vartheta$ instead of $\rho\frac{\varphi\vartheta}{\varphi+\vartheta}$.

The fact that imports appears to be least elastic with respect to unloading time and most elastic with respect to customs' delays makes sense. For unloading, we observe the random unloading time and therefore identify $\rho\frac{\varphi\vartheta}{\varphi+\vartheta}$, where φ and ϑ capture cost elasticities specific to the unloading process. The shape parameter is high for unloading raising the elasticity. On the other hand, whether shipments are unloaded on the same day or the next day has likely little effect on the costs due to unloading and therefore we expect that ϑ is small. For customs clearance, we do observe the actual processing time and hence also identify $\rho\frac{\varphi\vartheta}{\varphi+\vartheta}$, where φ and ϑ now capture cost elasticities specific to the customs process. The reason why the elasticity is relatively high is then that ϑ must be high. This implies that especially after clearing the port firms are cost sensitive with respect to scheduling additional storage time.

Even though our rich sets of fixed effects make it possible to neutralize a large number of sources of omitted variable biases, endogeneity remains a concern as it can be argued that firms have some maneuver space to speed up their most important shipments. If the most import shipments are large in value, then this results in short processing times associated with low entry delays resulting in downward bias. On the other hand, if the most important shipments are small emergency shipments, of firms that run lean supply chains, then we expect small shipments associate with short delays resulting into upward biased elasticity estimates.

In order to address this concern, we also estimate the baseline equation by instrumental variables. To isolate a source of variation in the delays that is exogenous with respect to imports, we exploit both the degree of concurrent utilization of the port facilities and the mechanics of customs procedures. Simultaneous arrival of several vessels can translate into longer border handling and processing times. The same holds when shipments assigned to inspection. This assignment can be considered random conditional on importer and product-origin combinations.[20] Hence, we use the median number of other vessels that arrive the same date shipments of a given importer-product-origin do in a given year and the median assignment to the orange or red channels as instruments for the median total border delay and estimate Equation (2) by IV. The first stage equation is then as follows:

$$\Delta lnMedianDelay_{ihxy} = \beta \Delta lnA_{ihxy} + \delta \Delta ORC_{ihxy} + \gamma_{iy} + \gamma_{hxy} + \mu_{ihxy} \tag{14}$$

where $\Delta lnA_{ihxy} = lnA_{ihxy} - lnA_{ihxy-1}$, with A being the median number of vessels that share the arrival date with that carrying the firm-product-origin shipment in question or congestion; $\Delta ORC_{ihxy} = ORC_{ihxy} - ORC_{ihxy-1}$with ORC being the median allocation to the orange or red channel;; γ_{iy} is a set of firm-year fixed effects; π_{hxy} is a set of product-origin country-year fixed effects; and μ is the error term. ORC takes the value of one if 50% or more of the shipments in a given firm-product-destination-year quadruple is assigned to the orange or red channels.[21] The rationale for using this indicator, which also corresponds to the modal allocation, is twofold. First, we use the median to summarize the main explanatory variable –actual time spent at the border- at the level of the estimating data for the reasons explained above. We also resort to the median in the case of channel assignment for consistency. Second, the natural alternative, the sample proportion, has the drawback that the total number of shipments appears explicitly in the denominator. As shown in Volpe Martincus et al (2015), this is affected by border delays, thus making an average-based instrument less clean. In contrast, the median does not depend directly on the actual number of transactions.

To be valid instruments, port congestion and the median allocation to the orange or red channels should predict observed border delays, but it should be otherwise uncorrelated with imports. This involves two conditions. First, they must be correlated with delays once other relevant variables have been netted out. This can be expected to be the case, as firm-product-origin imports competing with many others for port handling facilities are likely to experience longer border delays. The same holds for counterparts for which more than half of the shipments are subject to controls. Second, congestion and assignment to the inspection must be uncorrelated with the error term once conditioned on all other relevant explanatory variables. In other words, they must be exogenous, which requires properly controlling for factors that influence imports and are correlated with congestion and that assignment. This is precisely what the firm-year and product-origin-year fixed effects do. This exclusion restriction

[20] Regress a day-by-day binary indicator that takes the value of one if a shipment is allocated to physical inspection and zero otherwise of the (natural logarithm of the) delay on the import value or a binary indicator that takes the value of one if the previous time the same shipment went through the customs was also allocated to material verification and zero otherwise along with importer and product- exporting country fixed effects. As expected, no systematic relationship seems to exist among these variables. These estimation results parallel those reported by Volpe Martincus et al. (2015) for exports and are available from the authors upon request.

[21] Main estimation results are the same if we use instead the median allocation to channels that involve some inspection (either orange or green). These results are available from the authors upon request.

can be considered valid since congestion and allocation to the orange or red channels are unlikely to affect foreign purchases through channels other than delays themselves.

The estimation results are presented in the last columns of Table 7 along with the respective first stage estimates (Columns 2 and 3) and test statistics (Columns 4 and 5). As for the latter, the F statistics indicate that the instruments are strong predictors of the border delays after netting out other driving forces of this variable, while the Hansen test statistics suggest that our overidentifying restrictions cannot be rejected.[22]

The first stage estimates indicate that delays increase with both port congestion and customs' documentary or physical inspections. Importantly, the instrumental variable estimates concur with our baseline OLS in suggesting that delays negatively affect firms' imports, but are clearly larger than the latter. A possible explanation for this difference is that firms attempt to speed up small shipments through the port, potentially because they are emergency shipments of missing parts or to fill in unusually high demand. In that case, we would see small shipment with short delays, biasing our OLS estimate closer to zero. As shown in Table A2 in the Appendix, the results do not depend on the specific time window used to capture port congestion but remains true for a number of alternative specifications of that window.

Based on the IV estimates of Equation (12) for the processing stages (port and customs), the reduction in imports as a consequence of an increase of 10% in the time spent in clearing these stages would be 2.4%. Again, the estimated impacts are different when all imports steps are considered thus including storage and paperwork preparation (higher) and when only one of the actual processing stages are taken into account (smaller). This further highlights the importance of both properly measuring import delays and adequately estimating their effects by accounting for the endogeneity biases.[23]

5.2 Robustness

Next we go through a number of robustness checks. First, as mentioned above, firms can opt to register their customs declaration (and be assigned a customs verification channel) before the vessel arrives. This is consistent with our model. Firms learn early about their customs clearance channel in order to decide how fast to move the shipment through the port or notify buyers if they expect that shipments will arrive late. From an identification point of view the key is that the express channel provides firms with an official way to speed up shipments through the port. In this case, we expect that

[22] The tests for overidentifying restrictions is a test of joint-exogeneity and, as such, does not strictly provide information on the validity of the instruments, but on their coherence, i.e., whether they identify the same vector of parameters (see Parente and Santos Silva, 2012).

[23] Note that port delays and customs delays are instrumented with their respective relevant source of exogenous variation, namely, port congestion and allocation to the green channel.

delays in the port are mostly driven by processing and not by choice. We assess whether this makes a difference by taking advantage of information on this express import modality to exclude flows making use of it. We report the respective estimates in the first panel of Table 8. The estimated impact of delays is virtually identical to that presented in Table 7.

Second, it is well known that imports of certain products require specific permits, so that additional border agencies intervene in their processing (see Carballo et al., 2016). While we could not get information on the associated times, we obtained a list of the products whose import documents must include permits issued by these agencies in each year of our sample period and are therefore able to exclude the products in question. The estimation results are shown in the second panel of Table 8. Again, these are similar to the baseline counterparts.

Third, given that we only consider maritime imports, it may be argued that possible substitution across transport modes may affect our estimates. We examine to what extent this is the case by excluding light products, which are the most likely to be alternatively shipped by air.[24] Estimates of Equation (12) based on this restricted sample are reported in the bottom panel of Table 8. They are in line with those shown in Table 7, too.

Fourth, we assess the robustness of our baseline results to using alternative specifications of the estimating equation. These alternative specifications both partially relax the restrictions on the sample imposed by the original set of fixed effects and allow us to control for more granular potential unobserved confounding factors through even more specific fixed effects. The results of these estimations are presented in Table 9. Note that first differencing already accounts for importer-product-origin specific effects in the import equation. Adding firm-year fixed effects controls for changesin importers' productivity and growth among other unobserved time-varying firm-level factors and focuses variation on within-firm, across product-origin variations (see Column 1). Product-origin-year fixed effects account for non-random price variation for a given import across sources, among other potential confounding factors at this level (see Column 2). Firm-origin-year fixed effects account for firms' preferences for certain export locations (see Column 4). We also estimate a specification with firm-product-year fixed effects for completeness, but note that we have the least identifying variation in this case, which explains the relatively high standard error (see Column 5). The reason is that this specification requires that importer source the same product from multiple exporting countries. As noted in Section 4, the sourcing pattern of Peruvian importers is more consistent with a discrete choice than a love-of-variety sourcing pattern. In another specification we allows for continuous growth or decay within importer-exporter relationships (see Column 7). The previous estimations do not control for idiosyncratic firm-specific market developments that may be correlated with border processing delays or the role of selling

[24] We consider light products those whose weight-to-value ratios as computed from worldwide product-level data are above the respective median.

companies in the international trade process and specifically in the assignment to customs' verification channels as discussed in Section 2. In order to minimize the risk of biased estimates due to these factors, we go a step further. We exploit our transaction-level information by estimating another variant of Equation (12) that incorporates firm-product-origin country-year fixed effects on data at the importing firm-product-origin country-exporting firm-year level. In this case, we also include exporting firm-year fixed effects to account for differences across suppliers over time in general and in the likelihood of their shipments being allocated to customs' inspection in particular (see Column 8).[25] Thus, while on one hand we only include firm-year or product-origin-year fixed effects, on the other hand we incorporate firm-product-year or firm-origin-year instead of merely firm-year fixed effects, firm-product-origin fixed effects along with firm-year fixed effect and product-origin-year fixed effects to account for possible time trends within the unit of our panel, or even firm-product-origin-year fixed effects when making use of the information on the selling firms. Remarkably, the estimated coefficient on border delay remains consistently negative and significant across all these alternative specifications.

Our preferred specification accounts for firm-year fixed effects and product-origin-year fixed effects. The reason is that the origin effects account for unobserved price, freight charge and tariff information at the product level that may be correlated with delays and import charges. For example, high tariff products may get more scrutiny in the customs process than low tariff products. Importer-year effects account for time-varying investment, productivity, and growth at the firm level. This is important if firm invest into supply chain management and infrastructure that lowers the cost of importing and affects port-of-entry management. For example, a small firm may hire dedicated supply chain managers to conduct the import process once it reaches a certain size. On the other hand, accounting for time trend within importer-exporting country relationships might not be an adequate strategy. The problem with this is that if there is continuous improvement at the port of entry, then this results in a reduction of entry delays that raises imports. This is exogenous time specific variation that is useful to identify the coefficients.

Finally, it should be noted that firm-product-destination flows are likely to be heavy-tailed (see, e.g., Eaton et al., 2012; di Giovanni and Levchenko, 2013; Gaubert and Itskhoki, 2015; Freund and Pierola, 2015; and Bernard et al., 2015). Hence, our estimated average effect could be largely driven by a majority of small import flows with significantly stronger responses than their larger counterparts and thus not be representative for that of the economy as a whole. In order to assess whether this is affecting our results we re-estimate Equation (12) by allowing for different effects depending on the initial size of the flow,

[25] In this estimation we only include those firm-product-origin-year import flows for which we have information on the buyers for all transactions. The reason is that for those flows with incomplete information we do not know whether the different shipments originated from different or the same exporting firms.

either in 2007 or the previous year.[26] The estimates clearly indicate that impacts are not only concentrated on the small flows. In fact, the impact is greater on larger imports.[27]

5.3 *Heterogeneous Effects and Extensive Margin*

In this subsection we investigate whether delays have heterogeneous effects across groups of firms, products, and origins by estimating variants of Equation (12) that include interactions that allow for differences in the estimated costs of entry delays across these dimensions.

The first two panels of Table 10 show that large and exporting firms and new firms are more elastic with respect to port-of-entry delays. This is consistent with the intuition that large exporting firms have more rigid production processes with complicated supply chains that make delays more costly. In the case of the new firms, the explanation can be that they primarily supply buyers who are sensitive to delivery schedules and thus tend to switch suppliers when they fail to meet these schedules. The second panel of Table 10 compares the delay elasticity of imports of different product categories. Time sensitive goods such food products are significantly more elastic with respect to delays. Figure 4 goes more granularly and reports estimates for each HS Section. These estimates reveal that delays are particularly costly for imports of vegetable products; wood and articles and pulp of wood; minerals (essentially fuels); footwear and accessories; and textiles and apparel..

Finally, the lower panel of Table 10 compares estimate for products sourced from different locations. The results show that imports from close by location are more elastic with respect to delays. This is consistent with Evans and Harrigan (2005) who provide evidence that time sensitive products are sourced from nearby locations. Shipments from high income countries are also more elastic with respect to delays, possibly because importer-exporter pairs between developed countries rely more heavily on lean supply chain strategies.

So far the analysis has focused on the effect of port-of-entry delays on the import intensive margin. As mentioned in Subsection 3.4., these delays may also affect the import extensive margin. Following the discussion therein, we specifically examine the impact of border processing times on the number of products imported by firms from given origins. More precisely, we estimate a variant of Equation (12) at the firm-destination-year level where the dependent variable is the change in the number of products and the main explanatory variable is the change in the border processing times, along with alternative sets of fixed effects (i.e., firm-year and destination-year fixed) to account for unobserved factors. According to

[26] We classify as small flows those with import values up to the median and large flows those with import values exceeding the median of the respective distribution.
[27] These estimation results are available from the authors upon request.

the estimates of this equation, increased time due to processing has a significant negative effect on the product import extensive margin.[28]

6 Conclusions

Timing is an important part of international trade decisions. Institutions invest resources to collect information about the time it takes to complete transactions and policymakers use them to evaluate efficiency and investors to make decisions. In this paper we provide theory that shows how firms allocate time to their supply chains to clear port of entry procedures and that the average time that shipments experience in the port is endogenous to the firm's decision. Based on this intuition we develop an identification strategy to estimate the effect of port of entry delays. We draw several conclusions.

Ranking countries based on survey evidence is difficult. In the case of Peru we find that a substantial amount of port of entry delays are due to endogenous storage and preparation time. It is not necessarily the port or customs that is inefficient, but firms who take a long time to clear the port. Identifying the benefits of reducing delays is accordingly challenging, because they depend on the source of the observed delay. Related to port of entry clearance, shorter total average clearance times are usually associated with shorter processing times. Our model, on the other hand, shows that if scheduling additional lead time is expensive, then firms allow for less buffer time in the supply chain and take the risk of running late. This has two consequences. Observed average clearance times are not necessarily informative about the relevant bottleneck in the supply chain, long processing times or a high cost of scheduling buffer time. In addition, when firms take into account the risk of running late, then the trade cost elasticity with respect to clearance times is not just a matter of how much the costs increase with each additional processing day.

The message for policy is that to evaluate investments into infra structure and rankings of countries efficiency, it is important to focus on delays that are driven by the actual processing of the shipments and cost estimates of these delays. In the Doing Business data, the customs clearance and port and terminal handling time is likely closest to an exogenous processing time. Based on these exogenous delays, we provide estimates that can be applied to estimate the cost savings of reducing these delays.

From the point of view of the academic literature, we show that firms in international trade endogenously choose lead times taking into account the distribution of processing times. In particular, our model highlights that the import demand elasticity of firms with respect to processing times is a combination of technology, demand, lead-time cost, and, parameters of the processing time distribution. The analysis further reveals that heterogeneity across groups of firms, product, and markets is fundamental to learn what determines trade elasticities and cost with respect to supply chain delays.

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

More specifically, our estimates explain why and how intensive and extensive margins respond to supply chain costs based on firm, product, and supply chain characteristics. , As such, our empirical results are a step forward in understanding the micro foundations of trade costs.

In particular, we provide estimates for newly importing firms. These firms face longer delays and, according to our estimates, are more sensitive with respect to each additional day of delay. The same holds for large firms with long supply chains. This is in contrast to standard trade theory that assumes that trade costs are homogenous across firms. We conclude that trade facilitation is especially effective for new entrants and large firms.

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Table 1

Border Delays: Total and Stages, by Customs Verification Channel, 2007 and 2013										
Year	**Stage**		**Mean**	**Percentile**						
				5	**10**	**25**	**50**	**75**	**90**	**95**
2007	**Total Border Delay**		**15.9**	**5.0**	**6.0**	**8.0**	**12.0**	**19.0**	**30.0**	**41.0**
		Green Channel	11.9	4.0	5.0	6.0	8.0	13.0	22.0	32.0
		Orange Channel	15.6	5.0	6.0	8.0	12.0	18.0	29.0	39.0
		Red Channel	20.0	7.0	8.0	11.0	15.5	23.5	36.0	50.0
2007	**Port Delay**		**2.5**	**1.0**	**2.0**	**2.0**	**2.0**	**3.0**	**4.0**	**4.0**
		Green Channel	2.5	1.0	1.5	2.0	2.0	3.0	4.0	4.0
		Orange Channel	2.5	1.0	1.5	2.0	2.0	3.0	4.0	4.0
		Red Channel	2.5	1.0	1.5	2.0	2.0	3.0	4.0	4.0
2007	**Preparation and Storage Delay**		**10.4**	**2.0**	**3.0**	**4.0**	**7.0**	**12.0**	**21.0**	**31.0**
		Green Channel	9.2	2.0	3.0	4.0	6.0	10.0	18.0	28.0
		Orange Channel	10.2	2.0	3.0	4.0	7.0	12.0	20.0	30.0
		Red Channel	11.4	2.0	3.0	4.0	7.0	13.0	24.0	34.0
2007	**Customs Delay**		**4.9**	**1.0**	**1.0**	**2.0**	**3.0**	**6.0**	**10.0**	**14.0**
		Green Channel	2.1	1.0	1.0	1.0	2.0	2.0	4.0	5.0
		Orange Channel	4.9	2.0	2.0	2.0	4.0	6.0	9.0	13.0
		Red Channel	8.0	2.0	3.0	4.0	6.0	9.0	14.0	19.0
2013	**Total Border Delay**		**16.5**	**4.0**	**5.0**	**7.5**	**12.0**	**20.0**	**33.0**	**44.0**
		Green Channel	11.6	4.0	4.5	6.0	8.0	13.0	21.0	29.5
		Orange Channel	16.9	5.0	6.0	8.0	13.0	21.0	31.0	42.5
		Red Channel	23.2	7.0	9.0	13.0	19.0	29.0	42.0	55.0
2013	**Port Delay**		**2.1**	**1.0**	**1.0**	**2.0**	**2.0**	**2.0**	**3.0**	**4.0**
		Green Channel	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
		Orange Channel	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
		Red Channel	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
2013	**Preparation and Storage Delay**		**11.0**	**2.0**	**3.0**	**5.0**	**7.0**	**13.0**	**22.0**	**32.0**
		Green Channel	9.7	2.0	3.0	4.5	7.0	11.0	19.0	27.0
		Orange Channel	10.7	1.0	3.0	4.5	7.0	13.0	22.0	31.0
		Red Channel	12.5	2.0	3.0	5.0	8.0	15.0	27.0	37.0
2013	**Customs Delay**		**5.2**	**1.0**	**1.0**	**1.0**	**2.0**	**7.0**	**13.0**	**18.0**
		Green Channel	1.7	1.0	1.0	1.0	1.0	2.0	3.0	4.0
		Orange Channel	6.0	1.0	2.0	2.0	4.0	7.0	13.0	17.0
		Red Channel	10.5	3.0	3.0	5.0	8.0	13.0	19.5	25.0

Source: Authors' calculations based on data from SUNAT.

The table reports the average and percentiles of the distribution of total and procedure-specific delays (i.e., port delays, preparation and storage delays, and customs delays) by customs' verification channel (i.e., green, orange, and red) for 2007 and 2013. The sample corresponds to all maritime imports entering into Peru through the port of Callao.

Table 2

Year	Stage		Mean	Percentile 5	10	25	50	75	90	95
Border Delays: Total and Stages, by Firm Types, 2007 and 2013										
Small Firms vs. Large Firms, Size Defined in Terms of Number of Employees										
2007	**Total Border Delay**									
		Small Firms	15.9	5.0	6.0	8.0	12.0	19.0	30.0	40.0
		Large Firms	16.6	5.0	6.0	8.0	11.0	19.0	34.0	48.0
2007	**Port Delay**									
		Small Firms	2.5	1.0	1.5	2.0	2.0	3.0	4.0	4.0
		Large Firms	2.5	1.0	1.5	2.0	2.0	3.0	4.0	4.0
2007	**Preparation and Storage Delay**									
		Small Firms	10.0	2.0	3.0	4.0	7.0	12.0	20.0	29.0
		Large Firms	12.3	2.0	3.0	4.5	7.0	14.0	28.0	40.0
2007	**Customs Delay**									
		Small Firms	5.3	1.0	1.0	2.0	3.0	7.0	11.0	15.0
		Large Firms	3.6	1.0	1.0	2.0	2.0	5.0	7.0	9.0
2013	**Total Border Delay**									
		Small Firms	17.2	4.5	6.0	8.0	13.0	21.0	34.0	45.0
		Large Firms	14.6	4.0	5.0	7.0	10.0	17.0	31.0	43.0
2013	**Port Delay**									
		Small Firms	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
		Large Firms	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
2013	**Preparation and Storage Delay**									
		Small Firms	11.1	3.0	3.0	5.0	8.0	13.0	22.0	32.0
		Large Firms	11.2	2.0	3.0	5.0	7.0	13.0	25.0	35.0
2013	**Customs Delay**									
		Small Firms	5.9	1.0	1.0	1.0	3.0	8.0	14.0	19.0
		Large Firms	3.1	1.0	1.0	1.0	1.0	3.0	7.0	12.0
New Importers vs. Incumbent Importers										
Year	**Stage**		**Mean**	**Percentile 5**	**10**	**25**	**50**	**75**	**90**	**95**
2007	**Total Border Delay**									
		New Importers	21.7	7.0	8.0	11.0	17.0	27.0	41.0	54.0
		Incumbent Importers	15.1	5.0	6.0	8.0	11.0	18.0	28.0	38.0
2007	**Port Delay**									
		New Importers	2.6	1.0	2.0	2.0	2.0	3.0	4.0	4.0
		Incumbent Importers	2.5	1.0	2.0	2.0	2.0	3.0	4.0	4.0
2007	**Preparation and Storage Delay**									
		New Importers	13.5	2.0	3.0	5.0	9.0	16.0	29.0	42.0
		Incumbent Importers	9.9	2.0	3.0	4.0	6.5	11.0	20.0	29.0
2007	**Customs Delay**									
		New Importers	7.6	2.0	2.0	3.0	6.0	9.0	15.0	21.0
		Incumbent Importers	4.5	1.0	1.0	2.0	3.0	6.0	9.0	13.0
2013	**Total Border Delay**									
		New Importers	24.7	7.0	9.0	13.0	20.0	30.5	49.0	60.0
		Incumbent Importers	15.2	4.0	5.0	7.0	11.0	19.0	30.0	40.0
2013	**Port Delay**									
		New Importers	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
		Incumbent Importers	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
2013	**Preparation and Storage Delay**									
		New Importers	15.1	3.0	4.0	6.0	11.0	19.0	33.0	44.0
		Incumbent Importers	10.4	2.0	3.0	5.0	7.0	12.0	21.0	29.0
2013	**Customs Delay**									
		New Importers	9.5	1.0	2.0	4.0	7.0	12.0	19.0	26.0
		Incumbent Importers	4.6	1.0	1.0	1.0	2.0	6.0	12.0	16.0

Source: Authors' calculations based on data from SUNAT.
The table reports the average and percentiles of the distribution of total and procedure-specific delays (i.e., port delays, preparation and storage delays, and customs delays) by importer type (i.e., new importers -firms that did not import before- and incumbent importers –firms that imported in previous years-) for 2007 and 2013. The sample corresponds to all maritime imports entering into Peru through the port of Callao.

Table 3

Year	Stage		Mean	5	10	25	50	75	90	95
Border Delays: Total and Stages, by Product Categories and by Origin, 2007 and 2013										
Time-Sensitive Products vs. Time-Insensitive Products										
				Percentile						
Year	**Stage**		**Mean**	**5**	**10**	**25**	**50**	**75**	**90**	**95**
2007	**Total Border Delay**									
		Time Insensitive Products	17.6	5.0	5.0	8.0	12.0	20.5	36.5	53.0
		Time Sensitive Products	15.9	5.0	6.0	8.0	12.0	19.0	30.0	40.0
2007	**Port Delay**									
		Time Insensitive Products	2.6	1.0	2.0	2.0	2.0	3.0	4.0	4.0
		Time Sensitive Products	2.5	1.0	2.0	2.0	2.0	3.0	4.0	4.0
2007	**Preparation and Storage Delay**									
		Time Insensitive Products	11.7	2.0	2.0	4.0	6.5	12.5	26.0	43.0
		Time Sensitive Products	10.3	2.0	3.0	4.0	7.0	12.0	21.0	30.0
2007	**Customs Delay**									
		Time Insensitive Products	5.0	1	1	2	3	6	11	16
		Time Sensitive Products	4.9	1	1	2	3	6	10	14
2013	**Total Border Delay**									
		Time Insensitive Products	17.0	4.0	5.0	7.0	12.0	21.0	34.0	50.0
		Time Sensitive Products	16.4	4.0	5.0	7.5	12.0	20.0	33.0	44.0
2013	**Port Delay**									
		Time Insensitive Products	2.2	1.0	1.0	2.0	2.0	2.0	3.0	4.0
		Time Sensitive Products	2.1	1.0	1.0	2.0	2.0	2.0	3.0	4.0
2013	**Preparation and Storage Delay**									
		Time Insensitive Products	10.8	2.0	3.0	4.0	7.0	12.0	23.0	35.0
		Time Sensitive Products	11.0	2.5	3.0	5.0	7.0	13.0	22.0	32.0
2013	**Customs Delay**									
		Time Insensitive Products	5.9	1.0	1.0	1.0	3.0	8.0	14.0	20.0
		Time Sensitive Products	5.2	1.0	1.0	1.0	2.0	7.0	13.0	18.0
Close Origins vs. Distant Origins										
				Percentile						
Year	**Stage**		**Mean**	**5**	**10**	**25**	**50**	**75**	**90**	**95**
2007	**Total Border Delay**									
		Close Origins	15.0	5.0	6.0	8.0	11.0	18.0	28.0	37.0
		Distant Origins	17.0	5.0	6.0	8.5	13.0	20.0	33.0	45.0
2007	**Port Delay**									
		Close Origins	2.5	1.0	2.0	2.0	2.0	3.0	4.0	4.0
		Distant Origins	2.6	1.0	2.0	2.0	2.0	3.0	4.0	4.0
2007	**Preparation and Storage Delay**									
		Close Origins	10.1	2.0	3.0	4.0	7.0	12.0	20.0	29.0
		Distant Origins	10.7	2.0	3.0	4.0	7.0	12.0	22.0	33.0
2007	**Customs Delay**									
		Close Origins	3.7	1.0	1.0	1.0	2.0	5.0	8.0	11.0
		Distant Origins	5.1	1.0	1.0	1.0	3.0	7.0	11.0	15.0
2013	**Total Border Delay**									
		Close Origins	15.3	4.0	5.0	7.0	11.0	18.0	31.0	43.0
		Distant Origins	17.5	5.0	6.0	8.0	14.0	22.0	34.0	44.0
2013	**Port Delay**									
		Close Origins	2.3	1.0	1.0	2.0	2.0	2.5	4.0	4.0
		Distant Origins	2.0	1.0	1.0	1.5	2.0	2.0	3.0	3.0
2013	**Preparation and Storage Delay**									
		Close Origins	10.8	2.0	3.0	5.0	7.0	12.0	22.0	33.0
		Distant Origins	11.2	3.0	3.0	5.0	8.0	13.0	23.0	31.0
2013	**Customs Delay**									
		Close Origins	3.7	1.0	1.0	1.0	1.0	4.0	10.0	14.0
		Distant Origins	5.8	1.0	1.0	1.0	2.0	8.0	15.0	20.0

Source: Authors' calculations based on data from SUNAT.

The table reports the average and percentiles of the distribution of total and procedure-specific delays (i.e., port delays, preparation and storage delays, and customs delays) by origin (i.e., close origins –countries whose distance to Peru is up to the median of the respective distribution- and distant origins –countries whose distance to Peru is above the median of the respective distribution-) for 2007 and 2013. The sample corresponds to all maritime imports entering into Peru through the port of Callao.

Table 4

Border Delays: Total and Stages, Driving Factors, 2007 and 2013			
2007		**2013**	
Stage and Fixed Effects	**R^2**	**Stage and Fixed Effects**	**R^2**
Total Border Delay		**Total Border Delay**	
Country of Origin	0.034	*Country of Origin*	0.034
Country of Origin + Product	0.130	*Country of Origin + Product*	0.122
Country of Origin + Product + Importing Firm	0.525	*Country of Origin + Product + Importing Firm*	0.551
Country of Origin+ Product + Importing Firm + Exporting Firm	0.781	*Country of Origin+ Product + Importing Firm + Exporting Firm*	0.808
Port Delay		**Port Delay**	
Country of Origin	0.015	*Country of Origin*	0.071
Country of Origin + Product	0.038	*Country of Origin + Product*	0.080
Country of Origin + Product + Importing Firm	0.256	*Country of Origin + Product + Importing Firm*	0.304
Country of Origin+ Product + Importing Firm + Exporting Firm	0.631	*Country of Origin+ Product + Importing Firm + Exporting Firm*	0.669
Preparation and Storage Delay		**Preparation and Storage Delay**	
Country of Origin	0.022	*Country of Origin*	0.015
Country of Origin + Product	0.088	*Country of Origin + Product*	0.067
Country of Origin + Product + Importing Firm	0.479	*Country of Origin + Product + Importing Firm*	0.500
Country of Origin+ Product + Importing Firm + Exporting Firm	0.763	*Country of Origin+ Product + Importing Firm + Exporting Firm*	0.781
Customs Delay		**Customs Delay**	
Country of Origin	0.046	*Country of Origin*	0.049
Country of Origin + Product	0.159	*Country of Origin + Product*	0.160
Country of Origin + Product + Importing Firm	0.534	*Country of Origin + Product + Importing Firm*	0.645
Country of Origin+ Product + Importing Firm + Exporting Firm	0.756	*Country of Origin+ Product + Importing Firm + Exporting Firm*	0.829

Border Delays: Correlation among Stages			
Preparation and Storage Delay		**Customs Delay**	
Port Delay	-0.175***	**Preparation and Storage Delay**	-0.003
	(0.006)		(0.004)
Firm-Year Fixed Effect	Yes	**Firm-Year Fixed Effect**	Yes
Product-Origin-Year Fixed Effect	Yes	**Product-Origin-Year Fixed Effect**	Yes
Observations	685,971	**Observations**	685,971

Source: Authors' calculations based on data from SUNAT.

The upper panel of the table reports the adjusted R^2 of regressions of the natural logarithm of the median total delay and the median procedure-specific delays (i.e., port delays, preparation and storage delays, and customs delays) at the importing firm-product-origin country-exporting firm-year level on sequential increasing sets of fixed effects: country of origin; country of origin and product; country of origin, product, and importing firm; and country of origin, product, importing firm, and exporting firm. Estimates correspond to 2007 and 2013. The lower panel of the table presents the correlation between the delays at consecutive border stages after conditioning by firm-year and product-origin-year fixed effects over the period 2007-2013. In particular, the first column shows estimates of an equation where the dependent variable is the change in the natural logarithm of the median preparation and storage delay and the main explanatory variable is the change in the natural logarithm of the median port delay. The second column reports estimates of an equation where the dependent variable is the change in the natural logarithm of the median customs delay and the main explanatory variable is the change in the natural logarithm of the median preparation and storage delay. Firm-year and product-origin-year fixed effects are included in both cases (not reported). Standard errors clustered by importing firm-product-origin 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

Aggregate Import Indicators							
Callao							
All Imports							
Year	**Import Value**	**Import Weight**	**Number of Shipments**	**Number of Importers**	**Number of Origins**	**Number of Products**	**Number of Customs**
2007	19,100	20,100	5,201	19,290	199	6,989	21
2008	27,900	21,300	6,026	22,542	205	6,230	21
2009	20,600	19,600	5,531	23,597	201	6,174	19
2010	28,200	24,400	6,979	25,592	203	6,233	20
2011	36,100	25,000	7,639	26,804	210	6,177	21
2012	40,200	26,700	8,380	28,799	211	6,302	21
2013	41,100	29,000	8,645	30,131	209	6,303	22
Percentage Share Callao							
Year	**Import Value**	**Import Weight**	**Number of Shipments**	**Number of Importers**	**Number of Origins**	**Number of Products**	**Number of Customs**
2007	72.3	71.6	56.3	64.0	86.4	92.4	4.8
2008	72.4	72.3	58.1	65.4	87.3	92.6	4.8
2009	73.8	72.4	56.6	65.7	93.0	93.0	5.3
2010	75.5	71.7	56.3	64.8	84.7	92.9	5.0
2011	76.7	72.0	57.1	65.8	84.8	93.2	4.8
2012	75.9	72.3	57.6	65.5	90.5	93.3	4.8
2013	74.7	71.0	59.0	65.6	88.5	93.2	4.5

Source: Authors' calculations based on data from SUNAT.
The table reports aggregate import indicators for each year of our sample period (2007-2013). In the first panel, all imports are considered. Import values are expressed in millions of US dollars. Import weights are expressed in thousands of tons. Number of shipments is expressed in thousands. In the second panel, only maritime imports entering into Peru through the Port of Callao are considered. Specifically, this panel shows the percentage share of total Peruvian imports accounted for by these maritime imports along the dimensions that correspond to the selected indicators.

Table 6

Average Importer									
Callao									
Year	**Import Value**	**Import Weight**	**Number of Shipments**	**Number of Origins**	**Number of Products**	**Number of Markets**	**Number of Employees**	**Age**	**Number of Customs**
2007	623.5	305.1	204.4	3.1	14.2	19.4	63.6	7.4	1.0
2008	785.1	347.8	207.3	3.0	13.2	18.2	60.4	7.4	1.0
2009	618.9	326.2	175.0	2.9	12.5	17.1	58.4	7.6	1.0
2010	660.8	323.2	186.0	2.9	12.7	17.2	58.1	7.7	1.0
2011	715.1	269.3	182.3	2.9	12.8	17.4	63.2	7.9	1.0
2012	700.5	257.7	175.6	2.9	12.8	17.5	64.8	8.0	1.0
2013	653.9	261.2	174.0	2.8	12.4	16.8	65.4	8.3	1.0
All Imports									
Year	**Import Value**	**Import Weight**	**Number of Shipments**	**Number of Origins**	**Number of Products**	**Number of Markets**	**Number of Employees**	**Age**	**Number of Customs**
2007	764.8	527.4	264.4	3.5	16.2	23.4	52.2	7.0	1.3
2008	1,009.3	580.6	264.7	3.3	14.8	21.6	48.4	7.0	1.3
2009	722.3	494.9	232.4	3.2	14.0	20.2	47.6	7.2	1.3
2010	904.8	582.6	268.4	3.2	14.2	20.7	47.8	7.3	1.3
2011	1,036.5	513.9	277.1	3.2	14.5	21.2	52.2	7.4	1.3
2012	1,057.4	521.4	276.2	3.2	14.4	21.2	52.2	7.5	1.3
2013	1,011.3	499.8	271.1	3.1	14.0	20.6	52.3	7.7	1.3
Excluding Minerals and Metals and Air-Shipped Imports									
Year	**Import Value**	**Import Weight**	**Number of Shipments**	**Number of Origins**	**Number of Products**	**Number of Markets**	**Number of Employees**	**Age**	**Number of Customs**
2007	718.5	258.7	202.1	2.8	12.2	16.5	65.6	8.3	1.0
2008	657.1	323.5	208.1	3.1	14.1	19.1	63.6	7.4	1.0
2009	814.5	332.5	212.0	3.0	13.1	18.0	60.5	7.4	1.0
2010	629.2	290.4	180.5	2.9	12.5	17.0	57.8	7.6	1.0
2011	723.6	331.0	201.8	2.9	12.6	17.1	58.1	7.7	1.0
2012	796.3	288.5	200.5	2.8	12.6	17.2	63.2	7.9	1.0
2013	792.4	296.6	196.6	2.8	12.6	17.1	64.8	8.0	1.0

Source: Authors' calculations based on data from SUNAT.
The table reports average import indicator for firms importing by sea through the Port of Callao, for all importers, and for firms that do not import minerals or metals or by air. Import values are expressed in thousands of US dollars. Import weights are expressed in thousands of kilos. Markets correspond to product-origin combinations.

Table 7

The Impact of Border Delay on Firms' Imports Baseline Specification						
ΔlnD						
		IV				
	OLS	**1st Stage**		**F-Statistics**	**Hansen**	**2nd Stage**
		Congestion	**Channel**			
Total Border Delay	-0.057***	0.009***	0.203***	4,591.9	0.689	-0.571***
	(0.005)	(0.000)	(0.002)	[0.000]	[0.407]	(0.031)
Port and Customs Delay	-0.049***	0.029***	0.469***	20,483.2	0.843	-0.240***
	(0.005)	(0.000)	(0.003)	[0.000]	[0.359]	(0.013)
Port Delay	-0.013*	0.043***		21,864.7		-0.157***
	(0.007)	(0.000)		[0.000]		(0.026)
Customs Delay	-0.058***		0.679***	44,515.8		-0.170***
	(0.004)		(0.003)	[0.000]		(0.009)
Firm-Year Fixed Effect	Yes	Yes				Yes
Product-Origin-Year Fixed Effect	Yes	Yes				Yes
Observations	685,971	685,971				685,971
ΔD						
		IV				
	OLS	**1st Stage**		**F-Statistics**	**Hansen**	**2nd Stage**
		Congestion	**Channel**			
Total Border Delay	-0.004***	0.115***	2.484***	2,116.9	0.646	-0.047***
	(0.000)	(0.007)	(0.004)	[0.000]	[0.421]	(0.003)
Port and Customs Delay	-0.009***	0.140***	2.494***	10,746.2	0.073	-0.046***
	(0.001)	(0.003)	(0.018)	[0.000]	[0.787]	(0.002)
Port Delay	-0.023***	0.119***		20,686.3		-0.057***
	(0.002)	(0.001)		[0.000]		(0.009)
Customs Delay	-0.010***		2.455***	19,292.2		-0.047***
	(0.001)		(0.018)	[0.000]		(0.003)
Firm-Year Fixed Effect	Yes	Yes				Yes
Product-Origin-Year Fixed Effect	Yes	Yes				Yes
Observations	685,971	685,971				685,971

Source: Authors' calculations based on data from SUNAT.

The table reports OLS and IV estimates of alternative specifications of Equation (12) (Columns 1 and 6, respectively) along with the first stage estimates (Columns 2 and 3) and the F-test statistics and the Hansen test statistics (Columns 4 and 5) for the latter. The dependent variable is the change in the natural logarithm of the import value at the importing firm-product-origin country-year level. In the first row the main explanatory variable is the change in the natural logarithm of the median total delay; in the second row the main explanatory variable is the change in the natural logarithm of the median port and customs delay; in the third row the main explanatory variable is the change in the natural logarithm of the median port delay; and in the fourth column, the main explanatory variable is the change in the natural logarithm of the median customs delay, all at importing firm-product-origin country-year level. In the IV estimations, the instruments are port congestion as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the firm-product-origin country import in question does in a given year and the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively) (Rows 1 and 2), the former (Row 3) or the latter (Row 4). Importing firm-year and product-origin country-year fixed effects included (not reported). Standard errors clustered by importing firm-product-origin are reported in parentheses below the estimated coefficients. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 8

The Impact of Border Delay on Firms' Imports Baseline Specification - Alternative Samples						
Sample Excluding Imports Processed through the Express Channel						
		IV				
	OLS	1st Stage		F-Statistics	Hansen	2nd Stage
		Congestion	Channel			
Total Border Delay	-0.056***	0.009***	0.210***	4,822.1	1.927	-0.568***
	(0.005)	(0.000)	(0.002)	[0.000]	[0.165]	(0.031)
Port and Customs Delay	-0.049***	0.029***	0.474***	19,777.2	0.574	-0.244***
	(0.005)	(0.000)	(0.003)	[0.000]	[0.449]	(0.026)
Port Delay	-0.012*	0.043***		21,013.0		-0.162***
	(0.007)	(0.000)		[0.000]		(0.013)
Customs Delay	-0.058***		0.687***	43,104.3		-0.172***
	(0.004)		(0.003)	[0.000]		(0.010)
Firm-Year Fixed Effect	Yes	Yes				Yes
Product-Origin-Year Fixed Effect	Yes	Yes				Yes
Observations	566,084	566,084	566,084			566,084
Sample Excluding Imports of Products subject to Permits						
		IV				
	OLS	1st Stage		F-Statistics	Hansen	2nd Stage
		Congestion	Channel			
Total Border Delay	-0.057***	0.010***	0.200***	3,798.3	1.254	-0.564***
	(0.006)	(0.000)	(0.002)	[0.000]	[0.263]	(0.034)
Port and Customs Delay	-0.049***	0.029***	0.463***	16,969.7	0.156	-0.237***
	(0.005)	(0.000)	(0.003)	[0.000]	[0.693]	(0.014)
Port Delay	-0.013*	0.043***		18,179.2		-0.167***
	(0.007)	(0.000)		[0.000]		(0.028)
Customs Delay	-0.058***		0.671***	36,675.4		-0.167***
	(0.004)		(0.004)	[0.000]		(0.010)
Firm-Year Fixed Effect	Yes	Yes				Yes
Product-Origin-Year Fixed Effect	Yes	Yes				Yes
Observations	493,386	493,386	493,386			493,386
Sample Excluding Imports of Light Products						
		IV				
	OLS	1st Stage		F-Statistics	Hansen	2nd Stage
		Congestion	Channel			
Total Border Delay	-0.069***	0.010***	0.204***	1,445.9	0.814	-0.615***
	(0.009)	(0.001)	(0.004)	[0.000]	[0.367]	(0.056)
Port and Customs Delay	-0.058***	0.029***	0.471***	6,572.9	0.016	-0.259***
	(0.008)	(0.001)	(0.004)	[0.000]	[0.899]	(0.234)
Port Delay	-0.002	0.043***		6,887.5		-0.186***
	(0.012)	(0.001)		[0.000]		(0.046)
Customs Delay	-0.068***		0.682***	14,436.7		-0.182***
	(0.007)		(0.006)	[0.000]		(0.017)
Firm-Year Fixed Effect	Yes	Yes				Yes
Product-Origin-Year Fixed Effect	Yes	Yes				Yes
Observations	274,773	274,773	274,773			274,773

Source: Authors' calculations based on data from SUNAT.

The table reports OLS and IV estimates of alternative specifications of Equation (12) (Columns 1 and 6, respectively) along with the first stage estimates (Columns 2 and 3) and the F-test statistics and the Hansen test statistics (Columns 4 and 5) for the latter. In the first panel, imports processed through the expressed channel are excluded. In the second panel, imports involving product subject to permits are removed. In the third panel, imports of light products (i.e., products with weight-to-value ratios are up to the median of their distribution across products as computed from worldwide data from COMTRADE). The dependent variable is the change in the natural logarithm of the import value at the importing firm-product-origin country-year level. In the first row the main explanatory variable is the change in the natural logarithm of the median total delay; in the second row the main explanatory variable is the change in the natural logarithm of the median port and customs delay; in the third row the main explanatory variable is the change in the natural logarithm of the median port delay; and in the fourth column, the main explanatory variable is the change in the natural logarithm of the median customs delay, all at importing firm-product-origin country-year level. In the IV estimations, the instruments are port congestion as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the firm-product-origin country import in question does in a given year and the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively) (Rows 1 and 2), the former (Row 3) or the latter (Row 4). Importing firm-year and product-origin country-year fixed effects included (not reported). Standard errors clustered by importing firm-product-origin are reported in parentheses below the estimated coefficients. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 9

The Impact of Border Delays on Firms' Imports Alternative Specifications							
OLS							
Level of the Data				**Firm-Product-Origin-Year**			**+Exporter**
Port and Customs Delay	-0.046***	-0.034***	-0.049***	-0.053***	-0.049***	-0.046***	-0.049***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.011)	(0.006)	(0.019)
Firm-Year Fixed Effect	Yes	No	Yes	No	No	Yes	No
Product-Origin-Year Fixed Effect	No	Yes	Yes	Yes	Yes	Yes	No
Firm-Origin-Year Fixed Effect	No	No	No	Yes	No	No	No
Firm-Product-Year Fixed Effect	No	No	No	No	Yes	No	No
Firm-Product-Origin Fixed Effect	No	No	No	No	No	Yes	No
Firm-Product-Origin-Year Fixed Effect	No	No	No	No	No	No	Yes
Exporting Firm-Year Fixed Effect	No	No	No	No	No	No	Yes
Observations	685,971	685,971	685,971	685,971	685,971	685,971	296,617
IV							
Level of the Data				**Firm-Product-Origin-Year**			**+Exporter**
Port and Customs Delay	-0.228***	-0.189***	-0.240***	-0.264***	-0.224***	-0.243***	-0.153***
	(0.011)	(0.010)	(0.013)	(0.015)	(0.032)	(0.018)	(0.043)
First Stage							
Congestion	0.029***	0.028***	0.029***	0.030***	0.029***	0.029***	0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)
Channel	0.476***	0.522***	0.469***	0.452***	0.398***	0.411***	0.715***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.005)	(0.003)	(0.011)
Test Statistics							
F-Statistics	27,698.2	28,591.8	20,483.2	15,606.0	3,498.4	10,070.9	2,053.0
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Hansen	0.466	1.878	0.843	1.786	0.049	0.369	1.735
	[0.495]	[0.171]	[0.359]	[0.183]	[0.825]	[0.544]	[0.188]
Firm-Year Fixed Effect	Yes	No	Yes	No	No	Yes	No
Product-Origin-Year Fixed Effect	No	Yes	Yes	Yes	Yes	Yes	No
Firm-Origin-Year Fixed Effect	No	No	No	Yes	No	No	No
Firm-Product-Year Fixed Effect	No	No	No	No	Yes	No	No
Firm-Product-Origin Fixed Effect	No	No	No	No	No	Yes	No
Firm-Product-Origin-Year Fixed Effect	No	No	No	No	No	No	Yes
Exporting Firm-Year Fixed Effect	No	No	No	No	No	No	Yes
Observations	685,971	685,971	685,971	685,971	685,971	685,971	296,617

Source: Authors' calculations based on data from SUNAT.

The table reports OLS and IV estimates of alternative specifications of Equation (12) (first and second panels, respectively) along with the first stage estimates (Rows 2 and 3 in the second panel) and the F-test statistics and the Hansen test statistics (Rows 4 and 5 in the second panel) for the latter. The dependent variable is the change in the natural logarithm of the import value at the importing firm-product-origin country-year level (Columns 1-6) and the importing firm-product-origin country-exporting firm-year level (Column 7). In the latter case, only those firm-product-origin country-year import flows for which we have information on the buyers for all transactions are included. The main explanatory variable is the change in the natural logarithm of the median port and customs delay. In the IV estimations, the instruments are port congestion as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the firm-product-origin country import in question does in a given year and the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively). In the first column, importing firm-year fixed effects are included; in the second column, product-origin country-year fixed effects are included; in the third column, importing firm-year fixed effects and product-origin country-year fixed effects are included; in the fourth column, importing firm-country of origin-year fixed effects and product-origin country-year fixed effects are included; in the fifth column, importing firm-product-year fixed effects and product-origin country-year fixed effects are included; in the sixth column, importing firm-year fixed effects, product-origin country-year fixed effects, and firm-product-country of origin fixed effects are included; in the seventh column, importing firm-product-country of origin-year fixed effects and exporting firm-year fixed effects are included (not reported). Standard errors clustered by importing firm-product-origin are reported in parentheses below the estimated coefficients. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 10

The Impact of Border Delays on Firms' Imports
Heterogeneous Effects

Firm Types: Small Firms (SF) vs. Large Firms (LF), Exporting Firms (EF) vs. Non-Exporting Firms (NEF), and New Importers (NI) vs. Incumbent Importers (II)

	SF	LF	EF	NEF	NI	II
Port and Customs Delay	-0.039***	-0.085***	-0.070***	-0.038***	-0.075***	-0.046***
	(0.005)	(0.011)	(0.009)	(0.006)	(0.011)	(0.005)
Firm-Year Fixed Effect	Yes		Yes		Yes	
Product-Origin-Year Fixed Effects	Yes		Yes		Yes	
Observations	685,971		685,971		685,971	

Product Categories

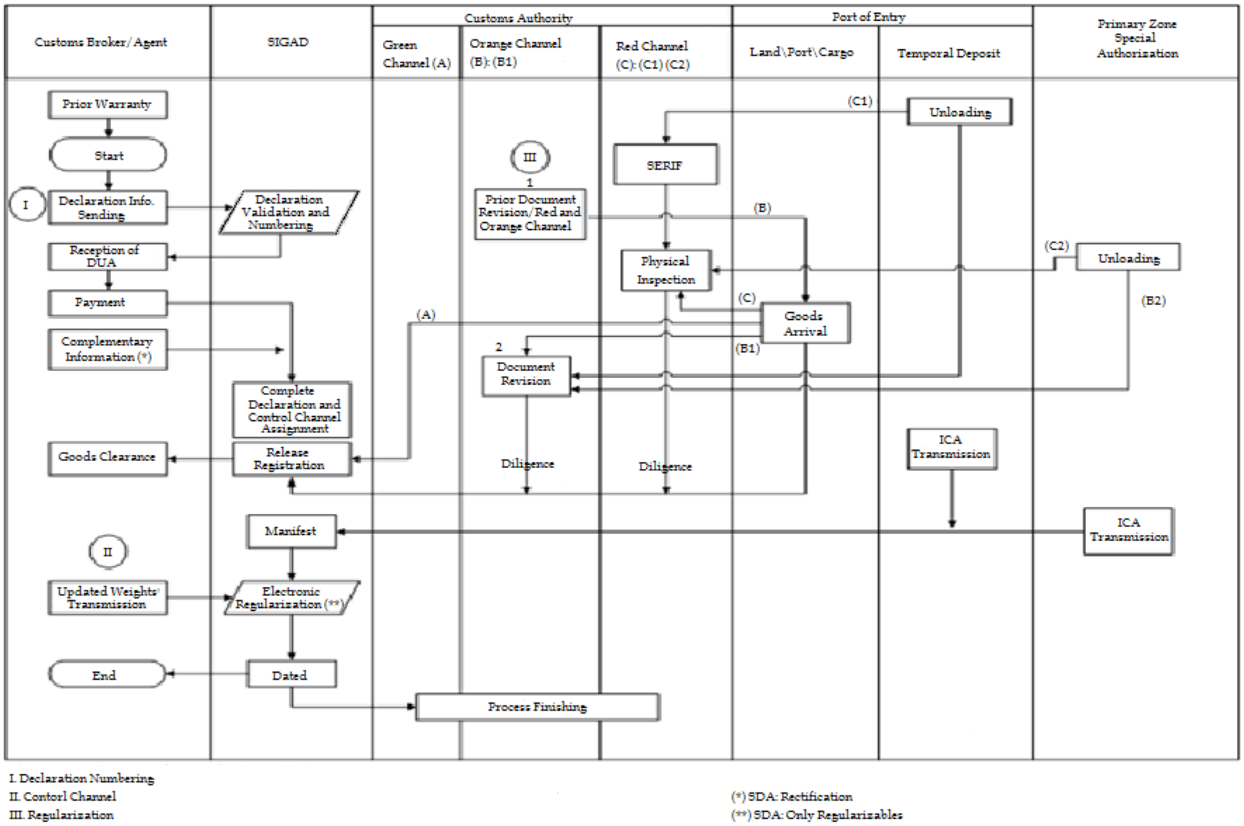
	Food	Textiles	Industrial Supplies	Consumer Goods	Other Goods
Port and Customs Delay	-0.091***	-0.040***	-0.053***	-0.058***	-0.043***
	(0.025)	(0.015)	(0.008)	(0.010)	(0.007)
Firm-Year Fixed Effect			Yes		
Product-Origin-Year Fixed Effects			Yes		
Observations			685,971		

Origins: OECD Countries (OECD) vs. Non-OECD Countries (NOECD) and Distant Origins (DO) vs. Close Origins (CO)

	OECD	NOECD	CO	DO
Port and Customs Delay	-0.053***	-0.046***	-0.055***	-0.044***
	(0.007)	(0.006)	(0.007)	(0.006)
Firm-Year Fixed Effect	Yes		Yes	
Product-Origin-Year Fixed Effects	Yes		Yes	
Observations	685,971		685,971	

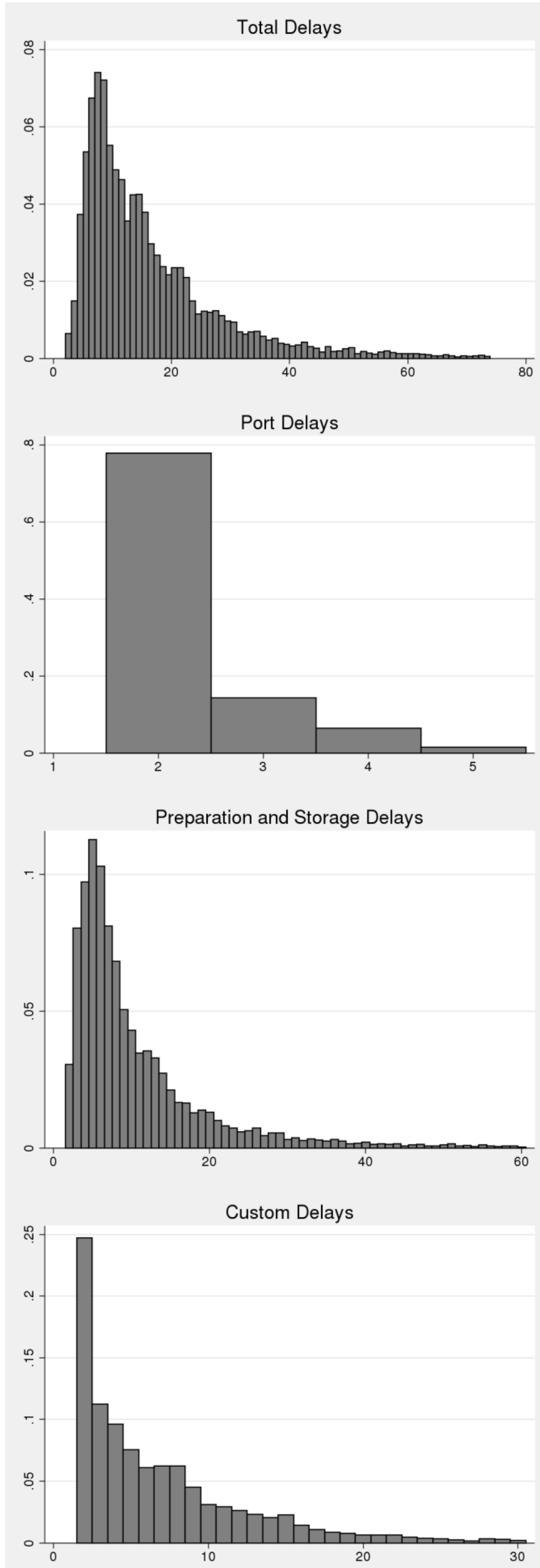
Source: Authors' calculations based on data from SUNAT.
The table reports OLS estimates of variants of Equation (12) that allows for different effects across types of firms (first panel): small firms (SF, with up to 200 employees) and large firms (LF, with more than 200 employees) (Columns 1 and 2); exporting firms (EF) and non-exporting firm (NEF) (Columns 3 and 4); for new importers (NI, firms that never imported before) and incumbent importers (II, firms that imported before) (Columns 5 and 6); for different effects across product categories as identified based on the BEC classification (second panel): food products, textile products, industrial supplies, consumer goods, and other goods (second panel); and for across origins (third panel): OECD countries (OECD) and non-OECD countries (NOECD); and distant origins (DO, origins whose distance to Peru is above the median of the respective distribution) and close origins (CO, (DO, origins whose distance to Peru is up to the median of the respective distribution). Importing firm-year and product-origin country-year fixed effects included (not reported). Standard errors clustered by importing firm-product-origin are reported in parentheses below the estimated coefficients. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Figure 1
Importing into Peru: Steps, Procedures, and Actors



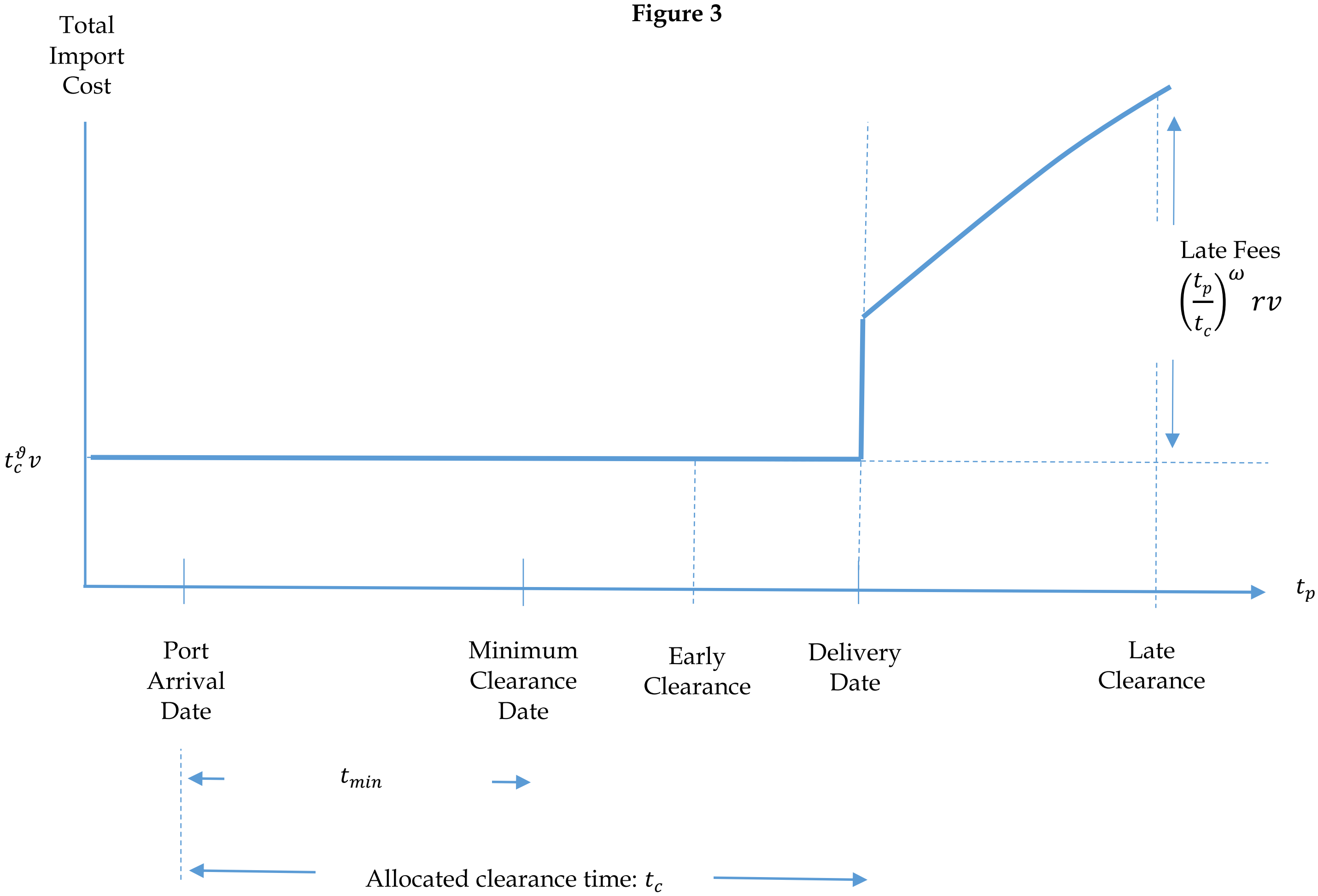
Source: SUNAT (2015)

Figure 2
Border Delays: Distributions, 2013



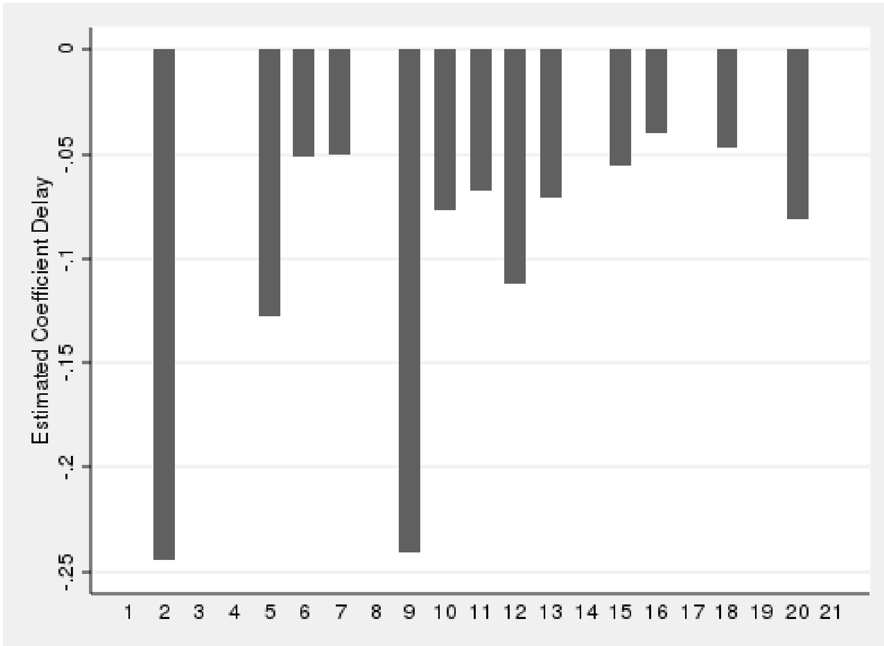
Source: Authors' calculations based on data from SUNAT.
The figures are histograms that show the distribution of the total and procedure-specific delays. Data corresponds to 2013.

Figure 3



Total
Import
Cost
$t_c^{\vartheta}v$
Late Fees
$\left(\frac{t_p}{t_c}\right)^{\omega} rv$
t_p
Port
Arrival
Date
Minimum
Clearance
Date
Early
Clearance
Delivery
Date
Late
Clearance
t_{min}
Allocated clearance time: t_c

Figure 4
Delays' Heterogeneous Effects across Products Groups



Source: Authors' calculations based on data from SUNAT.
The figure reports estimates of a variant of Equation (12) including interactions that allow for different effects across HS Sections.
Section 1: Live animals; animal products, Section 2: Vegetable products, Section 3: Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes, Section 4: Prepared foodstuffs; beverages, spirits and vinegar; tobacco and manufactured tobacco substitutes, Section 5: Mineral products, Section 6: Products of the chemical or allied industries, Section 7: Plastics and articles thereof; rubber and articles thereof, Section 8: Raw hides and skins, leather, fur skins and articles thereof; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut), Section 9: Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto or of other plaiting materials; basket-ware and wickerwork, Section 10: Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard; paper and paperboard and articles thereof, Section 11: Textiles and textile articles, Section 12: Footwear, headgear, umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair, Section 13: Articles of stone, plaster, cement, asbestos, mica or similar materials; ceramic products; glass and glassware, Section 14: Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation jewelry; coin, Section 15: Base metals and articles of base metal, Section 16: Machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles, Section 17: Vehicles, aircraft, vessels and associated transport equipment, Section 18: Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; clocks and watches; musical instruments; parts and accessories thereof, Section 19: Arms and ammunition; parts and accessories thereof, Section 20: Miscellaneous manufactured articles, Section 21: Works of art, collectors' pieces and antiques.

Appendix

Table A1

The Impact of Border Delay on Firms' Imports								
Baseline Specification								
ΔlnD								
		IV						
	OLS	**1st Stage**		**F**		**Hansen**		**2nd Stage**
		Congestion	**Channel**	**Statistics**	**p-value**	**Statistics**	**p-value**	
Total Border Delay	-0.057	0.009	0.203					-0.571
Cluster Firm-Product-Origin	(0.005)***	(0.000)***	(0.002)***	4,592.0	[0.000]	0.689	[0.493]	(0.109)***
Cluster Product	(0.005)***	(0.000)***	(0.003)***	2,990.0	[0.000]	0.620	[0.407]	(0.103)***
Cluster Product HS 2 Digit	(0.007)***	(0.000)***	(0.007)***	656.7	[0.000]	0.418	[0.518]	(0.117)***
Cluster Origin	(0.006)***	(0.001)***	(0.007)***	1,867.0	[0.000]	0.657	[0.418]	(0.146)***
Cluster Firm	(0.007)***	(0.001)***	(0.005)***	981.2	[0.000]	0.469	[0.493]	(0.127)***
Cluster Product Origin	(0.006)***	(0.001)***	(0.007)***	1,696.0	[0.000]	0.631	[0.427]	(0.146)***
Cluster Product HS 2 Digit Origin	(0.007)***	(0.001)***	(0.009)***	671.6	[0.000]	0.380	[0.538]	(0.161)***
Cluster Firm Product	(0.007)***	(0.001)***	(0.005)***	982.2	[0.000]	0.440	[0.507]	(0.120)***
Cluster Firm Product HS 2 Digit	(0.008)***	(0.001)***	(0.008)***	416.5	[0.000]	0.355	[0.551]	(0.124)***
Cluster Firm Origin	(0.006)***	(0.001)***	(0.007)***	1,023.0	[0.000]	0.568	[0.451]	(0.147)***
Cluster Firm Product-Origin	(0.007)***	(0.001)***	(0.005)***	1,078.0	[0.000]	0.448	[0.503]	(0.120)***
Cluster Firm Product HS 2 Digit-Origin	(0.007)***	(0.001)***	(0.005)***	841.3	[0.000]	0.561	[0.454]	(0.107)***
Port and Customs Delay	-0.049	0.029	0.469					-0.240
Cluster Firm-Product-Origin	(0.005)***	(0.000)***	(0.003)***	20,483.0	[0.000]	0.843	[0.359]	(0.013)***
Cluster Product	(0.004)***	(0.000)***	(0.005)***	9,765.0	[0.000]	0.696	[0.404]	(0.012)***
Cluster Product HS 2 Digit	(0.006)***	(0.000)***	(0.013)***	6,319.0	[0.000]	0.429	[0.512]	(0.015)***
Cluster Origin	(0.004)***	(0.001)***	(0.023)***	4,130.0	[0.000]	1.659	[0.198]	(0.028)***
Cluster Firm	(0.006)***	(0.001)***	(0.007)***	2,963.0	[0.000]	0.601	[0.438]	(0.016)***
Cluster Product Origin	(0.004)***	(0.001)***	(0.023)***	3,857.0	[0.000]	1.307	[0.253]	(0.028)***
Cluster Product HS 2 Digit Origin	(0.005)***	(0.001)***	(0.025)***	6,836.0	[0.000]	0.560	[0.454]	(0.029)***
Cluster Firm Product	(0.005)***	(0.001)***	(0.007)***	2,838.0	[0.000]	0.526	[0.468]	(0.015)***
Cluster Firm Product HS 2 Digit	(0.006)***	(0.001)***	(0.013)***	2,082.0	[0.000]	0.381	[0.537]	(0.017)***
Cluster Firm Origin	(0.004)***	(0.001)***	(0.022)***	2,270.0	[0.000]	1.388	[0.239]	(0.028)***
Cluster Firm Product-Origin	(0.005)***	(0.001)***	(0.007)***	3,191.0	[0.000]	0.571	[0.450]	(0.016)***
Cluster Firm Product HS 2 Digit-Origin	(0.005)***	(0.001)***	(0.010)***	2,139.0	[0.000]	0.672	[0.412]	(0.017)***
Firm-Year Fixed Effect	Yes	Yes						Yes
Product-Origin-Year Fixed Effect	Yes	Yes						Yes
Observations	685,971	685,971						685,971

Source: Authors' calculations based on data from SUNAT.

The table reports OLS and IV estimates of alternative specifications of Equation (12) (Columns 1 and 6, respectively) along with the first stage estimates (Columns 2 and 3) and the F-test statistics and the Hansen test statistics (Columns 4 and 5) for the latter. The dependent variable is the change in the natural logarithm of the import value at the importing firm-product-origin country-year level. In the first panel the main explanatory variable is the change in the natural logarithm of the median total delay, while in the second panel the main explanatory variable is the change in the natural logarithm of the median port and customs delay. In the IV estimations, the instruments are port congestion as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the firm-product-origin country import in question does in a given year and the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively). Importing firm-year and product-origin country-year fixed effects included (not reported). Standard errors clustered at alternative levels are reported in parentheses below the estimated coefficients. * 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 A2

The Impact of Border Delay on Firms' Imports Alternative Specifications of Port Congestion					
	ΔlnD				
	IV				
	1st Stage				
	Congestion	Channel	F-Statistics	Hansen	2nd Stage
Total Border Delay					
Port Congestion - Window: 1 Day	0.009***	0.203***	4592	0.689	-0.571***
	(0.000)	(0.002)	[0.000]	[0.407]	(0.031)
Port Congestion - Window: 2 Days	0.010***	0.203***	4562	0.917	-0.572***
	(0.000)	(0.002)	[0.000]	[0.338]	(0.031)
Port Congestion - Window: 3 Days	0.010***	0.203***	4527	1.693	-0.574***
	(0.000)	(0.002)	[0.000]	[0.193]	(0.031)
Port Congestion - Window: 4 Days	0.011***	0.203***	4521	1.336	-0.573***
	(0.000)	(0.002)	[0.000]	[0.248]	(0.031)
Port Congestion - Window: 5 Days	0.012***	0.203***	4542	1.26	-0.573***
	(0.001)	(0.002)	[0.000]	[0.262]	(0.031)
Port and Customs Delay					
Port Congestion - Window: 1 Day	0.029***	0.469***	20483	0.843	-0.240***
	(0.000)	(0.003)	[0.000]	[0.359]	(0.013)
Port Congestion - Window: 2 Days	0.033***	0.469***	20595	1.275	-0.239***
	(0.000)	(0.003)	[0.000]	[0.259]	(0.013)
Port Congestion - Window: 3 Days	0.035***	0.469***	20416	0.746	-0.240***
	(0.000)	(0.003)	[0.000]	[0.388]	(0.013)
Port Congestion - Window: 4 Days	0.037***	0.469***	20432	1.162	-0.239***
	(0.001)	(0.003)	[0.000]	[0.281]	(0.013)
Port Congestion - Window: 5 Days	0.038***	0.469***	20236	0.484	-0.241***
	(0.001)	(0.003)	[0.000]	[0.487]	(0.013)
Firm-Year Fixed Effect	Yes				Yes
Product-Origin-Year Fixed Effect	Yes				Yes
Observations	685,971				685,971

Source: Authors' calculations based on data from SUNAT.

The table reports IV estimates of alternative specifications of Equation (12) along with the first stage estimates (Columns 2 and 3) and the F-test statistics and the Hansen test statistics (Columns 4 and 5). The dependent variable is the change in the natural logarithm of the import value at the importing firm-product-origin country-year level. In the first panel the main explanatory variable is the change in the natural logarithm of the median total delay, while in the second panel the main explanatory variable is the change in the natural logarithm of the median port and customs delay. In the IV estimations, the first instrument is port congestion as proxied by the median number of other vessels that arrive at the port the same date that the one carrying the firm-product-origin country import in question does in a given year (Rows 1 and 6); the average of that date and the previous one (Rows 2 and 7), the average of that date and the two previous ones (Rows 3 and 8), the average of that date and the three previous ones (Rows 4 and 9), and the average of that date and the four previous ones (Rows 5 and 10). The second instrument is the median allocation to inspection (either documentary or physical as required in the orange and red channels, respectively). Importing firm-year and product-origin country-year fixed effects included (not reported). Standard errors clustered at alternative levels are reported in parentheses below the estimated coefficients. * 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.