Customs as Doorkeepers: What Are Their Effects on International Trade?♦

Christian Volpe Martincus*
Inter-American Development Bank

Jerónimo Carballo
University of Maryland

Alejandro Graziano
Inter-American Development Bank

This version: February 2013
Preliminary

Abstract

In this paper, we estimate the trade effects of custom-related delays on firm exports. In so doing, we use a unique dataset that consists of the universe of Uruguay export transactions over the period 2002-2011 and includes precise information on the actual time it took for each of these transactions to go through the customs (i.e., the time spanning between channel request and shipment release). We find that delays have a significant negative impact on exports. In particular, an increase of 10% in the median time spent in customs translates into a 1.8% decline in the growth rate of exports. Effects are particularly severe for exports of time-sensitive products, in destinations with tougher competition and suffering from banking crises, and to non-core buyers.

Keyword: Customs, Exports, Uruguay
JEL-Code: F10, F13, F14

♦ We would like to thank Nicolas Berman, Olivier Cadot, Jim de Melo, Michael Ferrantino, Alan Fox, Aaditya Mattoo, Michelle Median Millian, Marcelo Olarreaga, Mariya Polner, Donnette Rimmer, Georg Schaur, Eleanor Thornton, and participants at seminars at the World Customs Organization (Brussels), the USITC Research Seminar Series (Washington), and the FERDI-International Trade Center-World Bank Workshop "Aid For Trade: What Have We Learnt?"(Geneva) for very helpful comments and suggestions. The views and interpretations in this paper are strictly those of the authors and should not be attributed to the Inter-American Development Bank, its executive directors, its member countries, or Uruguay's Dirección Nacional de Aduanas. Other usual disclaimers also apply.
* 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.

Customs as Doorkeepers:
What Are Their Effects on International Trade?

1 Introduction

Time is an important trade barrier. In his seminal paper, Hummels (2001) shows that each additional day spent in transit reduces the probability that the United States sources a manufactured good from a given country by 1.5%, and estimates that such a day is worth 0.8% *ad valorem* for this kind of goods.[1] Importantly, from an economic policy point of view, the transit time between origins and destinations can be influenced by actions of public agencies that intervene in the administrative processing of trade flows. This is particularly the case with customs, which oversee the compliance of shipments with trade regulations. In fact, customs are the doorkeepers of international trade. All trade transactions leaving or entering countries must be processed by the respective national customs and such a processing takes time. How long does it take for a firm to clear customs? The simple answer to this question is that, so far, we do not really know beyond some "national averages". The truth is, however, that the within-country distribution of customs delays is far from degenerate. Thus, in 2011, export processing times by the Uruguayan customs ranged between 1 day (i.e., goods were released in the same day) and 31 days. To put these figures into perspective, 31 days triples the time required to ship a good from Montevideo, Uruguay's main port, to Baltimore in the United States and amounts to 1.5 times that needed to reach Singapore.[2] Such transaction-specific delays, which are primarily under the control of the respective intervening public agency, can therefore be substantial and highly variable and, in particular, even have larger variance than international shipping times. Hence, the time it takes to complete customs-related procedures is likely to have non-negligible effects on firms' export outcomes. However, evidence in this regard is virtually missing. In this paper, we precisely fill this gap using an unprecedented dataset for Uruguay that consists of the entire universe of export transactions and, for the first time to our knowledge, real customs clearance times over the period 2002-2011.

Since customs procedures can increase the transit time between origin and destination, these intermediating public entities can play a major role in facilitating or hindering exports and imports. A number of papers have estimated gravity models and variants thereof to examine the effects of total time to trade, customs and technical control times, and time at the border on aggregate bilateral trade, overall and distinguishing among time sensitive and time insensitive goods (see, e.g, Djankov et al., 2010; Freund and Rocha, 2011; and Hornok, 2011), sectoral bilateral trade (see, e.g., Martínez-Zarzoso and Márquez-

[1] In the most recent version of this study, Hummels and Schaur (2012) report that each day in transit is equivalent to an *ad valorem* tariff of 0.6% to 2.3%

[2] These shipping times have been taken from See Rates (www.searates.com), a sea-freight broker based on Miami assuming a vessel speed of 20 knots (see, e.g., Feyrer, 2011, and Berman et al., 2012).

Ramos, 2008; and Bourdet and Persson, 2010), the product extensive margin (see, e.g., Persson, 2010), the destination extensive margin (see, e.g., Nordas, 2006), and the frequency and size of shipments (see Hornok and Koren, 2011) for various samples of countries and product categories.[3] A few studies use firm-level data to explore the influence of time to clear customs on export statuses, export intensity (i.e., exports to sales ratio), and destination diversification (see Dollar et al., 2006; Yoshino, 2008; Wilson and Li, 2009a, 2009b). These papers generally conclude that delays associated with customs procedures have a significant negative impact on export outcomes, especially for time-sensitive products.

While certainly insightful, this literature has three limitations, which makes the evidence on how the time that takes for customs to process a shipment affects firms' export performance at best preliminary and incomplete. Thus, most analyses are based on cross-sectional aggregated country-level data or relatively small samples of manufacturing firms of heterogeneous countries that are pooled together for estimation purposes. In addition, these analyses generally rely on cross-country variation in customs delays to identify the effects of interest. This identification strategy has the drawback that country characteristics that are relevant for trade but are unobserved by the econometrician and potentially correlated with administrative delays are not properly controlled for.[4] More generally, endogeneity problems are not properly addressed. Further, virtually all studies utilize the single-value, country-level measure of time to trade (or its components) from the World Bank's Doing Business Indicators. These data are without any hesitation valuable and useful as a first approximation, but they have clear limitations that are mainly related to the coverage and underlying assumptions of the survey, which in turn echoes in their precision, and to the fact that relevant heterogeneities are out of the picture.[5] First, these survey-based measures are not real clearance times, but personal assessments of what those times would be for a certain typical transaction primarily from trade facilitators working with freight-forwarding companies. While 345 trade facilitators have systematically participated in the surveys since their inception, in the particular case of Uruguay only four individuals/firms answered the most recent questionnaire on trading across the borders (see Doing Business, 2012).[6] Second, several assumptions are made about the exporting company whose customs experience the data are supposed to capture. The company is a local business, has at least 60 employees, is located in the country's most populous city, does not operate under special export regimes, and has a management familiar with trading rules and

[3] Wilson et al. (2005) and Portugal-Pérez and Wilson (2010) investigate how the customs environment and border and transport efficiency affect total bilateral trade using summary indicators as proxies for these variables, whereas Engman (2005) and Milner et al. (2008) present surveys of the empirical literature.

[4] Also important, standard measures of administrative delays do not vary across products.

[5] The study by Hornok (2011) is the only exception. She uses average waiting times at the border from voluntary reports gathered by the International Road Union and, to identify the effects of their changes on trade, assumes that those that were positive went down to zero with 2004 European enlargement.

[6] In our database, we have identified at least several hundreds of carriers in 2011. In its evaluation of the Doing Business 2007 Report, the IEG (2008) notices that the small number of informants was an important source of weakness of the data. See also the discussion in Nathan Associates (2007) on this issue based on the Mozambique case.

requirements (i.e., sales abroad account for more than 10% of the total sales).[7] Whereas these firms may jointly account for a substantial portion of country's total exports, these are only a small share of the entire population. Thus, for instance, according to data from Uruguay's tax agency (*Dirección General Impositiva*-DGI), there are only around 200 medium to large companies (i.e., companies with more than 20 employees) in tradable sectors located in Montevideo, which amounts to roughly 10% of the total number of firms registering exports each year in Uruguay. Third, various assumptions are also made on the cargo. The product is transported in a dry cargo, 20- ft. full container load, it is not hazardous, does neither require refrigeration nor special phytosanitary or environmental safety standards. Given these conditions, surveyed time to trade measures were initially presented as to be representative for three categories of goods: textile yarns and fabrics (SITC 65), clothing accessories (SITC 84), and coffee, tea, species, and manufactured thereof (SITC 07) (see Djankov et al., 2010).[8] In its more recent versions, the survey asks respondents to focus on a leading export product in the country that meets the previous requirements, although this product is not identified along with the public data.[9] Finally, the shipment is assumed to be ocean-transported. In Uruguay, maritime transport represented around 60% of total exports and less than 50% of the total number of export transactions between 2002 and 2011. Specifically, over our sample period, relatively few firms were located in Montevideo, had more than 60 employees, and shipped products abroad by ocean and these amounted together to a small share of Uruguay´s total number of exporters in 2011, which makes them hardly representative of the universe of companies as a whole. In this paper, we aim at filling the aforementioned gaps in the literature while overcoming the data constraints discussed above.

More precisely, this paper addresses three main questions: What are the effects of delays associated with customs processing of shipments on firms' exports? What are the channels through which these effects arise? To what extent are these effects heterogeneous? In answering these questions, we first make use of a unique dataset that includes all Uruguayan export transactions over the period 2002-2011 along with measures of the respective actual processing time by the national customs. Second, in order to identify their impacts on firms' exports, we exploit the conditional random variation in clearance times associated with the customs procedures. In particular, conditional on firms and product-destination combinations, transactions are randomly allocated to physical inspection. Depending on whether shipments have to go through this material verification or not, processing times and thereby transit times increase for some exports while those for others remain the same. We therefore primarily compare the

[7] In the original version of the survey, firms were supposed to have more than 200 employees (see Djankov et al., 2010).
[8] These categories of products jointly accounted for only 4.2% and 12.1% of 2011 Uruguayan total exports and total number of exporting companies, respectively, and, more generally, for predictably very heterogeneous shares of these aggregates across countries.
[9] More specifically, "…the product must not be hazardous, require refrigeration, or be used for military purposes. It is...exported in a dry-cargo, 20 ft. full container load (FCL), weighs 10 tons and is valued at USD 20,000. The product should be one of your country's leading exports…".

before and after change in exports subject to increased delays with that in exports that did not suffer from additional delays while rigorously controlling for potential confounding factors. This allows us to consistently estimate the effects of interest.

The contribution of our paper to the existing literatures is thereby six fold. First, to our knowledge for the first time, we present actual measures of the exact time that takes to complete customs procedures based on official data covering the entire universe of a country's transactions over a long period of time and not from a survey on a limited sample of trade actors or flows. Second, also for the first time to our knowledge, we provide robust evidence on the effects of these administrative delays on firm export outcomes based on data for the whole population of a country's exporting firms. Noteworthy, our microeconometric evaluation focuses on a public intervention that potentially affects all companies trading across the borders, unlike other in principle narrower policies such as export promotion. Third, by exploring the responses of the intensive and extensive margins of firms' exports along various dimensions, we disentangle the channels through which the effects arise. Fourth, we go beyond the average effect and uncover potential heterogeneous impacts depending, among others, on the toughness of the competition faced in the destination, the degree of time-sensitiveness involved in the trade relationship, and, as a remarkably novelty, the relative importance of the buyers. Fifth, our results can shed new light on the effects of trade facilitation on comparable developing countries. Last but certainly not least, we believe that our analysis can feed and provide guidance for future theoretical work on the impact of time on trade.[10]

We find that delays associated with customs procedures have a significant negative impact on exports. More specifically, a 10% increase in the time that these procedures add to the transit time between the origin and the destination results in a 1.8% decline in the export growth rate. This effect is stronger for exports of time-sensitive goods (i.e., food and textile products), in developed countries' markets, and to secondary buyers. These findings highlight the importance of controls that are expedite without jeopardizing their quality and accordingly the fulfillment of their purposes.

The remainder of this paper is organized as follows. Section 2 describes the export process in Uruguay. Section 3 introduces the dataset and presents basic statistics and preliminary evidence. Section 4 explains the empirical strategy. Section 5 discusses the estimation results, and Section 6 concludes.

[10] In this sense, key ingredients of the possible models should be trade costs that encompass a stochastic transit time component and a firm-specific mechanism that generates expectations of delays that are updated after each of their realizations. In this framework, a shock to transit times would lead to an upward revision of the respective expectation, increased expected trade costs and accordingly effective price in the destination, and, as a consequence, reduced foreign sales. Further, our finding according to which the effect of customs delay differ for the main and secondary buyers seem to suggest that factors on the demand side should specifically play a role (see, e.g., Egan and Mody, 1992; and Rauch and Watson, 2003).

2 Customs Processing of Exports in Uruguay

In Uruguay as well as in several other Latin American countries, the typical export process consists of a series of steps that are illustrated in Figure 1 in a stylized manner (see URUGUAY XXI, 2012). Once the terms of the trade deal (i.e., quantity, price, quality, payment method, shipment method, etc.) between the exporter and the buyer are established, the former requests the service of a customs broker, who is given the *proforma* invoice or final commercial invoice and the packing list (if applicable).[11] This broker completes an electronic Single Customs Document (DUA – for its name in Spanish, *Declaración Única Aduanera*) and sends it to the customs (*Dirección Nacional de Aduanas*-DNA), which validates the DUA and sends back a message containing the number assigned to the DUA and the registration date. When the shipment is at the Customs departure point, the DUA is printed and all export documentation is put into an envelope along with a sworn declaration (signed by the customs broker and the exporter), the *proforma* or final invoice, a copy of the bill of lading and any other documentation required (e.g., sanitary certificates, etc.). At this stage, the customs broker requests the *ex ante* verification channel for the operation and, conditional on product-destinations, the customs information system randomly assigns it to no verification (*green channel*) or verification of documents and merchandise (*red channel*).[12] It is worth stressing herein that the random allocation to the "customs treatment" (i.e., red channel) allows us to directly rule out thinkable selection problems in relationship to transactions that suffer from delays. Also important for our purposes, and again conditional on product-destinations, there is *a priori* no systematic relationship between the characteristics of the shipments and the time that takes its inspection.[13] In order to check this randomness, we carry out daily regressions of firm-product-destination flows subject to the green channel on a binary indicator that takes the value of one if the flow is allocated to the red channel the next time it goes through the customs and zero otherwise or on the (logarithm of the) median delay it experiences this next time and firm and HS6 product-destination fixed effects.[14] Estimates together with their confidence intervals are shown in Figure 2 along with the respective smoothed values obtained from a kernel weighted local polynomial regression.[15] As expected, these estimates are overwhelmingly non-significant. In particular, for the almost 1,000 regressions with at least 30 degrees of freedom, the

[11] In order to be able to export, companies must be registered with the-DGI, the social security administration (*Banco de Previsión Social*-BPS) and the state insurance company (*Banco de Seguros del Estado*-BSE).

[12] Exports are subject to physical verification because Uruguay collects taxes on foreign sales of certain products. Other reasons include control of tax reimbursement claims and fighting of illegal trade.

[13] In our estimations below we also accommodate the possibility that the probabilities to be allocated to the red channel are adjusted for particular firms if they did not successfully pass verifications in the past.

[14] The average (median) number of transactions per day ranges between 236.2 and 357 (257 and 427) over the period 2002-2011.

[15] We have also conducted daily unconditional two sample t-tests to assess whether there were significant differences in mean firm exports under the green channel for companies with at least one of their transaction allocated to the red channel their next visit to the customs and their counterparts with all their transactions going again through the green channel. According to the test statistics, differences are not significantly different from zero for 83% of the roughly 2,700 comparisons. Similar shares are also observed for other firm export outcomes such as the number of products exported, the number of destinations, and the number of buyers. Detailed tables presenting summary statistics of the tests are available from the authors upon request.

estimated coefficient on the channel allocation indicator is insignificant in more than 90% of the times, whereas that on the delay is insignificant in approximately 85% of the cases.[16]

After the verification, if any, has taken place, the customs sends the DUA with the clearance of the shipment. The merchandise is then loaded at the port, airport, or border crossing. Afterwards, the customs broker sends an electronic message to complete the transaction, based on information that will be sent to the DNA in the third and last electronic message with definitive shipping data (i.e., weight, quantity, number of packages, value).[17] Finally, the DNA completes the export in its information system and carries out an ex post documentation verification against the third message sent by the customs broker.[18]

In this paper we measure the customs clearance time as the time elapsed between the request of verification channel and release of the goods by the customs (see Figure 1). This precisely corresponds to the time it takes for the customs to carry out the verifications, if any, and hence, to the exact time this public entity adds to transit between origin and destination, and it therefore excludes the time required for previous documentation preparation and inland transportation as well as that for port or airport handling. The reason is threefold. First, there is virtually no delay between the initial submission of the DUA by the customs broker and its registration by the customs. Second, exporters may begin work on documentation while production is underway, so that it appears convenient to also exclude this portion from the time to trade (see Hummels, 2007). Third, there may be several factors affecting the schedule of the domestic transportation of the goods to the exit point and that these factors are generally out of the control of the customs (see WCO, 2011).

3 Dataset and Descriptive Evidence

Our main dataset consists of transaction level export data from 2002 to 2011 from the Uruguayan customs DNA. Specifically, each record includes the firm's tax ID, the product code (10-digit HS), the customs through which the shipment exits Uruguay, the destination country, the foreign buyer (coded), the transport mode, the export value in US dollars, the quantity (weight) in kilograms, the channel through which the transaction was processed (either green or red), the date in which the customs-processing of the shipment was requested (channel request) and date in which the shipment was authorized to leave the customs (release date) (see Figure 1). We should mention herein that the sum of

[16] Proportions are virtually identical when regressions with degrees of freedom between 20 and 30 are also considered. Detailed tables reporting estimates and summary statistics are available from the authors upon request.
[17] In this instance, if exports involve raw wool, live cattle, dried and salted hides, leather and split, or pickled and wet-blue leather, a 5% export tax must be paid to the state bank BROU, which officially acts as collection agent.
[18] An export refund is then requested from the DGI, which goes into effect starting in the 12th month following the shipment.

these firms' exports virtually adds up to the total merchandise exports as reported by the Uruguayan Central Bank, with the annual difference being always less than 1.0%.

Table 1 reports Uruguay's total exports in 2002 and 2011 along with key aggregate extensive margin indicators and customs processing patterns, namely, the portion of transactions going through red channel and the median time spent in customs conditional on this channel. Exports grew more than 300% between these years to reach 8 billion US dollars in 2011. These foreign sales expanded along the firm, destination, and product extensive margins. Thus, the number of firms, destination countries, and product exported, increased by 27.1%, 27.4%, and 20.5% from 2002 to 2011, respectively. Yet, most of the expansion is accounted for by a larger intensive margin on the product-country dimension, i.e., larger average exports by product and country. This was the result of both larger average shipments and a larger number of shipments, which raised nearly 75.3%. This is evident in Figure 3, which presents kernel density estimates of firms' total exports, average exports, average number of shipments, and average shipment size by good and destination for each sample year.

Exports exit the country through 16 customs. Figure 4 shows the evolution over time of total foreign sales and total number of transactions along with that corresponding to those processed under red channel from 2002 to 2011. Roughly 15.2% of the transactions go through this channel and were accordingly subject to material inspection over these years, and this portion declined in more recent years. It is worth noticing that shipments going through the green channel are always cleared within one day (i.e., the same day the broker requests the channel), whereas release of goods whose exports were subject to red channel can take one day or substantially longer.[19] This can be clearly seen in Figure 5, which presents a kernel density estimate of the distribution of number of days spent in the customs over all transactions allocated to red channel in 2011. Thus, the 2-days processing time recorded by the Doing Business Indicators for Uruguay in 2011 would correspond to the 95th percentile of the respective entire distribution and to the 31st percentile of the distribution of those export flows that were verified.[20] This highlights that such a single dimensional figure hides an ample variability of administrative-driven delays, which may potentially have potentially significant and heterogeneous implications for firm export outcomes and their dynamics. Further, customs delays can substantially change over time. In fact, the median clearance time for those transactions subject to red channel increased from 2 to 5 days between 2003 and 2011. More generally, as illustrated by Figure 6, the distribution of these delays experienced a substantial shift to the right between these years, particularly in its upper part.[21]

[19] Some of the delays we observe in the data are unreasonably high (several hundred days) likely due to entry error. To address this problem we drop the highest 0.5 percentile of the delays from the dataset.

[20] Customs delays specifically observed in textile yarns and fabrics; clothing accessories; and coffee, tea, and species significantly differ from those registered in other product categories. Figures and test statistics are available from the authors upon request.

[21] The absolute number of transactions subject to material inspection slightly declined in most recent years, which suggests that increased delays cannot be traced back to the expansion in exports registered over this period (see Figure 4). Instead, this development can be considered the result of the reduction in the number of employees that carry out the verifications of export

Table 2 characterizes the average Uruguayan exporter in these years. On average, the exporting firms sell 4.4 products to 6.6 buyers in 3.1 countries for approximately 4.2 million US dollars. In so doing, each of these firms makes 59.6 annual shipments through 1.8 customs. Do customs delays affect these firms export outcomes? A naïve approach to answer this question would be to compare firms' exports at the product- destination level processed under the green channel and thus released within the same day with that of their counterparts processed under the red channel and subject to actual delays, i.e., released in more than one day. This is done in Figure 7 for the year 2011. This figure presents kernel density estimates of the distribution of both non-inspected exports and exports physically inspected and facing increased transit times. The density of the former exports is clearly to the right to that corresponding to the latter exports, which indicates that exports experiencing delays were smaller than the non-delayed ones. More specifically, according to the Kolmogorov-Smirnov test-based procedure proposed by Delgado et al. (2002), the former distribution stochastically dominates the latter. Of course, this comparison may yield a poor measure of the impact of the administrative procedures because such differences in exports might stem from systematic differences between firms or product-destinations across the groups being compared. In the next section we formally estimate the effects of customs delays on firms' export outcomes while accounting for these potential systematic differences.

4 Empirical Methodology

We aim at estimating the effects time spent in customs on exports. Clearly, factors other than customs procedures may affect firms' exports. Thus, exports may have decreased because lower firm productivity or lower foreign demand. Failure to properly account for these other factors would result in biased impact estimates. A possible strategy to isolate these potential confounders consists of using disaggregated export data and including appropriate sets of fixed effects in the equation estimated on these data (see, e.g., Paravisini et al., 2011). We adopt this approach here. In particular, our empirical model of exports is as follows:

$$lnX_{fpct} = \alpha lnD_{fpct} + \lambda_{fpc} + \delta_{ft} + \rho_{\tilde{p}ct} + \varepsilon_{fpct} \quad (1)$$

where f denotes firm, p ($\tilde{p}$) stands for product at the HS-10 (HS-6) digit-level, c indicates country, and t indexes time. The main variables are X and D. The former represents export value.[22] The latter is the median delay experienced by all transactions of product p that firm f ships to destination country c in

shipments. This number decreased from 96 in 2003 to 76 in 2011. Two factors explain this decrease, namely, the pensioning of employees who reached the retirement age and the fact that there were no incorporations of personnel due to the 1995 public administration law that froze hiring of public employees.

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

year t.[23] The coefficient on the indicator variable D, α, is accordingly our parameter of interest. If $\alpha < 0$ ($\alpha = 0$), then increased delays associated with longer customs processing times have a negative (no) impact on exports. The remaining terms of Equation (1) correspond to control variables. Thus, λ_{fpc} is a set of firm-product-country fixed effects that captures, for instance, the firm knowledge of the market for a given product in a given country; δ_{ft} is a set of firm-year fixed effects that accounts for time-varying firm characteristics (e.g., size), competences (e.g., delivery of goods according to the specifications agreed upon), overall performance (e.g., productivity), and firm-level public policies (e.g., export promotion) as well as the companies' changing probabilities of being selected for material inspection (which we assume might potentially occur if a firm fails a verification in the past), and abilities to comply with customs regulations; $\rho_{\tilde{p}ct}$ is a set of product-destination fixed effects that controls for potentially different probabilities across product-destination pairs of being allocated to the red channel; for time-varying customs and other administrative procedures and trade costs associated therewith in the various destinations; and for product-destination shocks such as changes in tariffs applied on products across importing countries, specific variations in international transport costs, and fluctuations in demand for goods across markets; and ε is the error term.

In estimating Equation (1), we use first-differencing to eliminate the firm-product-destination fixed effects. We therefore estimate the following baseline equation:

$$\Delta lnX_{fpct} = \alpha \Delta \ln D_{fpct} + \delta'_{ft} + \rho'_{\tilde{p}ct} + \varepsilon'_{fpct} \quad (2)$$

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

Notice that, by comparing changes over time in exports that virtually suffer from no delay (i.e., goods are released within one day) and those for exports that experienced larger delays, we are controlling for observed and unobserved time-invariant factors as well as time-varying ones common to both groups that might be correlated with being exposed to the customs treatment and exports. In addition, Equation (2) includes fixed effects that account for systematic differences across firms and product-destination shocks, thus substantially reducing the risk of omitted variable biases and particularly of heterogeneity in export dynamics. Further in this sense, given the mechanism of allocation to the verification channel (see Section 2) and that firms might be aware of its main criteria, these fixed effects can be considered to also at least partially account for their expectations on time-in-customs over time. Under this assumption, we are primarily identifying the effects of deviations from these expected delays. Such deviations can be costly in terms of trade. More specifically, uncertainty in time to complete customs procedures makes it

[23] We use the median delay because it is more representative of the central tendency of the data. The media, instead, can strongly affected by extreme delays (see, e.g., Greene, 1997).

harder to meet delivery deadlines and can thereby negatively affect exports (see, e.g., Freund and Rocha, 2011).

Estimation of Equation (2) can be potentially affected by severe serial correlation problems because it relies on non-trivial time series. In our baseline estimation, we therefore allow for an unrestricted covariance structure over time within firm-product-destinations, which may differ across them (see Bertrand et al., 2004).

The baseline equation assumes that the effect of customs delays on exports is symmetric across firms, products, and destinations. There are, however, reasons to believe that these effects may differ among groups of companies and goods, in which case such a restriction would not hold. Thus, for instance, impacts can be larger for time-sensitive products (see, e.g., Djankov et al., 2010) or in destinations with tougher competition (see, e.g., Mayer et al., 2011; and Carballo et al., 2013). Hence, we also generalize this equation to explore the existence of heterogeneous effects across those groups as follows:

$$\Delta lnX_{fpct} = \sum_{i=1}^{I} \alpha_i \Theta_i \Delta \ln D_{fpct} + \delta'_{ft} + \rho'_{\tilde{p}c} + \varepsilon'_{fpc} \quad (3)$$

where i indexes the groups of firms, products, or countries, and their combinations; and Θ is the corresponding group indicator.[24]

5 Estimation Results

In this section we implement the empirical approach outlined in Section 4 to estimate the impact of delays associated with customs procedures on firms' exports at the product-destination level. We first present the baseline results and then assess their robustness to changes in the specification of the estimating equation such as using an alternative functional form or the inclusion of alternative sets of fixed effects to account for potential remaining unobserved heterogeneity. Second, we investigate the channels through which observed effects on export values take place. More specifically, we examine whether and how customs clearance times influenced the quantity shipped, the unit values, the shipment extensive and intensive margins, and the buyer extensive and intensive margins. Finally, we explore whether there are heterogeneous effects across groups of exporters (small vs. large), products (time sensitive vs. time-insensitive), destinations (markets with stronger competition vs. markets with weaker competition and countries experiencing banking crises vs. countries not experiencing banking crises), product-destination pairs (high-volatility of demand vs. low volatility of demand), transport modes (air-shipping, ocean shipping, and others), and buyers (main vs. secondary).

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

5.1 Baseline Results

The first column of Table 3 presents estimates of Equation (2). These estimates suggest that customs-driven delays have a significant negative effect on exports. In this case, the estimated coefficient informs us the respective elasticity. This estimated elasticity suggests that the export growth rates decline by 18.4% in response to a 10% increase in customs delays. In the second column of Table 3 we report the estimates of a variant of Equation (2) where the main explanatory variable is the absolute change in the time it takes for customs to release the goods instead of its logarithmic change. In particular, the estimated coefficient on the variable of interest indicates that an increase of one day in the time spent has translated in a reduction of 2.8% in the export growth rate.[25] In assessing the significance of these effects, we use standard errors clustered by firm-product-destination. Admittedly, exports may be potentially correlated across other dimensions, e.g., across products or destinations for given firms or across firms in given products, or destinations. Hence, we have also re-estimated Equation (2) using alternative clustered errors to account for these potential correlations. More specifically, we also consider standard errors clustered at the firm, product, destination, product-destination, firm-destination, and firm-product levels. The results are robust to these alternative clusterings.

A simple back-of-the- envelope calculation reveals that, if all exports that were subject to the read channel and spent more than two days in customs would have been released within two days as suggested by the Doing Business, total exports in 2011 would have been 1.4% larger than they actually were. Further, if these shipments would have been authorized to leave customs within one day as those processed under the green channel were, exports would have been approximately 2% larger. This latter export response is far from negligible as, for instance, corresponds to more than 2.2 times the annual budget allocated to Uruguay's national customs DNA and to almost 50 times the annual budget of Uruguay's national export promotion organization URUGUAY XXI, but is substantially smaller than those estimated from aggregated data (see, e.g., Djankov et al., 2010).[26]

A superficial reading of our results might create the impression that there is a tradeoff between monitoring and exports. More precisely, there is a relevant policy question that needs to be addressed, namely, whether the observed negative impact comes from how frequently shipments are subject to merchandise verification or from the delays that they sometimes cause. In order to answer this question, we exploit the fact that an increase in the share of shipments allocated to the red channel does not mechanically imply longer delays. We accordingly estimate a modified version of Equation (2) where the main explanatory variable is the change in the share of shipments going through the red channel. The

[25] Effects are slightly larger when Equation (2) is estimated using only data for the years in which our randomness tests are estimated more precisely, i.e., 2004-2008 (see Figure 2). These estimation results are available from the authors upon request.
[26] According to the estimates reported in Djankov et al. (2010), a 10% increase in country's delay is associated with a 4% reduction in its exports under the assumption that only own delays matter.

third column of Table 3 presents the estimation results. These results reveal that inspections *per se* do not make a significant difference for export outcomes. The is not surprising as these inspections do not need to add transit time relative to that of shipments processed through the green channel. In fact, 30.5% of the red channel-transactions are cleared within one day, i.e., exactly like their green-channel counterparts (see Figure 3).

5.2 Robustness

While we have included comprehensive sets of fixed effects that allow us to control for unobserved firm and product-destination shocks, there might potentially be space for remaining heterogeneity that contaminates our estimates. Thus, for instance, tariffs or transport costs may have caused heterogeneous demand shifts across countries at narrower product-levels than those accounted for by our HS 6-digit product-destination year fixed effects. Furthermore, firms more affected by delays may have received support from URUGUAY XXI to participate in trade missions and international marketing events leading to foreign sales in specific sectors or destinations, in which case we would be underestimating the effect of interest (see, e.g., Volpe Martincus and Carballo, 2010). Similarly, there might have occurred shocks to input provision that might have differential effects on production across goods or changes in firms' competencies across them. Moreover, in our baseline estimations we do not distinguish across the 16 customs operating in Uruguay. It might be the case that our results are driven by a specific subset of branches. We have therefore also estimated alternative specifications of Equation (2) in which product-destination-year fixed effects are defined at the HS 10 digit-level, we include firm-country-year or firm-product-year fixed effects instead of merely firm fixed-year effects, and we add main customs-year or individual customs-year fixed effects. Estimates of these alternative specifications along with those of variants based on subsets of fixed effects are reported in the first row of the first panel of Table 4. These estimates essentially corroborate our initial findings. [27]

Unfortunately, previous estimation cannot control for potential remaining unobserved confounding factors, i.e., idiosyncratic firm-specific market developments that are correlated with customs delays. In order to minimize the risk of biased estimates due to these unobservables, we exploit our transaction-level information in which we estimate another variant of Equation (2) that incorporates firm-product-destination-year fixed effects, this time on semester-frequency data and on data at the firm-product-

[27] On the other hand, larger set of fixed effects impose larger restrictions on the estimation sample. However, this does not seem to drive our results. Estimates based on specifications that do not include fixed effects or just include firm fixed effects, product fixed effects, destination effects or their alternative pairwise combination at a time also confirm that customs delays have a significant negative impact on export growth although smaller in absolute value. These estimation results are available from the authors upon request.

destination-buyer level. Estimation results, which are shown in the second panel of Table 4, are also in line with the baseline.[28]

If shipments are ordered several months in advance, trade can only respond sluggishly to changes in clearance times. In other words, increased customs delays can potentially have lagged effects on export growth. If this is the case and these effects are not properly accounted for, our estimates would suffer from an omitted variable bias. We therefore control for these impacts by incorporating up to three lags of the change in time-in-customs variable in the estimating equation.[29] The results, which are shown in the third panel of Table 4, do not substantially differ from our baseline, thus providing additional evidence in their favor.[30]

Finally, we carry out a placebo test as an additional robustness check. More specifically, administrative delays in particular periods should not cause any gap in export growth rates registered by flows subject to material verification and their counterparts exempted thereof in previous periods. The plausibility of this identifying assumption can be assessed by artificially allocating the change in the clearance times faced by export flows that went through the red channel (or that in the share of the respective transactions that were red-channeled) to the previous two years or to the previous two years conditional on having been assigned to the green channel in these years and re-estimating Equation (2) on these and the remaining flows processed under the latter channel. In short, we are regressing current export changes in future changes in allocation to red channel or their associated delays. Estimates are shown in the lower panel of Table 4. Reassuringly, none of these estimated coefficients are significantly different from zero.

Hence, there is robust evidence suggesting that customs delays can have a significant negative effect on exports. Importantly, this effect is primarily related to the actual time that verifications take, but not to their occurrence or frequency.

5.3 Channels and Heterogeneous Effects

In this subsection we first explore the channels through which this effect arises. In particular, we estimate the impact of customs delays on the quantity (weight) shipped, the unit values, the number of shipments, the average value and quantity per shipment, the number of buyers, the average value and quantity per buyer, and the average number of shipments per buyer, based on Equation (2). Estimation

[28] We have also estimated this variant of Equation (2) on firm-product-destination-custom level data as well as on four-month frequency data. Both confirm our main findings. In this regard, it is worth noticing that, as expected, point estimates are smaller when these higher frequency data are used. These estimation results are available from the authors upon request.

[29] Including these lagged delays requires that the firm-product-destination be present in the data continuously over the respective period to enter the estimation. This causes the estimation sample to reduce.

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

results are presented in Table 5. These results reveal that these administrative delays have mainly affected the number of shipments and thereby the quantity shipped as well as the number of buyers and the number of transactions per buyer, and therewith the average value and quantity of exports per buyer. Thus, a 10% increase in the number of days spent in customs reduces the rate of growth of the number of shipments by 1.3% and those of the number of buyers and exports per buyer by 0.6% and 1.3%, respectively. Nevertheless, they have neither influenced the unit values nor the size of the shipments in terms of value or quantity.

Second, we investigate whether there are heterogeneous effects across groups of exporters, products, destinations, and buyers. This is done by estimating alternative specifications of Equation (3), in which we allow for different impacts across these groups. More specifically, we first distinguish between small exporters (i.e., firm with initial exports up to the sample median) and large exporters (i.e., firms whose initial exports were larger than the sample median). Estimates are shown in Table 6. These estimates indicate that exports from larger firms appear to suffer more from the increased transit times associated with customs delays. On average, spending 10% more time in customs is associated with a reduction in these firms' export growth of 1.9%. The sources of this negative impact are those identified above on the entire sample. A possible reason for this finding is that large firms are present in many markets, in some of which only a few of their peers are also active –the so-called "less popular" destinations-. These firms tend therefore to be more regularly affected by changes in trade costs (and demand) across a range of markets and can accordingly be expected to have more dynamic trade patterns (see, e.g., Lawless, 2009).[31] We will explicitly come back to the destination dimension below.

Time matters for trade particularly when goods are subject to rapid depreciation. This loss of value may be driven by spoilage (e.g., fresh produce), fashion cycles (e.g., shoes and garment), and technological obsolescence (e.g., consumer electronics) (see Hummels, 2007).[32] It can therefore be expected that delays have stronger effects on these goods. In order to ascertain whether this is the case, we discriminate across goods according to their time-sensitiveness using the estimation results from Hummels (2001), who analyzes how ocean shipping times and air freight rates affect the probability that air transport is chosen.[33] Products classified as time sensitive based on these results include several in those categories referred to above such as meat and meat preparations; travel goods and handbags; telecommunications and sound recording apparatuses; and professional, scientific, and controlling

[31] Interestingly, more developed countries (i.e., OECD countries) and time-sensitive products account for 21% and 27.9% of the exports by large exporters and for 23.6% and 31.5% of those of smaller peers, respectively. Similar cross-groups patterns are also observed in terms of the number of export flows.

[32] According to Egan and Mody (1992), bicycles for sale during the US summer season must be in the warehouses of wholesalers by April. If delivery is delayed by even a month, then the season peak may be missed and product prices may have to be substantially marked down. In the case of fashion goods, a difference of a few days in the delivery may be critical.

[33] We use the estimated effect of shipping times on the probability of selecting air transport. In particular, goods are identified as time-sensitive if the estimated coefficient on shipping time (i.e., days/rate ratio) of the respective 2 digit SITC is positive and significant.

instruments. The respective estimates of Equation (3) are reported in Table 7. These estimates confirm that the negative effects of increased transit times are generally stronger on sales of time-sensitive goods. This is particularly the case with food and textile (clothing) products (see right panel of Table 7).

Heterogeneous effects can also arise across destinations. Thus, longer customs delays are likely to hurt more exports to markets subject to more intense competition. In the left panel of Table 8, we examine whether this holds in our data by distinguishing, first, between OECD countries, and, second, between destinations whose supply access as computed following Redding and Venables (2004) and Mayer et al. (2011) is high (at or above the median) and low (below the median).[34] Evidence presented in this table consistently suggests that, as anticipated, the negative response of foreign sales to increased customs processing times is larger in markets with tougher competition.[35]

Not only toughness of competition, but also financial conditions in the destination countries interact with the customs delays in shaping export behavior. Berman et al. (2012) show that, during financial crisis, the transit time between origin and destination amplifies the negative impact of a higher probability of default on trade. In other words, time to ship increases the elasticity of exports to the expected cost of default. The rationale is that exporters react by increasing their price and decreasing their export quantities and values more for importers at larger shipping times because, during banking crisis, the probability that these importers default on their payment obligations rises as time passes and hence with shipping time, and also because the opportunity costs of funds increases with transit lags and the interest rate, which can jump upward suddenly during those episodes. Similarly, Levchenko et al. (2011) argue that, if trade finance needs are positively related to the time it takes for shipments to reach their destination, trade finance costs can be expected to increase with delivery delays and accordingly, in those cases, trade in sectors with longer lags to fall the most. Here, we examine the role played by financial factors by differentiating between destinations that suffer from a banking crisis in the year in question and those destinations that do not. In making this distinction, we follow Berman et al. (2012) in using the Reinhart and Rogoff (2011)'s dataset on financial crises over the period 1800-2010. In addition, we utilize

[34] Supply access is defined as the aggregate predicted exports to a destination based on a bilateral trade gravity equation (in logs) with both exporter and importer fixed effects and the standard bilateral measures of trade barriers/enhancers. These measures have been computed for 2000 using country-level trade data from COMTRADE and data on trade barriers/enhancers from CEPII and the WTO.

[35] Building on these previous results, we have also explored whether the impacts of longer time-in-customs vary across products categories in the different destinations by combining the time-sensitive/time-insensitive and OECD/non-OECD breakdowns used before. From the estimates of this variant of Equation (3), we can conclude that the negative effects of increased transit times are generally stronger on sales of time-sensitive goods to OECD countries. Specifically, the effect of customs delays is the strongest for exports of time-sensitive goods to OECD countries. In this case, a 10% increase in the number of days spent in customs costs a 2.8% reduction in the export growth rate and this primarily comes from a decline in the growth of the number of shipments, the number of buyers, and average exports per buyer. In this regard, it is worth mentioning that miscellaneous manufactured articles; chemical materials and products; power generating machinery and equipment; electrical machinery, apparatus, and appliances; other transport equipment; and fundamentally meat and meat preparations are among the time-sensitive goods exported by Uruguayan firms to the OECD countries. These products jointly account for 98.2% of these exports. In contrast, there is virtually no impact on exports of time-insensitive goods to non-OECD countries. These results are available from the authors upon request.

the Laeven and Valencia (2012)'s database on systemic banking crises over the period 1970-2011.[36] The binary indicators taken from these databases are then interacted with our measure of change in time-in-customs.[37] Estimation results of this version of Equation (3) are presented in the right panel of Table 8. Consistent with previous findings, these results reveal that longer customs clearance times have a stronger impact on exports to countries experiencing banking crises.

Time also makes a difference when demand is uncertain, i.e., consumers prefer certain good varieties over others and their preferences change quickly overt time (see, e.g., Deardorff, 2001). If the time elapsed between ordering and delivery is long enough, the volume and composition of shipments must be decided well before the resolution of demand uncertainty, in which case forecasting errors will result in lost profitability because of inventory-holding costs or forgone business opportunities derived from over- or undersupplying the market or mismatch between varieties offered and demanded (see Hummels and Schaur, 2012). These costs can be transmitted throughout the value chains and will accordingly be higher when spatial fragmentation of production prevails. Further, in this particular case, delayed delivery of critical inputs can hold up the entire production process and can generate costs that are higher than the market value of the components in question (see Nordas et al., 2006). A series of papers precisely analyze how the interplay between timeliness and demand uncertainty affects trade, location, and modal choice (e.g., Aizenman, 2004; Evans and Harrigan, 2005; Harrigan and Venables, 2006; Hummels and Schaur, 2010; and Harrigan, 2010). The main messages that come out of these papers is that, when timely delivery is important, firms tend to rely more on closer providers the higher is their products' restocking rate; resort more to air shipping the more volatile is the demand for their products and the lighter these products (i.e., the higher their value to weight ratios) are; and co-agglomerate in the presence of vertical linkages.

This literature highlights that exports from firms facing volatile demand are likely to be particularly affected by long transit lags because these delays create an important barrier to ex-post adjustments to shocks (see Hummels and Schaur, 2010). In our case, this implies that the negative effect of customs clearance times on exports would be magnified when demand is volatile. We investigate whether this is observed in our data. In so doing, we first calculate a volatility measure following Hummels and Schaur (2010). In particular, for each product-destination pair, we compute the median of the coefficient of variation of the quantities sold by each firm in the different transactions within a given year, averaged

[36] Reinhart and Rogoff (2011) consider that a country experiences a banking crisis if the following events are observed: "(i) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; and (ii) if there are no bank runs, closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that makes the start of a string of similar outcomes for other financial institutions". Laeven and Valencia (2012) identify as (systemic) banking crises those episodes characterized by two conditions: "(i) significant signs of financial distress in the banking system as indicated by significant bank runs, losses in the banking system, and/or bank liquidations: (ii) significant banking policy intervention measures in response to significant losses in the banking system".

[37] Notice that the direct impact of financial crisis is accounted for by the product-destination-year fixed effects.

over the period 2000-2002.[38] Second, we estimate a variant of Equation (3) whereby the change in the median number of days spent in customs is interacted by a binary indicator that takes the value of one if the volatility of the demand in a particular product-destination combination computed as indicated above is at or above the median and zero otherwise. Estimates of this equation are shown in the left panel of Table 9, both when considering all product-destination combinations existing in 2000-2002 or only those for which firms register more than 10 transactions in the year in question. These estimates confirm that the negative impact of increased administrative-driven delays on export growth is larger for product-destinations with more volatile demand. In fact, their impact is only statistically different from zero when the volatility of demand is relatively high.

As mentioned above, firms tend to rely more on air-shipping the more volatile is the demand (see Hummels and Schaur, 2010). If we breakdown exports by transport mode, we consistently find that the impact of increased time-in-customs is larger on those flows that are air-shipped (see the right panel of Table 9). Notice, further, that if we take transport mode as a proxy for the length of time-to-ship overseas with air-shipping taking less time than ocean-shipping, these results also indicate that the effect of longer delays is greater the shorter is the international shipping time, i.e., the higher is the importance of the time spent in customs relative to the total transit time.[39]

The impact of time lags can also vary depending on how important or well-established the buyer-seller relationships are. Our database notably includes information on the specific foreign companies Uruguayan exporters sell to and hence allows us to explore the existence of such heterogeneous effects along the buyer dimension.[40] More specifically, we first differentiate between main buyers (i.e., the importing company that accounts for the largest share of exports) and secondary buyers (i.e., remaining importing companies) in a given product-destination market. In this case, results, which are reported in the upper panel of Table 10, suggest that the effect of longer clearance times is significantly larger on exports to relatively less important customers.[41] Second, we also find that the impact of customs delays varies depending on how well-established is the buyer-seller relationship. In particular, their negative impact is greater on exports to new buyers (i.e., importing companies that bought for the first time from the exporting firm in the years in question) than on exports to older buyers (i.e., importing companies that were already buying from the exporting firm before).[42]

[38] We use data for 2000-2001 and 2002 –in which all transactions were processed under the green channel- to avoid contamination, because, as we have seen, customs delays affect the number of transactions.
[39] Caution, however, should be exercised when interpreting these results. The reason is that, while the firm-year and the product-destination fixed effects account for firm-level characteristics, volatility of demand, and other relevant factors over time that can influence the modal choice, this is an endogenous decision.
[40] In so doing, we restrict the sample to those firm-product-destinations exports with two or more buyers.
[41] Results presented in Table 10 are based on estimations in which the main explanatory variable is the change in the median customs delays specific for the groups of buyer being considered. Estimates are similar when using instead the change in exporters' overall median delays for the product-destination in question.
[42] These estimation results are available from the authors upon request.

According to the model developed by Carballo et al. (2013), these results, whereby higher trade costs would lead firms to skew their export sales towards their main business partners, hold primarily in markets where tougher competition prevails. In the same vein, this stronger response of exports to secondary buyers to increased time-in-customs can be more or less pronounced depending on the sensitiveness of the products involved or the degree of the volatility of their demand. Similarly, Berman et al. (2012) argue that, during banking crisis, exporters can discriminate among importers according to their trustworthiness. We accordingly provide evidence thereon in Table 11. The estimation results presented therein consistently indicate that longer customs processing times have a larger negative impact on exports of time-sensitive goods, to destinations with tougher competition (OECD countries) or experiencing a banking crisis, or whose demand is more volatile to secondary buyers than to primary buyers.

So far the analysis has focused on the effect of longer times spent in customs on the export intensive margin (i.e., continuing flows). In addition, these delays may have caused some exports to disappear. Hence, we also examine the effects of changes in customs clearance times on the firm-product-destination and firm extensive margins. Thus, we estimate of variant of Equation (2) where the dependent variable is a binary indicator that takes the value of one if an export flow is present in the year in question and zero otherwise and the main explanatory variable is the change in the median customs processing times between the two previous years. In addition, we estimate another variant of this equation at the product-destination level in which the dependent variable is the change in the number of firms exporting a given product to a given destination and the main explanatory variable is the change in the respective median clearance times, and which includes alternative sets of fixed effects (i.e., destination-year fixed effects and product-year fixed effects) to account for unobserved factors. Estimates of these equations are shown in Table 12. According to these estimates, increased time in transit due to customs procedures has had a significant negative effect on both the firm-product-destination and the firm export extensive margins.

Summing up, our estimation results indicate that delays caused by customs procedures seem to have particularly affected large firms' exports of time-sensitive goods to non-core buyers in more developed countries and appear to have even induced some firms to stop exporting certain products to certain destinations.

6 Concluding Remarks

Time matters for trade, probably more now than ever, and its importance is likely to continue to grow because of increasingly segmented production chains and rising lean retailing, among other reasons. In this context, which is also characterized by relatively low traditional trade barriers such as tariffs, the effectiveness of public entities affecting the transit time between origin and destination becomes critical.

This is particularly the case with the customs, which process all trade flow entering and leaving the countries. While a number of studies have analyzed the impact of time to trade on trade, our understanding of the effects of delays specifically associated with customs procedures has been so far limited because of the absence of precise measures of these delays and the virtual lack of evidence on firm-level responses based on comprehensive samples.

This paper fills these gaps in the previous literature. We investigate how increased transit times caused by customs processing of shipments affect firms' exports outcomes by exploiting a unique database that contains export transaction and actual customs clearance time data and covers the entire universe of export transactions in Uruguay over the period 2002-2011. We find that customs-driven delays have a significant negative effect on firms' foreign sales. In particular, an increase of 10% in the median time spent in customs is associated with an average reduction of 1.8% in the export growth rate. This impact is even more pronounced for sales to non-core buyers, of time-sensitive goods, and to OECD countries. These effects can be traced back to reduced growth of the number of transactions, the number of buyers, and exports per buyer, in terms of both value and quantity. Estimates further suggest that some firms may have been forced to cease to exports to certain markets. Importantly, the frequency of material verification does not seem to influence exports.

These results convey a clear message to customs of developing countries. Monitoring can and should be done as it does not hurt trade, as long as it is carried out in an expedite manner, so that no substantial increase in transit time occurs relative to those shipments exempted from physical control. Caution, however, is required in moving in this direction. Expediting should by no means come at the expense of the quality of the verifications. In other words, the time that controls take should be minimized whenever possible, but always subject to the condition that their goals are actually achieved. We should mention in closing that our findings can serve as a basis for further theoretical developments on time as a trade barrier, which will be the subject of future research.

References

Aizenman, J., 2004. Endogenous pricing to market and financing costs. Journal of Monetary Economics, 51, 4.

Berman, N.; de Souza, J.; Martin, P.; and Mayer, T., 2012. Time to ship during financial crises. Graduate Institute Geneva and Science Po, mimeo.

Bernard, A. and Jensen, B., 2004. Why some firms export? Review of Economics and Statistics, 86, 2.

Bertrand, M.; Duflo, E.; and Mullainathan, S., 2004. How much should we trust difference-in-differences estimates? Quarterly Journal of Economics, 119, 1.

Bourdet, Y. and Persson, M., 2010. Completing the EU customs union. The effects of trade procedure harmonization. IFN Working Paper 848, Research Institute for Industrial Economics,

Carballo, J.; Ottaviano, G.; and Volpe Martincus, C., 2013. The buyer margins of firms' exports. LSE and IDB, mimeo.

Deardorff, A., 2001. Time and trade: The role of time in determining the structure and effects of international trade, with an application to Japan. Paper prepared for the conference "Analytical Issues in the Trade, Foreign Direct Investment, and Macro/Financial Relations of the United States and Japan".

Delgado, M.; Fariñas, J.; and Ruano, S., 2002. Firm productivity and export markets: A nonparametric approach. Journal of International Economics, 57.

Doing Business, 2012. Doing business in a more transparent world. World Bank.

Dollar, D; Hallward-Driemeier, M.; and Mengistae, T., 2006. Investment climate and international integration. World Development, 34, 9.

Djankov, S.: Freund, C.; and Pham, C., 2010. Trading on time. Review of Economics and Statistics, 92, 1.

Egan, M. and Mody, A., 1992. Buyer-seller links in export development. World Development, 20, 3.

Engman, M., 2005. The economic impact of trade facilitation. OECD Trade Policy Working Paper 21.

Evans, C. and Harrigan, J., 2005. Distance, time, and specialization: Lean retailing in general equilibrium. American Economic Review, 95, 1.

Feyrer, J., 2011. Distance, trade, and income – The 1967 closing of the Suez Canal as a natural experiment. Dartmouth College, mimeo.

Freund, N. and Rocha, N., 2011. What constrain Africa's exports? World Bank Economic Review, 26, 1.

Greene, W., 1997. Econometric analysis. Prentice Hall.

Harrigan, J., 2010. Airplanes and comparative advantage. Journal of International Economics, 82, 2.

Harrigan, J. and Venables, T., 2006. Timeliness and agglomeration. Journal of Urban Economics, 59, 2.

Hornok, C., 2011. Need for speed: Is faster trade in the EU trade creating? CEPR Discussion Paper 8451.

Hornok, C. and Koren, M., 2011. Administrative barriers and the lumpiness of trade. Central European University, mimeo.

Hummels, D., 2001. Time as a trade barrier. Purdue University, mimeo.

Hummels, D. 2007. Calculating tariff equivalents for time in trade. USAID.

Hummels, D. and Schaur, G., 2010. Hedging price volatility using fast transport. Journal of International Economics, 82, 1.

Hummels, D. and Schaur, G., 2012. Time as a trade barrier. NBER Working Paper 17758.

IEG (Independent Evaluation Group), 2008. Doing Business: An independent evaluation. World Bank, Washington DC.

Laeven, L. and Valencia, F., 2012. Systemic banking crises database: An update. IMF Working Paper 12/163.

Lawless, M., 2009. Firm export dynamics and the geography of trade. Journal of International Economics, 77, 2.

Levchenko, A.; Lewis, L.; and Tesar, L., 2011. The role of trade finance in the US trade collapse: A skeptic's view, in Chauffour and Malouche (eds.), "Trade finance during the great trade collapse".

Li, Y. and Wilson, J., 2009a. Time as a determinant of comparative advantage. World Bank Policy Research Working Paper 5128.

Li, Y. and Wilson, J., 2009b. Trade facilitation and expanding the benefits of trade: Evidence from firm level data. Asia-Pacific Research and Training Network on Trade Working Paper 71.
Martínez-Zarzoso, I. and Márquez-Ramos, L., 2008. The effect of trade facilitation on sectoral trade. The B.E. Journal of Economic Analysis & Policy, 8, 1.
Mayer, T.; Melitz, M.; and Ottaviano, G., 2011. Market size, competition, and the product mix of exporters. NBER Working Paper 16959.
Milner, C.; Morrissey, O.; and Zgovu, E., 2008. Trade facilitation in developing countries. CREDIT Working Paper 08/05, University of Nottingham.
Nathan Associates, 2007. The "Doing Business" methodology for rating Mozambique on time to trade. USAID/Mozambique Trade and Investment Project.
Nordas, H., 2006. Time as a trade barrier: Implications for low-income countries. OECD Economic Studies 42.
Nordas, H.; Pinali, E.; and Geloso Grosso, M., 2006. Logistics and time as a trade barrier. OECD Trade Policy Working Papers 35.
Paravisini, D.; Rappoport, V.; Wolfenzon, D.; and Schnabl, P., 2011. Dissecting the effect of credit supply on trade: Evidence from matched credit-export data. Columbia University, mimeo.
Persson, M., 2010. Trade facilitation and the extensive margin. IFN Working Paper 828, Research Institute in Industrial Economics.
Portugal-Perez, A. and Wilson, J., 2010. Export performance and trade facilitation reform: Hard and soft infrastructure. World Bank Policy Research Working Paper 5261.
Redding, S. and Venables, A., 2004. Economic geography and international inequality. Journal of International Economics, 62.
Reinhart, C. and Rogoff, K., 2011. From financial crash to debt crisis. American Economic Review, 101, 5.
Roberts, M. and Tybout, J., 1997. The decision to export in Colombia: An empirical model of entry with sunk costs. American Economic Review, 87, 4.
URUGUAY XXI, 2012. Export requirements and taxes. Montevideo, Uruguay.
Volpe Martincus, C. and Carballo, J., 2010. Entering new country and product markets: Does export promotion help? Review of World Economics, 146, 3.
Rauch, J. and Watson, J., 2003. Starting small in an unfamiliar environment. International Journal of Industrial Organization.
Wilson, J.; Mann, C.; and Otsuki, T., 2005. Assessing the benefits of trade facilitation: A global perspective. World Economy, 28, 6.
Wooldridge, J., 2002. Econometric analysis of cross section and panel data. The MIT Press, Cambridge, Massachusetts.

Table 1

Aggregate Export Indicators		
Indicators	**2002**	**2011**
Export Value	1,855.0	8,011.5
Number of Transactions	64,747	113,533
Number of Exporters	1,498	1,904
Number of Products	2,464	2,969
Number of Destinations	146	186
Number of Buyers	4,902	6,410
Number of Customs	15	16
Transactions through Red Channel	0.0	0.1
Median Delay in Red Channel	N/A	5.0

Source: Authors' calculations based on data from DNA.
Export values are expressed in millions of US dollars.

Table 2

Average Exporter		
Indicators	**2002**	**2011**
Export Value	1238.3	4207.7
Number of Transactions	43.2	59.6
Exports per Transaction	28.7	70.6
Number of Products	4.3	4.4
Exports per Product	238.5	981.7
Number of Destination	2.9	3.3
Exports per Destination	207.6	837.3
Number of Buyers	6.4	7.0
Exports per Buyer	234.9	781.7
Number of Customs	1.8	1.8
Exports per Customs	385.1	1398.3
Exports per Product and Destination	254.2	776.4
Number of Shipments per Product and Destination	5.7	7.1
Number of Buyers per Product and Destination	2.3	2.4
Number of Customs per Product and Destination	1.1	1.1

Source: Authors' calculations based on data from DNA.
Export values are expressed in thousands of US dollars.

Table 3

The Impact of Customs Delay on Firms' Export Growth Baseline Specification			
	ΔlnD	**ΔD**	**ΔRC**
Customs Delay	-0.184	-0.028	-0.041
Heteroscedasticity-Consistent	(0.028)***	(0.006)***	(0.045)
Cluster Firm-Product-Destination	(0.030)***	(0.006)***	(0.049)
Cluster Firm	(0.037)***	(0.008)***	(0.053)
Cluster Product	(0.041)***	(0.008)***	(0.052)
Cluster Destination	(0.059)***	(0.013)**	(0.044)
Cluster Product-Destination	(0.033)***	(0.007)***	(0.051)
Cluster Chapter HS2-Destination	(0.044)***	(0.010)***	(0.058)
Cluster Firm-Product	(0.031)***	(0.006)***	(0.050)
Cluster Firm-Chapter HS2	(0.037)***	(0.008)***	(0.055)
Cluster Firm-Destination	(0.034)***	(0.007)***	(0.053)
Firm-Year Fixed Effect	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes
Observations	63,471	63,471	63,471

Source: Authors' calculations based on data from DNA.

The table reports estimates of Equation (2). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination level. The main explanatory variables are the logarithmic change in the median number of days spent in customs ($\Delta \ln D$), the absolute change in the median number of days spent in customs (ΔD), and the change in the share of transactions allocated to the red channel (ΔRC). Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Robust standard errors reported in parentheses below the estimated coefficient. Standard errors clustered at alternative levels are shown next. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level. The significance indicator is along with the respective standard errors.

Table 4

The Impact of Customs Delay on Firms' Export Growth
Alternative Specifications

Year to Year Changes								
ΔlnD	-0.158***	-0.144***	-0.184***	-0.197***	-0.191***	-0.193***	-0.185***	-0.180***
	(0.017)	(0.026)	(0.030)	(0.042)	(0.035)	(0.044)	(0.030)	(0.030)
Firm-Year Fixed Effect	Yes	No	Yes	Yes	No	No	Yes	Yes
Product-Destination-Year Fixed Effect	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Product HS10-Destination-Year Fixed Effect	No	No	No	Yes	No	No	No	No
Firm-Product-Year Fixed Effect	No	No	No	No	Yes	No	No	No
Firm-Country-Year Fixed Effect	No	No	No	No	No	Yes	No	No
Main Customs-Year Fixed Effect	No	No	No	No	No	No	Yes	No
Customs-Year Fixed Effect	No	No	No	No	No	No	No	Yes
Observations	63,471	63,471	63,471	63,471	63,471	63,471	63,471	63,471
	Semester-to-Semester Changes					**Buyer Changes**		
ΔlnD	-0.056***	-0.053***	-0.059***	-0.057***	-0.119***	-0.152***	-0.114***	-0.163**
	(0.017)	(0.017)	(0.014)	(0.014)	(0.025)	(0.043)	(0.034)	(0.079)
Firm-Product-Destination-Year Fixed Effect	Yes	Yes	No	No	Yes	Yes	No	No
Firm-HS10 Product-Destination-Year Fixed Effect	No	No	Yes	Yes	No	No	Yes	Yes
Semester/Four Month Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
Observations	87,482	87,482	87,482	87,482	79,365	79,365	79,365	79,365
Lagged Effects								
ΔlnD			-0.184***	-0.252***	-0.246***	-0.313***		
			(0.030)	(0.046)	(0.059)	(0.072)		
ΔlnD (-1)				-0.006	0.032	-0.021		
				(0.040)	(0.056)	(0.074)		
ΔlnD (-2)					-0.012	-0.050		
					(0.047)	(0.066)		
ΔlnD (-3)						-0.053		
						(0.056)		
Firm-Year Fixed Effect			Yes	Yes	Yes	Yes		
Product-Destination-Year Fixed Effect			Yes	Yes	Yes	Yes		
Observations			63,471	39,301	26,183	17,801		
Placebo Tests								
			No Conditioning on Green Channel		**Conditioning on Green Channel**			
ΔlnD			-0.077		-0.153			
			(0.050)		(0.124)			
Firm-Year Fixed Effect			Yes		Yes			
Product-Destination-Year Fixed Effect			Yes		Yes			
Observations			26,183		7,911			

Source: Authors' calculations based on data from DNA.

The first panel of the table report estimates of Equation (2). The dependent variable is the change in the natural logarithm of export value at the firm-product-destination level. The main explanatory variable is the logarithmic change in the median number of days spent in customs ($\Delta \ln D$) In the first panel, changes are computed across years. Firm-year fixed effects are included in the first column; product-destination-year fixed effects are included in the second column; firm-year fixed effects and product-destination-year fixed effects are included in the third column; firm-year fixed effects and HS 10-digit product-destination-year fixed effects are included in the fourth column; firm-product-year fixed effects and product-destination-year fixed effects are included in the fifth column; firm-country-year fixed effects and product-destination-year fixed effects are included in the sixth column; firm-year fixed effects, product-destination-year fixed effects, and main customs-year fixed effects are included in the seventh column; firm-year fixed effects, product-destination-year fixed effects, and customs-year fixed effects are included in the eighth column (not reported). The second panel shows estimates of Equation (2) based on data at the firm-product-destination-semester level (left) and at the firm-product-destination-buyer level (right). Firm-product-destination-year fixed effects are included in the first column; firm-product-destination-year fixed effects and semester fixed effects are included in the second columns; firm-HS10 product-destination-year fixed effects are included in the third column; firm-HS10 product-destination-year fixed effects and semester fixed effects are included in the fourth column; firm-product-destination-year fixed effects are included in the fifth column; firm-product-destination-year fixed effects and four-month period fixed effects are included in the sixth columns; firm-HS10 product-destination-year fixed effects are included in the seventh column; and firm-HS10 product-destination-year fixed effects and four-month period fixed effects are included in the eight column (not reported).The third panel of the table reports estimates of a modified version of Equation (2) that incorporates up to three lags of the main explanatory variable. Firm-year and production-destination-year fixed effects are included (not reported).The fourth panel of the table presents the results of placebo exercises, whereby the logarithmic change of export between any two years (in general or conditional on having been assigned to the green channel) is regressed on the change in the frequency of allocation to the red channel or that of the associated delay that these exports experience in the following two years. Firm-year and production-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 5

The Impact of Customs Delay on Firms' Export Growth Channels	
Export Outcomes	**ΔlnD**
Export Value	-0.184***
	(0.030)
Export Quantity	-0.178***
	(0.030)
Unit Value	-0.006
	(0.007)
Number of Shipments	-0.160***
	(0.022)
Export Value per Shipment	-0.024
	(0.020)
Export Quantity per Shipment	-0.019
	(0.020)
Number of Buyers	-0.059***
	(0.014)
Number of Shipments per Buyer	-0.100***
	(0.018)
Export Value per Buyer	-0.125***
	(0.026)
Export Quantity per Buyer	-0.119***
	(0.027)
Firm-Year Fixed Effect	Yes
Product-Destination-Year Fixed Effect	Yes
Observations	63,471

Source: Authors' calculations based on data from DNA.

The table reports estimates of Equation (2). The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination level. The main explanatory variable is the logarithmic change in the median number of days spent in customs (ΔlnD). Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 6

The Impact of Customs Delay on Firms' Export Growth Heterogeneous Effects by Exporter Size		
Export Outcomes	**Small Exporters**	**Large Exporters**
Export Value	-0.081	-0.190***
	(0.107)	(0.031)
Export Quantity	-0.083	-0.184***
	(0.124)	(0.031)
Unit Value	0.002	-0.006
	(0.052)	(0.007)
Number of Shipments	-0.107*	-0.163***
	(0.064)	(0.023)
Export Value per Shipment	0.026	-0.027
	(0.072)	(0.021)
Export Quantity per Shipment	0.024	-0.021
	(0.083)	(0.021)
Number of Buyers	-0.015	-0.062***
	(0.027)	(0.015)
Number of Transactions per Buyer	-0.093	-0.101***
	(0.058)	(0.018)
Export Value per Buyer	-0.067	-0.128***
	(0.102)	(0.027)
Export Quantity per Buyer	-0.068	-0.122***
	(0.120)	(0.027)
Firm-Year Fixed Effect	Yes	
Product-Destination-Year Fixed Effect	Yes	
Observations	63,471	

Source: Authors' calculations based on data from DNA.

The table reports estimates of a specification of Equation (3) that allow for different effects on exports from small exporters (i.e., firm with initial exports up to the sample median) and large exporters (i.e., firms whose initial exports were larger than the sample median). The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination level. The main explanatory variable is the logarithmic change in the median number of days spent in customs (ΔlnD). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 7

The Impact of Customs Delay on Firms' Export Growth
Heterogeneous Effects by Product Categories

Export Outcomes	Product Categories		Sectoral Effects						
	Time Sensitive	**Time Insensitive**	**Food**	**Textiles**	**Others**	*Other Industrial Supplies*	*Capital Goods*	*Transport Equipment*	*Other Consumer Goods*
Export Value	-0.233***	-0.148***	-0.191***	-0.239***	-0.114*	-0.086	-1.291	0.153	-0.082
	(0.046)	(0.040)	(0.032)	(0.085)	(0.069)	(0.094)	(0.886)	(1.203)	(0.124)
Export Quantity	-0.226***	-0.141***	-0.181***	-0.220**	-0.125*	-0.093	-1.258	0.072	-0.084
	(0.045)	(0.040)	(0.032)	(0.087)	(0.074)	(0.102)	(0.845)	(0.900)	(0.136)
Unit Value	-0.007	-0.007	-0.010	-0.019	0.011	0.007	-0.033	0.081	0.002
	(0.011)	(0.009)	(0.007)	(0.017)	(0.025)	(0.035)	(0.242)	(0.512)	(0.049)
Number of Shipments	-0.176***	-0.146***	-0.161***	-0.180***	-0.139***	-0.095	-0.639	-0.551***	-0.238***
	(0.035)	(0.027)	(0.024)	(0.054)	(0.051)	(0.073)	(0.419)	(0.203)	(0.076)
Export Value per Shipment	-0.056*	-0.002	-0.030	-0.059	0.025	0.008	-0.652	0.704	0.156*
	(0.032)	(0.026)	(0.022)	(0.053)	(0.048)	(0.057)	(0.602)	(1.085)	(0.083)
Export Quantity per Shipment	-0.050	0.005	-0.021	-0.040	0.014	0.002	-0.619	0.623	0.154
	(0.032)	(0.026)	(0.022)	(0.054)	(0.053)	(0.066)	(0.543)	(0.820)	(0.094)
Number of Buyers	-0.065***	-0.054***	-0.058***	-0.089**	-0.040	-0.034	0.098	-0.392*	-0.051*
	(0.022)	(0.018)	(0.015)	(0.040)	(0.029)	(0.045)	(0.254)	(0.201)	(0.028)
Number of Transactions per Buyer	-0.111***	-0.092***	-0.102***	-0.091**	-0.099*	-0.061	-0.738*	-0.159	-0.187***
	(0.028)	(0.023)	(0.019)	(0.045)	(0.051)	(0.070)	(0.406)	(0.184)	(0.072)
Export Value per Buyer	-0.167***	-0.094***	-0.133***	-0.150**	-0.074	-0.052	-1.390*	0.545	-0.031
	(0.041)	(0.034)	(0.027)	(0.072)	(0.068)	(0.091)	(0.809)	(1.233)	(0.119)
Export Quantity per Buyer	-0.161***	-0.087**	-0.123***	-0.131*	-0.085	-0.059	-1.356*	0.464	-0.032
	(0.041)	(0.035)	(0.027)	(0.074)	(0.073)	(0.098)	(0.750)	(0.965)	(0.131)
Firm-Year Fixed Effect	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	63,096		22,669	14,328	26,473	13,669	3,505	737	8,266

Source: Authors' calculations based on data from DNA.

The left panel of table reports estimates of a specification of Equation (3) that allow for different effects on exports of time-sensitive goods and time-insensitive goods. Goods are classified using estimation results reported in Hummels (2001). We use the estimated effect of shipping times on the probability of selecting air transport. In particular, goods are identified as time-sensitive if the estimated coefficient on shipping time (i.e., days/rate ratio) of the respective 2 digit SITC is positive and significant. The right panel of the table presents estimates of Equation (2) for different product categories (subsamples): food products, textile products, and other products, which are then disaggregated in other industrial supplies, capital goods, transport equipment, and other consumer goods. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination level. The main explanatory variable is the logarithmic change in the median number of days spent in customs ($\Delta \ln D$). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 8

The Impact of Customs Delay on Firms' Export Growth
Heterogeneous Effects by Destinations

Export Outcomes	Toughness of Competition				Banking Crises			
	OECD	N-OECD	High Supply Access	Low Supply Access	Banking Crisis (LV)	N-Banking Crisis (LV)	Banking Crisis (RR)	N-Banking Crisis (RR)
Export Value	-0.276***	-0.117***	-0.259***	-0.022	-0.327***	-0.162***	-0.332***	-0.169***
	(0.049)	(0.037)	(0.038)	(0.050)	(0.076)	(0.038)	(0.082)	(0.038)
Export Quantity	-0.263***	-0.117***	-0.250***	-0.021	-0.316***	-0.159***	-0.327***	-0.164***
	(0.049)	(0.037)	(0.038)	(0.051)	(0.078)	(0.038)	(0.084)	(0.038)
Unit Value	-0.013	-0.000	-0.009	-0.001	-0.011	-0.003	-0.004	-0.005
	(0.012)	(0.009)	(0.009)	(0.012)	(0.017)	(0.009)	(0.020)	(0.009)
Number of Shipments	-0.201***	-0.130***	-0.185***	-0.099***	-0.197***	-0.165***	-0.194***	-0.168***
	(0.034)	(0.028)	(0.027)	(0.037)	(0.052)	(0.028)	(0.056)	(0.027)
Export Value per Shipment	-0.075**	0.012	-0.074***	0.077**	-0.130**	0.003	-0.138**	-0.002
	(0.034)	(0.024)	(0.026)	(0.032)	(0.053)	(0.025)	(0.058)	(0.025)
Export Quantity per Shipment	-0.062*	0.013	-0.065**	0.078**	-0.119**	0.006	-0.134**	0.004
	(0.034)	(0.025)	(0.026)	(0.033)	(0.055)	(0.025)	(0.059)	(0.025)
Number of Buyers	-0.067***	-0.054***	-0.077***	-0.025	-0.054	-0.071***	-0.049	-0.072***
	(0.022)	(0.018)	(0.017)	(0.025)	(0.035)	(0.018)	(0.037)	(0.018)
Number of Transactions per Buyer	-0.135***	-0.076***	-0.173***	0.003	-0.142***	-0.094***	-0.145***	-0.096***
	(0.028)	(0.022)	(0.034)	(0.044)	(0.041)	(0.023)	(0.045)	(0.022)
Export Value per Buyer	-0.210***	-0.063**	-0.108***	-0.074**	-0.273***	-0.091***	-0.283***	-0.098***
	(0.044)	(0.031)	(0.022)	(0.031)	(0.067)	(0.032)	(0.075)	(0.032)
Export Quantity per Buyer	-0.196***	-0.063**	-0.182***	0.003	-0.262***	-0.088***	-0.279***	-0.093***
	(0.044)	(0.032)	(0.033)	(0.043)	(0.069)	(0.033)	(0.078)	(0.032)
Firm-Year Fixed Effect	Yes		Yes		Yes		Yes	
Product-Destination-Year Fixed Effect	Yes		Yes		Yes		Yes	
Observations	63,471		62,163		51,529		51,635	

Source: Authors' calculations based on data from DNA.

The left panel of table reports estimates of a specification of Equation (3) that allow for different effects on exports to OECD countries (excluding Chile and Mexico, which are regional partners for Uruguay) and non-OECD countries and for countries with high (at or above the median) and low (below the median) supply access. Supply access is defined as the aggregate predicted exports to a destination based on a bilateral trade gravity equation (in logs) with both exporter and importer fixed effects and the standard bilateral measures of trade barriers/enhancers (see Redding and Venables, 2004; and Mayer et al., 2011). These measures have been computed for 2000 using country-level trade data from COMTRADE and data on trade barriers/enhancers from CEPII and the WTO. The right panel of table reports estimates of a specification of Equation (3) that allow for different effects on exports to countries that are experiencing a banking crisis and countries that are not experiencing a banking crisis. Banking crisis episodes are identified using the datasets constructed by Reinhart and Rogoff (2011) –RR- and Laeven and Valencia (2012) –LV-. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination level. The main explanatory variable is the logarithmic change in the median number of days spent in customs (ΔlnD). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 9

The Impact of Customs Delay on Firms' Export Growth
Heterogeneous Effects by Levels of Demand Volatility and Transport Modes

Export Outcomes	Demand Volatility				Transport Modes		
	All Observations		More than 10 Transactions				
	High Volatility	Low Volatility	High Volatility	Low Volatility	Sea	Air	Others
Export Value	-0.243***	-0.163***	-0.237***	-0.162***	-0.211***	-0.642***	-0.016
	(0.055)	(0.044)	(0.061)	(0.060)	(0.031)	-0.236	(0.074)
Export Quantity	-0.224***	-0.162***	-0.221***	-0.161***	-0.212***	-0.623***	-0.016
	(0.056)	(0.043)	(0.061)	(0.058)	(0.031)	(0.210)	(0.078)
Unit Value	-0.019	-0.001	-0.016	-0.002	0.001	-0.018	0.000
	(0.014)	(0.009)	(0.013)	(0.012)	(0.007)	(0.063)	(0.014)
Number of Shipments	-0.174***	-0.154***	-0.199***	-0.147***	-0.161***	-0.246***	-0.135***
	(0.041)	(0.032)	(0.050)	(0.044)	(0.022)	(0.085)	(0.048)
Export Value per Shipment	-0.069*	-0.009	-0.038	-0.015	-0.050**	-0.396*	0.119**
	(0.037)	(0.028)	(0.045)	(0.036)	(0.021)	(0.204)	(0.051)
Export Quantity per Shipment	-0.050	-0.008	-0.022	-0.014	-0.050**	-0.378**	0.119**
	(0.039)	(0.027)	(0.047)	(0.034)	(0.021)	(0.180)	(0.055)
Number of Buyers	-0.086***	-0.049**	-0.055*	-0.063**	-0.056***	-0.096*	-0.053*
	(0.024)	(0.022)	(0.030)	(0.028)	(0.014)	(0.055)	(0.030)
Number of Transactions per Buyer	-0.088***	-0.105***	-0.144***	-0.084***	-0.105***	-0.150*	-0.082**
	(0.033)	(0.025)	(0.044)	(0.032)	(0.017)	(0.080)	(0.039)
Export Value per Buyer	-0.157***	-0.114***	-0.182***	-0.099**	-0.155***	-0.546**	0.037
	(0.048)	(0.037)	(0.059)	(0.047)	(0.027)	(0.219)	(0.065)
Export Quantity per Buyer	-0.138***	-0.113***	-0.166***	-0.097**	-0.156***	-0.528***	0.037
	(0.050)	(0.036)	(0.059)	(0.046)	(0.027)	(0.192)	(0.069)
Firm-Year Fixed Effect	Yes		Yes		Yes		
Product-Destination-Year Fixed Effect	Yes		Yes		Yes		
Observations	39,743		21,761		66,099		

The left panel of table reports estimates of a specification of Equation (3) that allow for different effects on exports facing high volatility of demand (at or above the median) and low volatility of demand (below the median). Volatility is measured as the median of the coefficient of variation of the quantities sold by each firm in the different transactions in each product-destination pair within a given year, averaged over the period 2000-2002. In the first two columns all product-destination combinations existing in 2000-2002 are considered, whereas in the third and fourth columns only those for which firms register more than 10 transactions in the year in question are taken into account. The right panel of the table presents estimates of a specification of Equation (3) that allow for different effects on exports depending on the transport mode (air-shipping, ocean-shipping, and others). This equation has been estimated on data at the firm-product-destination-transport mode level. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, average export quantity per shipment, number of buyers, number of shipments per buyer, average export value per buyer, and average export quantity per buyer at the firm-product-destination level (left panel) and at the firm-product-destination-transport mode level (right panel). The main explanatory variable is the logarithmic change in the median number of days spent in customs ($\Delta \ln D$). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 10

The Impact of Customs Delay on Firms' Export Growth Heterogeneous Effects by Buyers		
Export Outcomes	**Main Buyer**	**Secondary Buyer**
Export Value	-0.073***	-0.114***
	(0.021)	(0.03)
Export Quantity	-0.084***	-0.108***
	(0.022)	(0.031)
Unit Value	0.012	-0.006
	(0.007)	(0.007)
Number of Shipments	-0.090***	-0.116***
	(0.021)	(0.022)
Export Value per Shipment	0.018	0.001
	(0.018)	(0.022)
Export Quantity per Shipment	0.006	0.008
	(0.018)	(0.023)
Firm-Year Fixed Effect	Yes	
Product-Destination-Year Fixed Effect	Yes	
Observations	37,309	

Source: Authors' calculations based on data from DNA.

The upper panel of the table reports estimates of a specification of Equation (3) that allow for different effects on exports to main buyers (i.e., the importing company that accounts for the largest share of exports) and secondary buyers (i.e., remaining importing companies. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, and the average export quantity per shipment at the firm-product-destination-buyer group level. The main explanatory variable is the logarithmic change in the median number of days spent in customs ($\Delta \ln D$). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 11

The Impact of Customs Delay on Firms' Export Growth
Heterogeneous Effects by Buyers, Products, and Destinations

Export Outcomes	Time-Sensitiveness				Toughness of Competition			
	MB-TS	SB-TS	MB-TI	SB-TI	MB-OECD	SB-OECD	MB-NOECD	SB-NOECD
Export Value	-0.107***	-0.133***	-0.054	-0.093**	-0.122***	-0.182***	-0.048**	-0.075**
	(0.033)	(0.051)	(0.028)	(0.038)	(0.041)	(0.057)	(0.024)	(0.034)
Export Quantity	-0.117***	-0.119**	-0.071**	-0.093**	-0.139***	-0.168***	-0.058**	-0.074**
	(0.034)	(0.052)	(0.029)	(0.038)	(0.043)	(0.058)	(0.026)	(0.035)
Unit Value	0.010	-0.014	0.016*	0.000	0.016	-0.015	0.010	-0.001
	(0.011)	(0.013)	(0.01)	(0.008)	(0.012)	(0.014)	(0.009)	(0.008)
Number of Shipments	-0.073**	-0.088**	-0.114***	-0.129***	-0.094**	-0.106***	-0.088***	-0.122***
	(0.032)	(0.037)	(0.027)	(0.027)	(0.036)	(0.039)	(0.025)	(0.027)
Export Value per Shipment	-0.034	-0.046	0.059**	0.036	-0.028	-0.077**	0.041*	0.047*
	(0.026)	(0.039)	(0.024)	(0.026)	(0.031)	(0.038)	(0.022)	(0.026)
Export Quantity per Shipment	-0.044	-0.032	0.043*	0.037	-0.045	-0.062	0.031	0.048*
	(0.027)	(0.041)	(0.024)	(0.027)	(0.032)	(0.041)	(0.023)	(0.027)
Firm-Year Fixed Effect		Yes				Yes		
Product-Destination-Year Fixed Effect		Yes				Yes		
Observations		37,099				37,099		

Export Outcomes	Banking Crises				Demand Volatility			
	MB-BC	SB-BC	MB-NBC	SB-NBC	MB-HDV	SB-HDV	MB-LDV	SB-LDV
Export Value	-0.116	-0.255***	-0.074***	-0.068	-0.070**	-0.160***	-0.085**	-0.132***
	(0.066)	(0.085)	(0.024)	(0.036)	(0.031)	(0.050)	(0.034)	(0.046)
Export Quantity	-0.126*	-0.220**	-0.091***	-0.074**	-0.098***	-0.138***	-0.08**	-0.135***
	(0.066)	(0.089)	(0.026)	(0.037)	(0.034)	(0.052)	(0.034)	(0.046)
Unit Value	0.009	-0.035*	0.018**	0.006	0.027**	-0.022	-0.004	0.004
	(0.018)	(0.02)	(0.009)	(0.009)	(0.013)	(0.014)	(0.009)	(0.008)
Number of Shipments	-0.078	-0.090	-0.107***	-0.125***	-0.062**	-0.155***	-0.100***	-0.114***
	(0.06)	(0.055)	(0.023)	(0.027)	(0.03)	(0.036)	(0.032)	(0.033)
Export Value per Shipment	-0.038	-0.165***	0.033	0.057**	-0.008	-0.004	0.015	-0.017
	(0.05)	(0.061)	(0.02)	(0.026)	(0.027)	(0.041)	(0.025)	(0.029)
Export Quantity per Shipment	-0.047	-0.130*	0.015	0.051*	-0.035	0.018	0.020	-0.021
	(0.049)	(0.066)	(0.021)	(0.027)	(0.029)	(0.044)	(0.026)	(0.03)
Firm-Year Fixed Effect		Yes				Yes		
Product-Destination-Year Fixed Effect		Yes				Yes		
Observations		30,934				29,782		

Source: Authors' calculations based on data from DNA.

The upper panel of the table reports estimates of a specification of Equation (3) that allow for different effects on exports to main buyers (i.e., the importing company that accounts for the largest share of exports) and secondary buyers (i.e., remaining importing companies) depending on the degree of time-sensitiveness of the products involved in the relationship, the toughness of the competition in the destination (OECD vs. Non-OECD), the existence or not of a banking crisis in the destination (based on Laeven and Valencia, 2012), and the level of volatility of demand. Breakdowns are those used in the respective previous tables. The dependent variables are the change in the natural logarithm of export value, quantity (weight) shipped, unit value, number of shipments, average export value per shipment, and the average export quantity per shipment at the firm-product-destination-buyer group level. The main explanatory variable is the logarithmic change in the median number of days spent in customs ($\Delta \ln D$). All relevant interacting terms and their combination are included. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

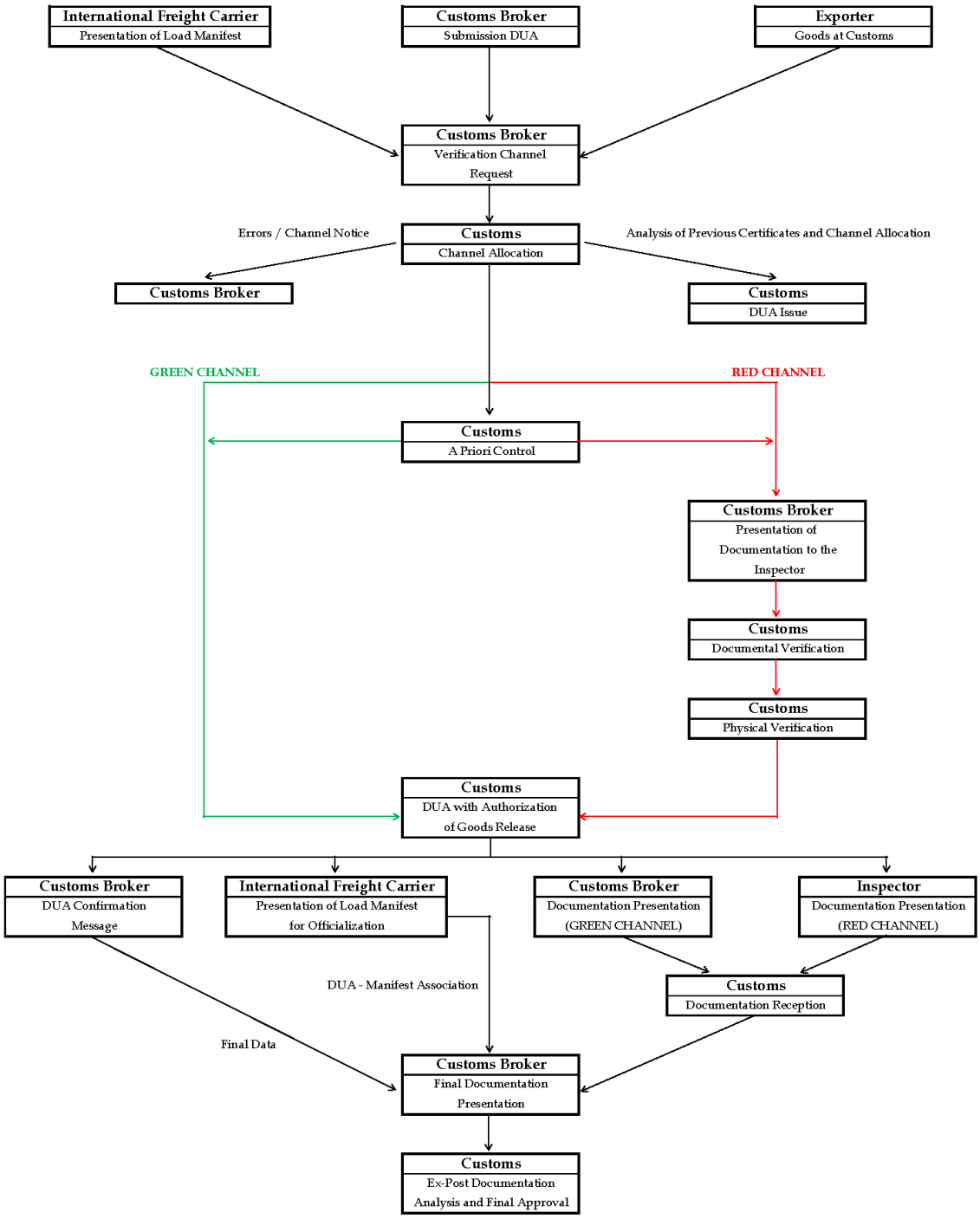
Table 12

The Impact of Customs Delay on Firms' Exports Extensive Margin		
	Presence	**Number of Firms**
ΔlnD	-0.024**	-0.028***
	(0.010)	(0.007)
Firm-Year Fixed Effect	Yes	No
Product-Destination-Year Fixed Effect	Yes	No
Product-Year Fixed Effect	No	Yes
Country-Year Fixed Effect	No	Yes
Observations	55,561	46,812

Source: Authors' calculations based on data from DNA.

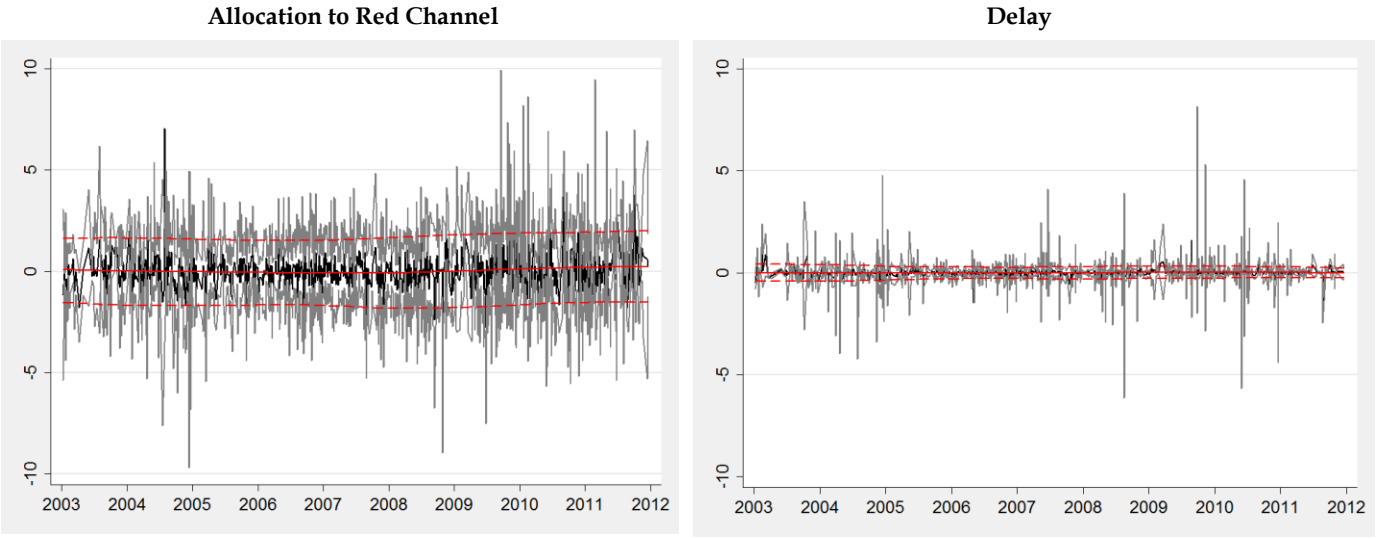
The table reports estimates of modified versions of Equation (2). In the first column, results correspond to an equation estimated on data at the firm-product-destination level. The dependent variables is a binary indicator that takes the value of one if the export flow is present in the year in question and zero otherwise and the main explanatory variable is the logarithmic change in the median customs processing times between the two previous years. In the second column, results correspond to an equation estimated on data at the product-destination level. The dependent variable is the change in the number of firms exporting a given product to a given destination and the main explanatory variable is the logarithmic change in the respective median clearance times. Firm-year fixed effects and product-destination-year fixed effects are included (not reported). Standard errors clustered by firm-product-destination are reported in parentheses below the estimated coefficient in the first column, whereas standard errors clustered by product-destination are reported in parentheses below the estimated coefficient in the second column. * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Figure 1
Stylized Export Process in Uruguay



Source: Authors' preparation based on DNA.

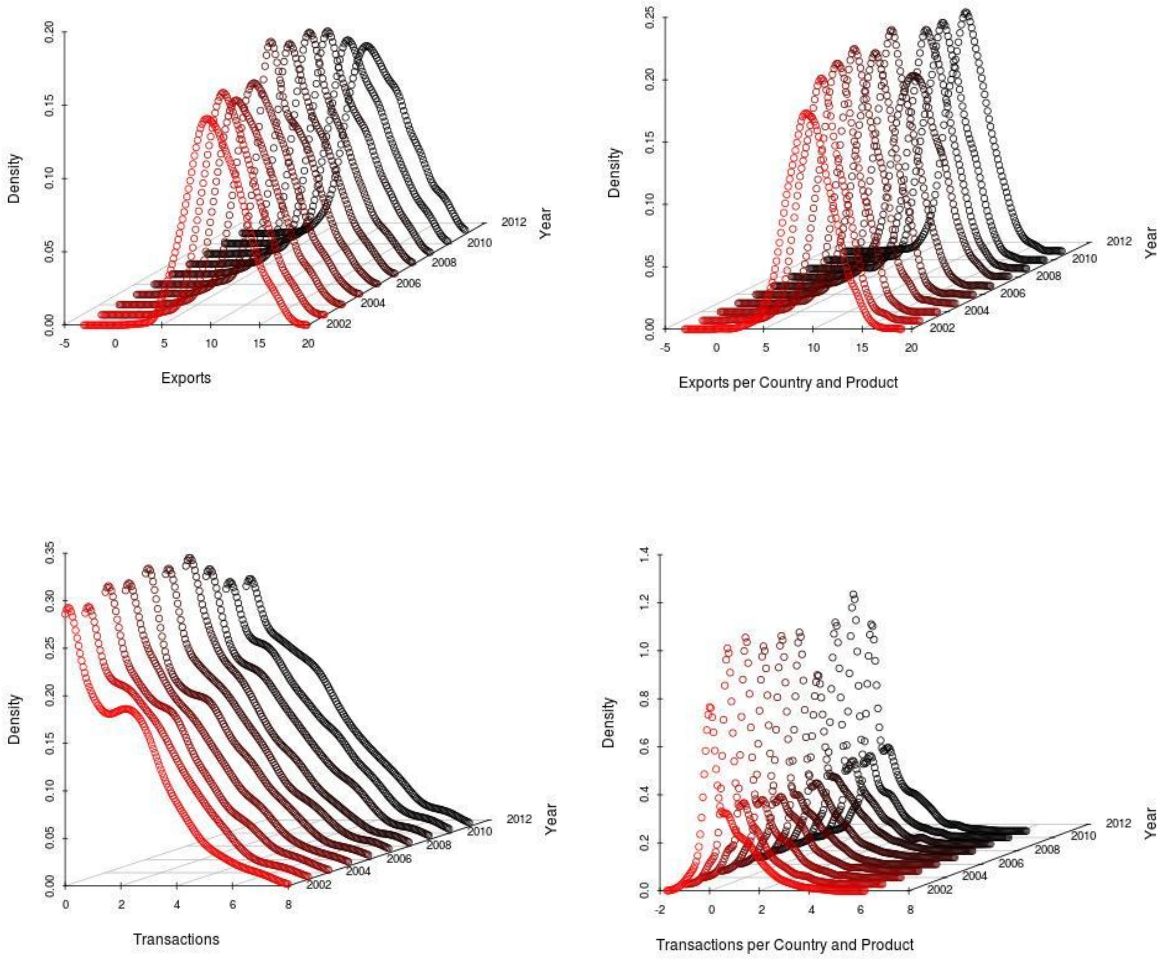
Figure 2



Source: Authors' calculations based on DNA.

The figure shows the estimated coefficient (black) and the confidence interval (grey) from daily regressions of firm-product-destination exports processed through the green channel on a binary indicator that takes the value of one if the next time the export flow is allocated to the red channel and zero otherwise (left panel) or on the delay the export experience the next time in that case (right panel) along the respective smoothed values from a kernel-weighted local polynomial regression (red). Firm and product-destination fixed effects are included. Only regressions with at least 30 degrees of freedom are considered.

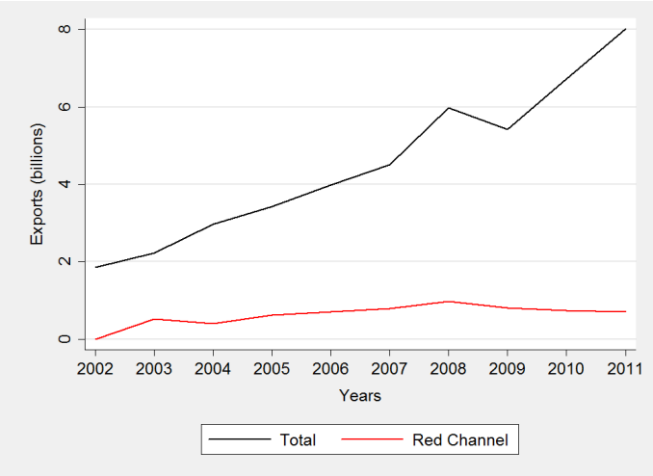
Figure 3
Distribution of Exports, Average Exports, Number of Shipments, and Average Shipment Size, 2002-2011



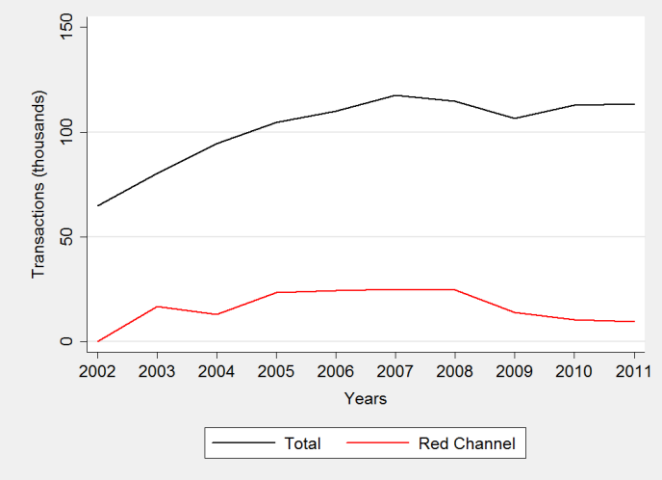
Source: Authors' calculations based on DNA.
The figure shows kernel density estimates of firms' (natural logarithm of) total exports, (natural logarithm of) average firms' exports by product and country, (natural logarithm of) average firms' number of shipment by product and country, and (natural logarithm of) average firms' shipment size by product and country for each sample year.

Figure 4

Share of Red-Channel Transactions in Total Export Value (1999-2011)

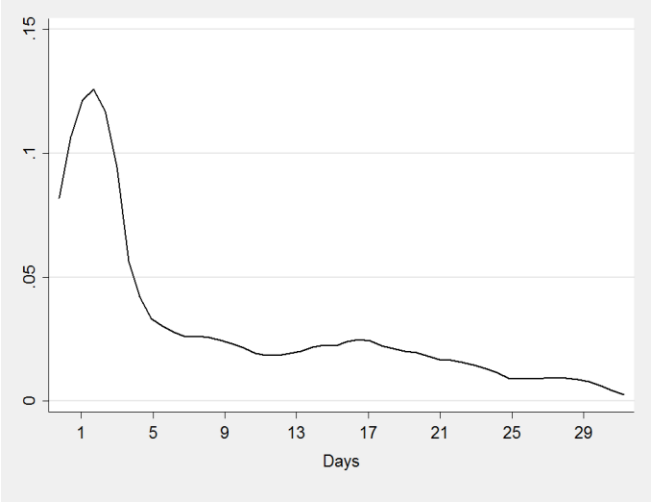


Share of Red-Channel Transactions in Total Number of Transactions (1999-2011



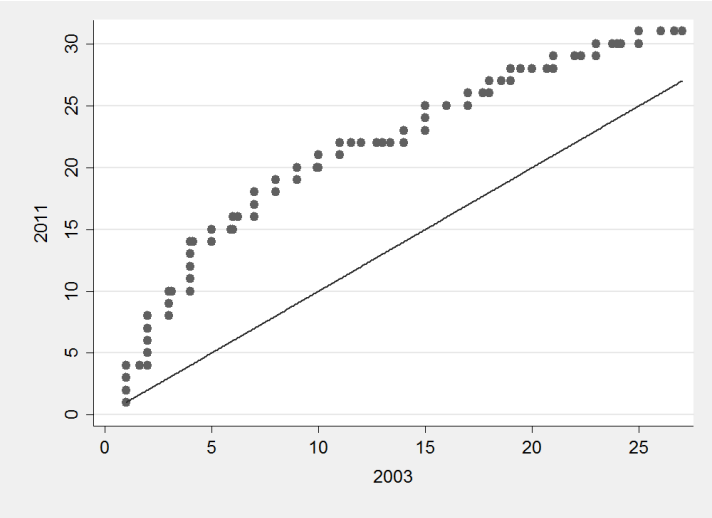
Source: Authors' calculations based on DNA.
Export values are expressed in billion of US dollars.

Figure 5
Distribution of Customs Clearance Times for Transactions Subject to Red Channel, 2011



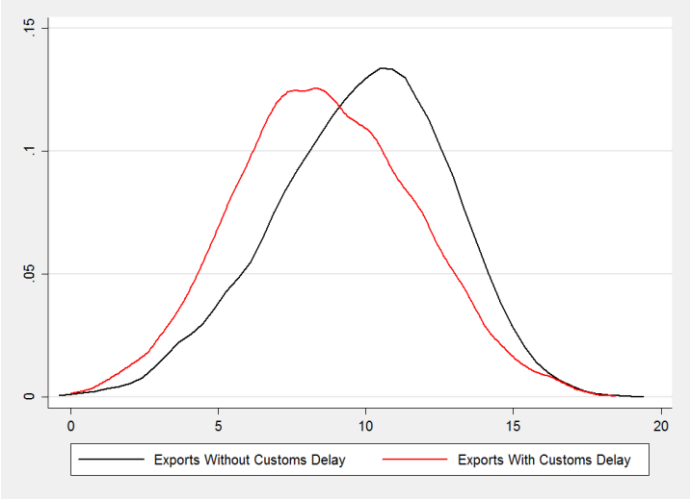
Source: Authors' calculations based on DNA.
The figure shows the distribution of customs clearance times until the 99.5th percentile, i.e., the highest 0.5 percentile is excluded.

Figure 6
Distribution of Customs Clearance Times Conditional to Red Channel, 2003 and 2011



Source: Authors' calculations based on DNA.
The figure shows the distributions of customs clearance times in days in 2003 and 2011 until the 99.5th percentile, i.e., the highest 0.5 percentile is excluded.

Figure 7
Customs Delays and Exports, 2011



Source: Authors' calculations based on DNA.
The figure presents kernel density estimates of the distribution of exports that are not physically inspected and thus released within the same day and exports physically inspected and facing increased transit times for 2011.