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

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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 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 one day in the median time spent in customs translates into a 1.4% decline in the growth rate of exports. Effects are particularly severe for exports of time-sensitive products to secondary buyers in OECD countries.

Keyword: Customs, Exports, Uruguay
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1 Introduction

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. Last year, export processing time by the Uruguayan customs ranged between 1 day (i.e., goods were released in the same day) and 23 days. This clearly reveals that the time it takes to complete customs-related procedures can be substantial and that this time can be highly variable. In this paper, we provide evidence on the impact of these administrative-driven delays on firms' exports in Uruguay over the period 2002-2011 using an unprecedented dataset that includes export transaction data and real customs clearance times.

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 good from a given country by 1% and that for a manufactured good by 1.5%, and estimates that such a day is worth 0.8% *ad valorem* for the latter goods.[1] 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).[2] 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

[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] 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.

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.

Customs procedures increase the transit time between origin and destination. These intermediating public entities can therefore 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-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. First, most analyses are based on aggregated country-level data or relatively small samples of manufacturing firms of heterogeneous countries that are pooled together for estimation purposes. Hence, evidence on how the time that takes for a customs to process a shipment affects firms' export performance is at best preliminary and incomplete. Second, 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] Third, 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 primarily related to the coverage and underlying assumptions of the survey, which in turn echoes in their precision.[5] First, these survey-based measures are not real clearance

[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 survey 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.

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 requirements (i.e., sales abroad more than 10%).[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 primarily 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 limitations 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

[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.

[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…".

effects arise? To what extent are these effects heterogeneous? In answering these questions, we exploit a unique dataset consisting of all Uruguayan export transactions over the period 2002-2011 and recorded measures of the processing time by the national customs.

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 these administrative delays on firm export outcomes based on data for the whole population of a country's exporting firms. 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 across groups of products (i.e., on export specialization patterns), destinations, and, as a noteworthy novelty, on 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, each additional day that these procedures add to the transit time between the origin and the destination results in a 1.4% decline in the export growth rate. This effect is stronger for exports of time-sensitive goods (i.e., food and textile products) to secondary buyers in developed countries' markets. 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.

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

[10] In this sense, key ingredients of the 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).

given the *proforma* invoice or final commercial invoice and the packing list (if applicable).[11] This broker completes an electronic Single Customs Document (DUA) 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 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 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

[11] In order to be able to export, companies must be registered with Uurguay's tax agency (Dirección General Impositiva-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 (media) 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.
[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.

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 dataset consists of transaction level export data from 2002 to 2011 from the Uruguayan customs (DNA-*Dirección Nacional de Aduanas*). 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 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 left the customs (release date) (see Figure 1). We should mention herein that the sum of 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

[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 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.

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 request the channel), whereas release of goods whose exports were subject to red channel can take one day or substantially longer. This can be clearly seen in Figure 5, which presents a kernel density estimate of the distribution 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.[19] 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 dynamics. Further, administrative 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 shifted to the right between these years, particularly in its upper part.[20] 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 firms export outcomes? A naïve approach to answer this question would be to compare the growth of 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

[19] 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.

[20] 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 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.

year 2011. This figure presents kernel density estimates of the distribution of the growth rates for 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 grew less 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 growth rates 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, these may have decreased because lower firm productivity or lower demand for their products. 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:

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

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.[21] The latter is the median delay experienced by all transactions of product p that firm f ships to destination country c in year t.[22] 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

[21] 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).

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

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), their expectation thereon, 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-country fixed effects. We therefore estimate the following baseline equation:

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

where $\Delta D_{fpct} = D_{fpct} - D_{fpct-1}$; $\delta'_{ft} = \delta_{ft} - \delta_{ft-1}$ 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. Equation (2) additionally includes covariates 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.

Estimation of Equation (2) can be potentially affected by severe serial correlation problems (see Bertrand, et al., 2004). First, estimation of this kind of equations relies on non-trivial time series. Second, exports (and number of products and countries as well) tend to be highly positively serially correlated (see, e.g., Roberts and Tybout, 1997; Bernard and Jensen, 2004). 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). Hence, we also generalize this equation to explore the existence of heterogeneous effects across those groups as follows:

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

where *i* indexes the groups of firms, products, or countries, and their combinations; and Θ is the corresponding binary group indicator.[23]

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 reference specification either in the form of 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), buyers (main vs. secondary), destinations (OECD vs. non-OECD), and products (time sensitive vs. time-insensitive).

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 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 1.4% in the export growth rate.[24] In assessing the significance of this effect, besides standard errors clustered by firm-product-destination and heteroscedasticity-consistent standard errors, we also consider standard errors clustered at the firm, product, destination, product-destination, firm-destination, and firm-product levels. We do so because exports may be correlated across products or destinations for given firms or across firms in given products, or destinations. In the second column of Table 3 we report the estimates of a variant of Equation (2) where the main explanatory variable is the logarithmic change in the time it takes for customs to release the goods instead of its absolute change. In this case, the estimated coefficient informs us the respective elasticity. This estimated elasticity suggests that the export growth rates decline by 18% in response to a doubling in the customs delays.

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

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's national export promotion organization –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 two rows of the first and second panels of Table 4. These estimates essentially corroborate our initial findings. [25]

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 and four-month frequency data. Estimation results, which are shown in the second panel of Table 4, are also in line with the baseline. [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 estimate a modified version of Equation (2) where the main explanatory variable is the change in the

[25] 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.

[26] It is worth noticing that, as expected, point estimates are smaller when forth-month frequency data are used.

share of shipments going through the red channel. The third panel of Table 4 presents the estimation results. These results reveal that inspections do not make a significant difference for export outcomes. This 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).

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 results are presented in Table 5. These results reveal that these administrative delays have primarily 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, an additional 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 0.4% and 1.0%, 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, buyers, products, and destinations. 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 the left panel of 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, each additional day in customs reduces these firms' export growth by 2 percent. 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)..[27] We will explicitly come back to the destination dimension below.

Moreover, since our database notably includes information on the specific foreign companies Uruguayan exporters sell to, we are also able to 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 right panel of Table 6, suggest that the effect of longer clearance times is significantly larger on exports to relatively less important customers.[28] If we replace products with buyers in the model developed by Mayer et al. (2011), this result, whereby higher trade costs would lead firms to skew their export sales towards their main business partners, might be seen as supplementary to theirs, as long as it mainly originates from markets where tougher competition prevails. Consistently, we also find that the impact of customs delays varies depending on 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).[29]

We next accordingly turn to assess the existence of heterogeneous effects across destinations and product categories. In this sense, we separate OECD from non-OECD markets, where the former are considered to be subject to more intense competition, and time-sensitive from time-insensitive goods, for which we use estimation results from Hummels (2001).[30] Respective estimates of Equation (3) are presented in Table 7. From these estimates, we can conclude that the negative effects of increased transit times are generally stronger on sales to OECD countries and of time-sensitive goods, in particular food

[27] 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.

[28] Results presented in Table 6 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.

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

[30] Goods are identified as time-sensitive if the estimated coefficient on shipping time (i.e., days/rate ratio) of the respective HS-2 chapter is positive and significant.

and textile products (see Table A1 in the Appendix). Specifically, the effect of customs delays is the strongest for exports of time-sensitive goods to OECD countries. In this case, each additional day spent in customs costs a 5.8% reduction in the export growth rate (with an elasticity of 28.4%) 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.

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 extensive margin. In so doing, we estimate an 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, product-year fixed effects and both) to account for unobserved factors. According to estimates of this equation, increased time in transit due to customs procedures has had a significant negative effect on the firm export extensive margin. [31]

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

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

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, each additional day spent in customs is associated with an average reduction of 1.4% in the export growth rate. This impact is even more pronounced for larger exporters and on sales to non-core buyers and of time-sensitive goods to OECD countries. In this latter case, export growth is 5.8% lower for each day elapsed under customs oversight. 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.

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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		
	ΔD	**ΔlnD**
Customs Delay	-0.014	-0.180
Heteroscedasticity-Consistent	(0.004)***	(0.027)***
Cluster Firm-Product-Destination	(0.005)***	(0.030)***
Cluster Firm	(0.006)***	(0.036)***
Cluster Product	(0.007)**	(0.040)***
Cluster Destination	(0.008)*	(0.058)***
Cluster Product-Destination	(0.007)**	(0.032)***
Cluster Chapter HS2-Destination	(0.007)**	(0.043)***
Cluster Firm-Product	(0.005)***	(0.031)***
Cluster Firm-Chapter HS2	(0.006)**	(0.036)***
Cluster Firm-Destination	(0.005)***	(0.034)***
Firm-Year Fixed Effect	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes
Observations	65,940	65,940

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-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) and the logarithmic change in the median number of days spent in customs ($\Delta \ln D$). 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							
	ΔD							
Customs Delay	-0.009***	-0.008**	-0.014***	-0.013*	-0.020***	-0.010	-0.014***	-0.014***
	(0.003)	(0.003)	(0.005)	(0.007)	(0.007)	(0.006)	(0.005)	(0.005)
	ΔlnD							
Customs Delay	-0.157***	-0.137***	-0.180***	-0.194***	-0.187***	-0.185***	-0.181***	-0.177***
	(0.017)	(0.026)	(0.030)	(0.041)	(0.035)	(0.044)	(0.030)	(0.029)
	ΔRC							
Share of Shipments Through Red Channel	-0.037	-0.002	-0.032	-0.058	-0.116	-0.030	-0.036	-0.032
	(0.027)	(0.039)	(0.049)	(0.068)	(0.073)	(0.061)	(0.049)	(0.048)
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	65,940	65,940	65,940	65,940	65,940	65,940	65,940	65,940
	Semester-to-Semester Changes				**Four Month-to-Four Month Changes**			
	ΔD							
Customs Delay	-0.001**	-0.001***	-0.001**	-0.001**	-0.001**	-0.001***	-0.001**	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	ΔlnD							
Customs Delay	-0.125***	-0.124***	-0.120***	-0.119***	-0.091***	-0.089***	-0.088***	-0.085***
	(0.022)	(0.023)	(0.029)	(0.029)	(0.015)	(0.015)	(0.017)	(0.017)
	ΔRC							
Share of Shipments Through Red Channel	-0.002	0.000	0.021	0.022	-0.027	-0.021	-0.019	-0.012
	(0.038)	(0.038)	(0.048)	(0.048)	(0.023)	(0.023)	(0.027)	(0.027)
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	91,093	91,093	91,093	91,093	130,926	130,926	130,926	130,926

Placebo Tests

	No Conditioning on Green Channel			Conditioning on Green Channel		
	ΔD	**ΔlnD**	**ΔRC**	**ΔD**	**ΔlnD**	**ΔRC**
Customs Delay	0.001	-0.069	-0.012	-0.040	-0.153	-0.202
	(0.004)	(0.049)	(0.085)	(0.035)	(0.126)	(0.250)
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26,956	26,956	26,956	8,158	8,158	8,158

Source: Authors' calculations based on data from DNA.

The first and second panels of the table reports estimates of Equation (2). The dependent variable is the change in the natural logarithm of export value at the firm-product-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) the logarithmic change in the median number of days spent in customs ($\Delta \ln D$), and the change in the share of transactions allocated to the red channel (ΔRC). 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). In the second panel, changes are computed either across semesters or four-month periods. 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 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	ΔD	ΔlnD
Export Value	-0.014***	-0.180***
	(0.005)	(0.030)
Export Quantity	-0.013***	-0.174***
	(0.005)	(0.030)
Unit Value	-0.000	-0.006
	(0.001)	(0.007)
Number of Shipments	-0.013***	-0.154***
	(0.004)	(0.021)
Export Value per Shipment	-0.000	-0.025
	(0.003)	(0.020)
Export Quantity per Shipment	0.000	-0.019
	(0.003)	(0.020)
Number of Buyers	-0.004***	-0.056***
	(0.002)	(0.013)
Number of Shipments per Buyer	-0.009***	-0.098***
	(0.003)	(0.017)
Export Value per Buyer	-0.009**	-0.124***
	(0.004)	(0.026)
Export Quantity per Buyer	-0.009**	-0.118***
	(0.004)	(0.026)
Firm-Year Fixed Effect	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes
Observations	65,940	65,940

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-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) and 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). 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 and Buyer Types

Export Outcomes	Small vs. Large Exporters				Main vs. Secondary Buyers			
	ΔD		ΔlnD		ΔD		ΔlnD	
	Small	Large	Small	Large	Main	Secondary	Main	Secondary
Export Value	-0.006	-0.020***	-0.110	-0.184***	-0.010***	-0.030***	-0.107***	-0.206***
	(0.005)	(0.006)	(0.101)	(0.031)	(0.004)	(0.010)	(0.023)	(0.055)
Export Quantity	-0.006	-0.019***	-0.130	-0.177***	-0.010***	-0.029***	-0.105***	-0.200***
	(0.004)	(0.006)	(0.110)	(0.031)	(0.003)	(0.011)	(0.023)	(0.056)
Unit Value	0.000	-0.001	0.020	-0.008	-0.000	-0.001	-0.003	-0.007
	(0.002)	(0.001)	(0.048)	(0.007)	(0.001)	(0.004)	(0.006)	(0.014)
Number of Shipments	-0.004	-0.020***	-0.129**	-0.156***	-0.011***	-0.022***	-0.104***	-0.141***
	(0.003)	(0.004)	(0.064)	(0.022)	(0.003)	(0.008)	(0.017)	(0.041)
Export Value per Shipment	-0.001	0.000	-0.003	-0.026	0.001	-0.008	-0.002	-0.063
	(0.003)	(0.005)	(0.068)	(0.021)	(0.002)	(0.008)	(0.018)	(0.041)
Export Quantity per Shipment	-0.002	0.001	-0.023	-0.018	0.001	-0.007	0.000	-0.056
	(0.002)	(0.004)	(0.075)	(0.021)	(0.002)	(0.007)	(0.018)	(0.043)
Number of Buyers	-0.000	-0.008***	-0.013	-0.059***				
	(0.000)	(0.002)	(0.022)	(0.014)				
Number of Shipments per Buyer	-0.004	-0.012***	-0.093	-0.097***				
	(0.003)	(0.003)	(0.098)	(0.018)				
Export Value per Buyer	-0.005	-0.012**	-0.113	-0.126***				
	(0.005)	(0.006)	(0.106)	(0.027)				
Export Quantity per Buyer	-0.006	-0.011**	-0.116*	-0.119***				
	(0.004)	(0.005)	(0.060)	(0.027)				
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	65,940	65,940	65,940	65,940	65,940	18,723	65,940	18,723

Source: Authors' calculations based on data from DNA.

The table reports estimates of alternative 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) (left panel) and 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) (right panel). 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-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) and 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). 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 Destinations and Product Categories

Export Outcomes	OECD Countries vs. Non-OECD Countries				Time-Sensitive Goods vs. Time -Insensitive Goods			
	ΔD		ΔlnD		ΔD		ΔlnD	
	OECD	N-OECD	OECD	N-OECD	TS	TI	TS	TI
Export Value	-0.015**	-0.012	-0.267***	-0.116***	-0.049***	-0.008*	-0.134***	-0.232***
	(0.007)	(0.008)	(0.048)	(0.037)	(0.010)	(0.004)	(0.039)	(0.046)
Export Quantity	-0.014**	-0.012*	-0.254***	-0.115***	-0.044***	-0.008*	-0.224***	-0.129***
	(0.006)	(0.007)	(0.047)	(0.037)	(0.010)	(0.004)	(0.046)	(0.039)
Unit Value	-0.001	0.000	-0.013	-0.001	-0.005	0.000	-0.008	-0.005
	(0.002)	(0.001)	(0.012)	(0.008)	(0.003)	(0.001)	(0.012)	(0.009)
Number of Shipments	-0.012**	-0.016***	-0.195***	-0.124***	-0.039***	-0.009***	-0.171***	-0.136***
	(0.005)	(0.004)	(0.033)	(0.027)	(0.008)	(0.003)	(0.036)	(0.026)
Export Value per Shipment	-0.003	0.004	-0.073**	0.010	-0.008	0.001	-0.058*	0.002
	(0.003)	(0.006)	(0.032)	(0.025)	(0.007)	(0.003)	(0.032)	(0.026)
Export Quantity per Shipment	0.004	-0.002	-0.060*	0.011	-0.003	0.001	-0.049	0.007
	(0.006)	(0.002)	(0.033)	(0.025)	(0.007)	(0.003)	(0.032)	(0.027)
Number of Buyers	-0.003*	-0.006**	-0.065***	-0.050***	-0.016***	-0.002	-0.065***	-0.044**
	(0.002)	(0.003)	(0.021)	(0.018)	(0.005)	(0.001)	(0.022)	(0.017)
Number of Shipments per Buyer	-0.008**	-0.009**	-0.130***	-0.074***	-0.024***	-0.007**	-0.106***	-0.092***
	(0.004)	(0.004)	(0.027)	(0.022)	(0.006)	(0.003)	(0.028)	(0.022)
Export Value per Buyer	-0.011*	-0.005	-0.203***	-0.067**	-0.033***	-0.006	-0.167***	-0.090***
	(0.006)	(0.007)	(0.043)	(0.032)	(0.009)	(0.004)	(0.041)	(0.034)
Export Quantity per Buyer	-0.011**	-0.005	-0.191***	-0.065**	-0.028***	-0.006	-0.159***	-0.085**
	(0.005)	(0.007)	(0.043)	(0.032)	(0.009)	(0.004)	(0.041)	(0.034)

Export Outcomes	OECD / Non-OECD Countries and Time-Sensitive/Insensitive Goods							
	ΔD				ΔlnD			
	OECD TS	N-OECD TS	OECD TI	N-OECD TI	OECD TS	N-OECD TS	OECD TI	N-OECD TI
Export Value	-0.058***	-0.040***	-0.009*	-0.005	-0.284***	-0.174***	-0.253***	-0.066
	(0.016)	(0.013)	(0.005)	(0.009)	(0.069)	(0.060)	(0.065)	(0.049)
Export Quantity	-0.049***	-0.040***	-0.009**	-0.004	-0.258***	-0.185***	-0.256***	-0.057
	(0.016)	(0.012)	(0.005)	(0.009)	(0.068)	(0.060)	(0.065)	(0.049)
Unit Value	-0.009*	0.000	-0.000	-0.000	-0.025	0.011	0.002	-0.009
	(0.005)	(0.001)	(0.004)	(0.002)	(0.017)	(0.015)	(0.017)	(0.011)
Number of Shipments	-0.048***	-0.031***	-0.007**	-0.011**	-0.195***	-0.144***	-0.202***	-0.100***
	(0.011)	(0.011)	(0.004)	(0.005)	(0.050)	(0.051)	(0.042)	(0.033)
Export Value per Shipment	-0.011	-0.006	-0.001	0.006	-0.090*	-0.050	-0.020	0.032
	(0.010)	(0.009)	(0.003)	(0.008)	(0.049)	(0.042)	(0.041)	(0.034)
Export Quantity per Shipment	-0.001	-0.005	-0.002	0.006	-0.065	-0.032	-0.053	0.041
	(0.011)	(0.009)	(0.002)	(0.008)	(0.049)	(0.041)	(0.043)	(0.033)
Number of Buyers	-0.021***	-0.011**	-0.001	-0.004	-0.077**	-0.052*	-0.052**	-0.040*
	(0.008)	(0.005)	(0.001)	(0.004)	(0.033)	(0.029)	(0.024)	(0.023)
Number of Shipments per Buyer	-0.027***	-0.020**	-0.006**	-0.007*	-0.118***	-0.092**	-0.150***	-0.060**
	(0.008)	(0.010)	(0.003)	(0.004)	(0.038)	(0.041)	(0.038)	(0.025)
Export Value per Buyer	-0.038***	-0.028**	-0.008	-0.001	-0.209***	-0.120**	-0.201***	-0.027
	(0.014)	(0.013)	(0.005)	(0.009)	(0.061)	(0.054)	(0.058)	(0.040)
Export Quantity per Buyer	-0.028*	-0.028**	-0.008*	-0.000	-0.184***	-0.132**	-0.203***	-0.018
	(0.014)	(0.011)	(0.004)	(0.009)	(0.061)	(0.053)	(0.058)	(0.041)
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	61,999	61,999	61,999	61,999	61,999	61,999	61,999	61,999

Source: Authors' calculations based on data from DNA.

The table reports estimates of alternative 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, exports of time-sensitive goods and time-insensitive goods, and their combination. Goods are classified using estimation results reported in Hummels (2001). 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-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) and 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). 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.

Appendix

Table A1

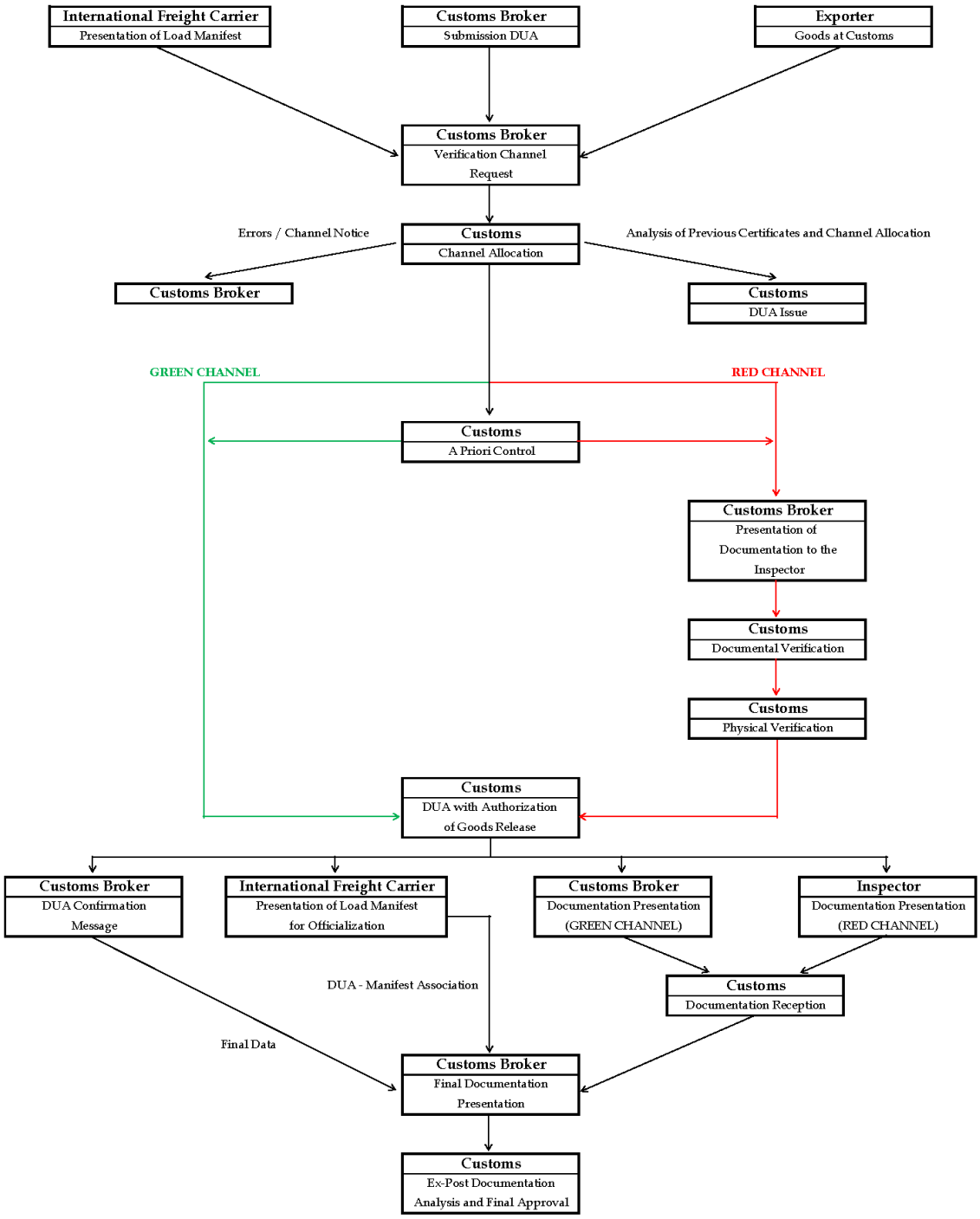
The Impact of Customs Delay on Firms' Export Growth
Sectoral Effects

Export Outcomes	ΔD						
	Food	**Textiles**	**Others**	*Other Industrial Supplies*	*Capital Goods*	*Transport Equipment*	*Other Consumer Goods*
Export Value	-0.012***	-0.042**	-0.010	-0.007	-1.037*	0.200	-0.044
	(0.004)	(0.020)	(0.011)	(0.015)	(0.530)	(0.418)	(0.028)
Export Quantity	-0.012***	-0.043**	-0.008	-0.006	-0.977*	0.169	-0.029
	(0.004)	(0.021)	(0.012)	(0.016)	(0.525)	(0.207)	(0.032)
Unit Value	0.000	0.001	-0.003	-0.001	-0.061	0.031	-0.015
	(0.001)	(0.004)	(0.004)	(0.004)	(0.136)	(0.221)	(0.011)
Number of Shipments	-0.012***	-0.034***	-0.012	-0.006	-0.528**	-0.147	-0.069***
	(0.003)	(0.013)	(0.008)	(0.009)	(0.250)	(0.092)	(0.017)
Export Value per Shipment	0.000	-0.008	0.001	-0.001	-0.509	0.347	0.027
	(0.003)	(0.011)	(0.009)	(0.011)	(0.415)	(0.376)	(0.019)
Export Quantity per Shipment	0.000	-0.009	0.004	-0.000	-0.449	0.316*	0.041*
	(0.002)	(0.012)	(0.011)	(0.012)	(0.379)	(0.189)	(0.021)
Number of Buyers	-0.004**	-0.021**	-0.001	0.000	0.076	-0.108	-0.014**
	(0.001)	(0.010)	(0.005)	(0.006)	(0.178)	(0.115)	(0.006)
Number of Shipments per Buyer	-0.008***	-0.014	-0.011	-0.007	-0.604**	-0.040	-0.056***
	(0.003)	(0.010)	(0.007)	(0.009)	(0.253)	(0.073)	(0.016)
Export Value per Buyer	-0.008**	-0.022	-0.009	-0.008	-1.114**	0.308	-0.030
	(0.004)	(0.017)	(0.012)	(0.016)	(0.444)	(0.426)	(0.027)
Export Quantity per Buyer	-0.008**	-0.023	-0.007	-0.007	-1.053**	0.276	-0.015
	(0.003)	(0.018)	(0.013)	(0.017)	(0.433)	(0.250)	(0.030)
Export Outcomes	**ΔlnD**						
	Food	**Textiles**	**Others**	*Other Industrial Supplies*	*Capital Goods*	*Transport Equipment*	*Other Consumer Goods*
Export Value	-0.185***	-0.238***	-0.104	-0.082	-1.847**	0.699	-0.090
	(0.031)	(0.089)	(0.073)	(0.101)	(0.911)	(1.528)	(0.122)
Export Quantity	-0.176***	-0.220**	-0.114	-0.094	-1.761*	0.608	-0.090
	(0.031)	(0.091)	(0.078)	(0.108)	(0.903)	(0.742)	(0.135)
Unit Value	-0.009	-0.018	0.010	0.012	-0.086	0.091	0.000
	(0.007)	(0.018)	(0.027)	(0.036)	(0.270)	(0.806)	(0.048)
Number of Shipments	-0.154***	-0.177***	-0.132***	-0.071	-0.972**	-0.487	-0.229***
	(0.023)	(0.057)	(0.051)	(0.072)	(0.429)	(0.327)	(0.074)
Export Value per Shipment	-0.028	-0.066	0.029	-0.009	-0.876	1.185	0.145*
	(0.022)	(0.055)	(0.050)	(0.065)	(0.747)	(1.332)	(0.081)
Export Quantity per Shipment	-0.020	-0.048	0.019	-0.021	-0.790	1.094*	0.145
	(0.022)	(0.056)	(0.056)	(0.073)	(0.688)	(0.593)	(0.093)
Number of Buyers	-0.053***	-0.097**	-0.024	-0.017	0.115	-0.377	-0.048*
	(0.015)	(0.042)	(0.030)	(0.047)	(0.341)	(0.328)	(0.027)
Number of Shipments per Buyer	-0.101***	-0.080*	-0.107**	-0.054	-1.087***	-0.110	-0.181**
	(0.018)	(0.047)	(0.047)	(0.067)	(0.411)	(0.251)	(0.070)
Export Value per Buyer	-0.132***	-0.146*	-0.080	-0.064	-1.963***	1.076	-0.042
	(0.027)	(0.075)	(0.071)	(0.099)	(0.749)	(1.509)	(0.117)
Export Quantity per Buyer	-0.123***	-0.128*	-0.090	-0.075	-1.877***	0.984	-0.042
	(0.027)	(0.077)	(0.076)	(0.105)	(0.712)	(0.793)	(0.129)
Firm-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-Destination-Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	22,177	13,856	26,258	13,263	3,493	694	8,543

Source: Authors' calculations based on data from DNA.

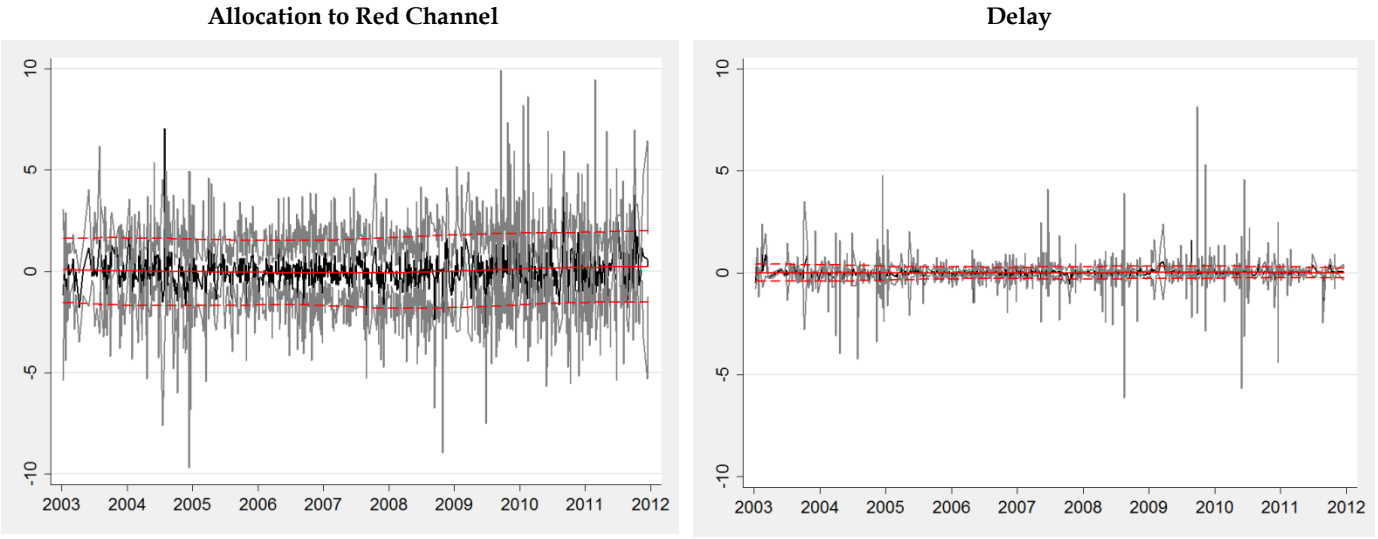
The table reports estimates of Equation (2) for different product categories (subsamples): food products, textile products, and other products, which are then disaggregated in other industrial supplies, capital goods, transport equipment, and other consumer goods. The dependent variables are the change 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-country level. The main explanatory variables are the absolute change in the median number of days spent in customs (ΔD) and 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). 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.

Figure 1
Stylized Export Process in Uruguay



Source: Authors' preparation based on DNA.

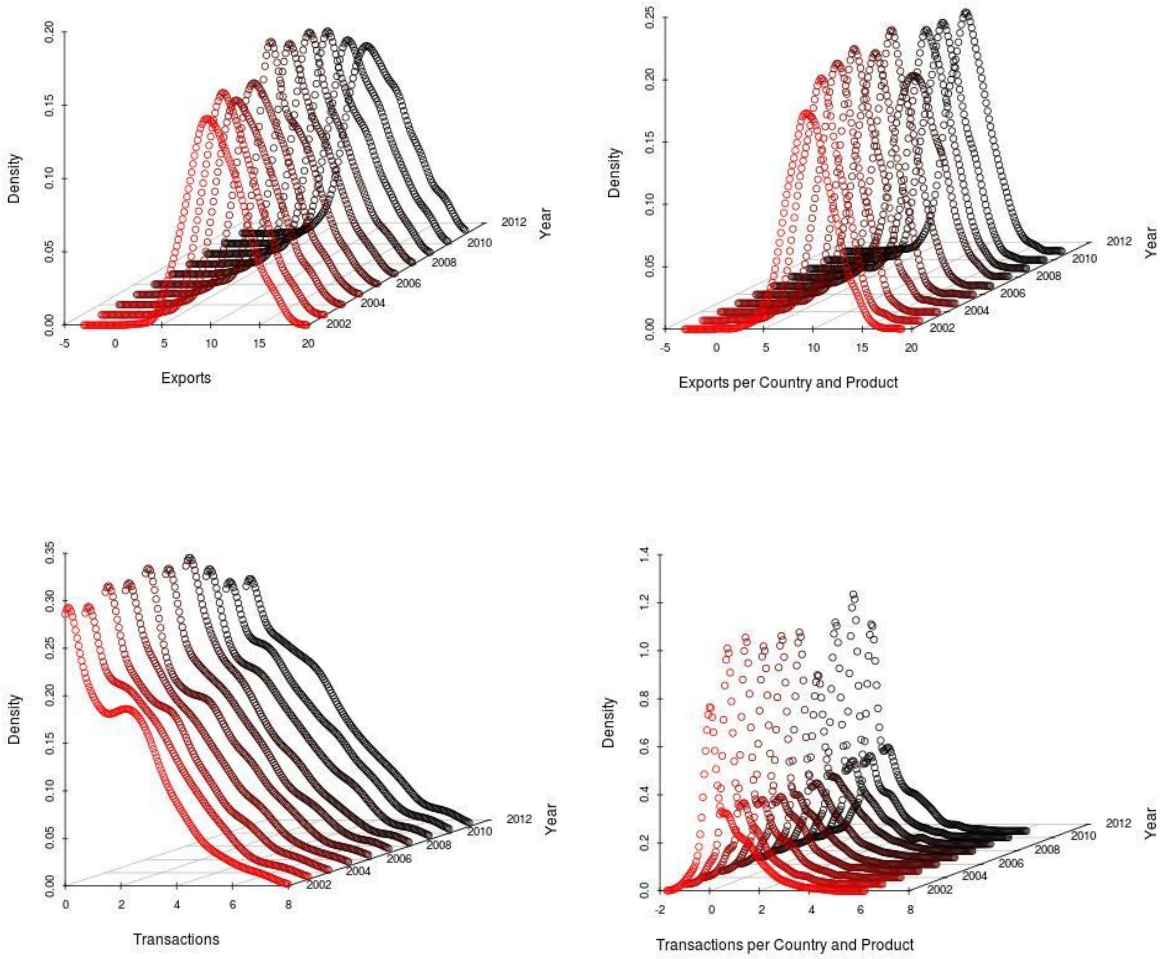
Figure 2



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.

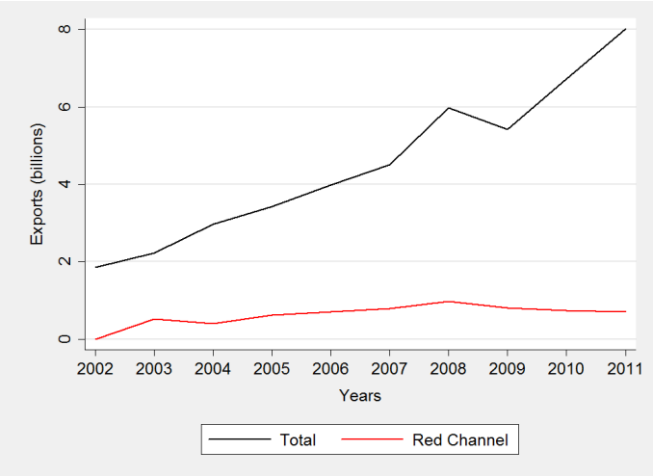
Figure 3
Distribution of Exports, Average Exports, Number of Shipments, and Average Shipment Size, 2002-2011



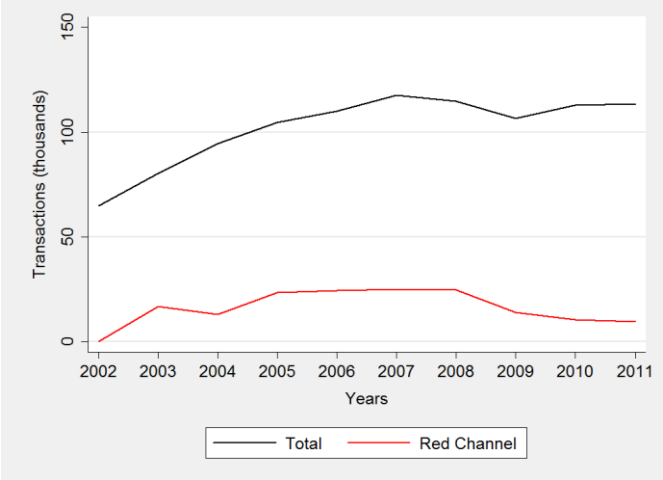
Source: Authors' calculations based on DNA.
The figure shows kernel density estimates of firms' (natural logarithm of) total exports, (natural logarithm of) average firms' exports by product and country, (natural logarithm of) average firms' number of shipment by product and country, and (natural logarithm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

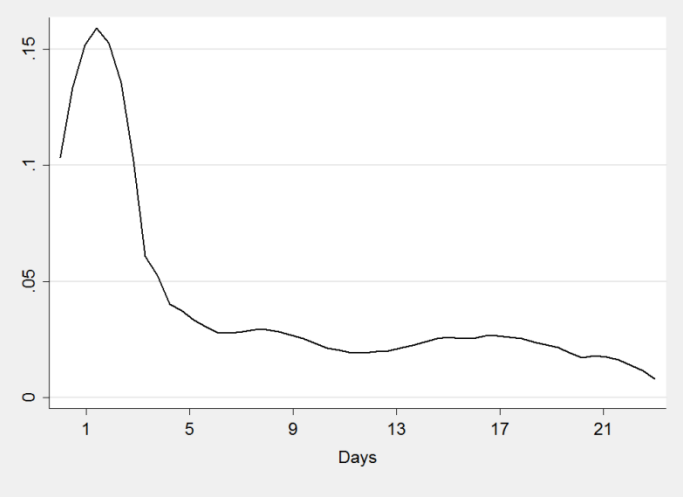


Share of Red-Channel Transactions in Total Number of Transactions (1999-2011



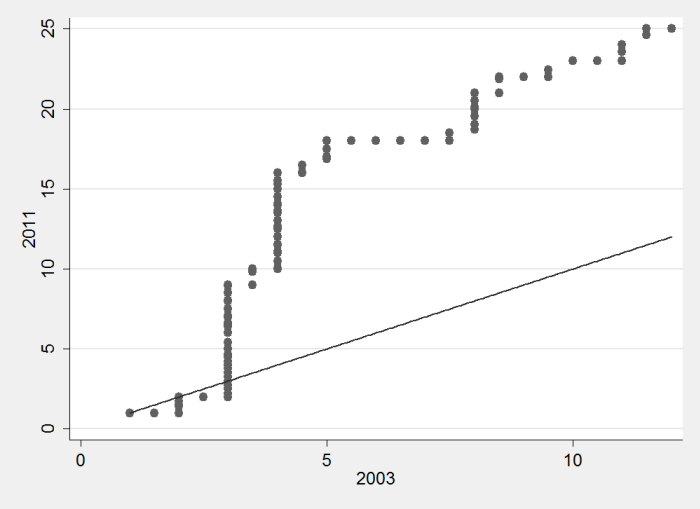
Source: Authors' calculations based on DNA.
Export values are expressed in billion of US dollars.

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



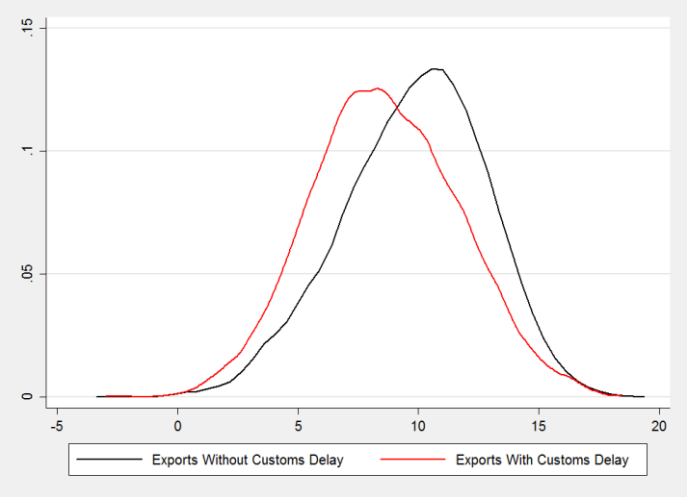
Source: Authors' calculations based on DNA.
The figure shows the distribution of customs clearance times until the 99th percentile, i.e., the highest percentile is excluded.

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 99th percentile, i.e., the highest percentile is excluded.

Figure 7
Customs Delays and Export Growth, 2011



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