Does Corruption Attenuate the Effect of Red Tape on Exports?*

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Abstract

In this paper I show that corruption can attenuate the adverse effects of customs-related red tape on firm exports. I first develop a model where exporters use bribes to encourage customs officials to process their documents in an expedited manner. This lowers the delay that they face at customs. The model shows that if the value of the reduced delays is greater than the bribe payment itself, then corruption can attenuate the adverse effects of customs-related red tape. I then use firm-level data to confirm that this attenuating effect exists. I find that the negative effect of greater red tape on firm exports is lower for firms in industries and countries where corruption at customs is more prevalent. This result suggest that, conditional on there being customs-related red tape, an exporter is better off if it can use bribes to lower the delay that it faces.

JEL Codes: F10, F14, K42
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1 Introduction

The ability to deliver goods and services on time is an increasingly important determinant of export success (World Bank, 2007). This is mainly due to two significant changes in the nature of exports in recent years. First, a greater share of exports is due to global production sharing, where stages of a firm's value chain are allocated in different countries (Hummels, Ishii, and Yi, 2001). Second, there has been an increase in competition among countries due to lower tariffs and non-tariff barriers. These changes mean that any delays that an exporter faces in its country of origin can have an important detrimental effect on its ability to remain competitive. This is reinforced by recent evidence that such delays can have a significant adverse effect on trade. For instance, Djankov, Freund, and Pham (2010) find that an additional day spent prior to shipment reduces trade by more than 1 percent. Similarly, Volpe Martincus, Carballo, and Graziano (2015) find that a 10 percent increase in customs delays lowers firm exports by 3.8 percent.

While delays can be caused by various factors (e.g. poor infrastructure), one that is particularly problematic is customs-related red tape. This is because such red tape can have both a direct as well as an indirect effect on exports. The direct effect is simply the increase in delays due to additional red tape. The indirect effect is due to the fact that, by providing customs officials with greater discretionary power, such red tape can promote corruption.[1]. Thus, not only will red tape raise delays it will also increase the cost of exporting by potentially requiring firms to bribe customs officials. It follows that the true transaction costs associated with such red tape may be greater in environments where corruption is more prevalent.

In this paper I use firm-level data to empirically examine whether the effect of customs-related red tape on firm exports depends on the extent of corruption. In contrast to the discussion above, I show that corruption need not exacerbate the adverse effect of red tape and in fact may attenuate it. To do so, I first develop a stylized model where an exporter and a customs official agree on the bribe that needs to be paid to process the exporter's goods through customs. In addition to the export-reducing effect described above, this model suggests that greater corruption can also raise

[1]This is related to the argument made by Krueger (1974) that government regulations create rents and motivate government officials to engage in rent-seeking behavior.

exports by allowing exporters to lower the delay it faces. In the model, exporters pay bribes to customs officials to encourage them to process their documents in an expedited manner. The time saved due to this lowers the delay that an exporter faces. If the value of this reduction in delay is greater than the total bribe payment, then corruption will attenuate the adverse effects of red tape on exports.

To examine this issue empirically I use firm-level data from the *Business Environment and Enterprise Performance Surveys*. These surveys were conducted jointly by the European Bank for Reconstruction and Development and the World Bank. The sample I use includes a rich set of information on firms from 25 Eastern European and Central Asian countries in 2005 and 2008. Apart from standard information on production, these data also report each firm's exports as well as information on the business environment (including interaction with customs officials) that they face. I combine these data with information on customs-related red tape from the World Bank's *Doing Business* reports. These are an annual publications that document the constraints to conducting business around the world including the regulatory barriers faced by firms that trade across borders. One of the variables used to measure this regulatory burden is the number of documents that exporters need to clear their goods through customs. This is my primary measure of customs-related red tape.

To evaluate the model's prediction, I use a reduced-form approach where I examine whether the effect of red tape on exports depends on the prevalence of corruption in a firm's industry and country. I define the prevalence of corruption as the fraction of firms in an industry-country pair that make unofficial payments to customs officials. This means that my measure of corruption prevalence is specific to customs and is not a more general measure of corruption. The rationale behind my empirical strategy is that, if it is the case that corruption allows exporters to lower the delay they face at customs, then we should observe that the adverse effect of customs-related red tape will be relatively weaker in magnitude for exporters located in industry-country pairs where corruption is more prevalent. Of course, we know that industries vary along other dimensions as well and that these other dimensions could also explain my findings. To account for this, I include industry and year interaction fixed effects in my econometric specification. Thus, when I examine whether the effect of customs-related red tape on firm exports depends on industry and country-level corruption prevalence, I am controlling for other unobserved, time-varying industry characteristics in a flexible manner.

The results suggest that the negative effect of greater red tape on firm exports is lower for firms in industries and countries where corruption at customs is more prevalent. In particular, my estimates suggest that, for a firm in an industry with the median level of corruption prevalence, adding a document needed to process goods through customs lowers exports by an additional 4.3 percentage points relative to a firm in an industry at the 75th percentile of corruption prevalence. These results imply that, conditional on there being customs-related red tape, an exporter is better off if it is in an environment where it can use bribes to lower the delay that it faces. These results remain robust when I allow customs-related red tape to have heterogeneous effects on firm exports through other industry-level channels. That is, even when I include alternate industry characteristics along with its interaction with customs-related red tape to my baseline specification, I find that the prevalence of corruption attenuates the adverse effects of red tape on firm exports.

This paper is related to a growing literature documenting the trade-increasing effects of greater trade facilitation, i.e. a reduction of delays and its associated transaction costs faced by firms at customs. For example, Wilson, Mann, and Otsuki (2004) use a gravity model to examine the effect of trade facilitation on trade volume. Their results confirm that such trade facilitation can have significant positive effects on trade. Similarly, Nordas, Pinali, and Geloso Grosso (2006) show that greater delays at the border have a significant negative effect on trade. As mentioned earlier, this result is confirmed by Djankov et al. (2010) and Volpe Martincus et al. (2015) who show that greater delays lower trade. A related literature examines the adverse effects of port inefficiency on shipping costs and trade flows. For instance, Clark, Dollar, and Micco (2004) find that increased port efficiency significantly lowers shipping costs while Blonigen and Wilson (2008) find that increased port efficiency significantly raises trade volumes.

This paper is also related to a literature on the efficiency effects of corruption. This literature can be divided into two camps. The first camp argues that corruption distorts behavior away from the first best and thereby reduces welfare (Shleifer and Vishny, 1993; Rose-Ackerman, 1999).

In the trade and corruption literature, this negative view of corruption is supported by an early study by Anderson and Marcouiller (2002). They use a gravity framework to examine whether inadequate institutions, which they proxy using corruption and imperfect contract enforcement, impacts bilateral trade between countries. Their findings suggest that the adverse effect of inadequate institutions are stronger than the effect of tariffs. More recently, Olney (2015) finds that corruption raises the probability of a firm exporting indirectly through an intermediary and lowers the probability of a firm exporting directly.

The second camp argues that corruption need not always be detrimental. Instead, this literature argues that corruption can improve efficiency (Leff, 1964; Huntington, 1968; Lui, 1985). Central to this argument is the notion that bribery allows firms to circumvent excessive red tape and thereby attenuate its regulatory burden. In the trade and corruption literature, this positive view of corruption is conditionally supported by Sequeira and Djankov (2014). In an important contribution, they distinguish between "collusive" and "coercive" corruption. The former occurs when customs officials and firms collude to share the rents from an illegal transaction (e.g. underreporting of export/import value) while the latter occurs when the customs officials extracts a bribe to provide a public service. Their results suggest that collusive corruption increases the volume of trade through a corrupt port while coercive corruption diverts trade towards competing ports. The view that corruption can enhance trade is also conditionally supported by the findings of Dutt and Traca (2010). They use a gravity framework to show that while greater corruption reduces trade at low levels of tariffs, it has the opposite effect at high levels of tariffs. In other words, in the latter case greater corruption can increase trade by allowing firms to avoid exorbitant tariffs.[2]

The remainder of this paper is structured as follows. In section 2 I describe a simple model of corruption, red tape, and exports that highlights the export-reducing and export-increasing effects of greater customs-related red tape. In section 3 I describe the data I use to measure customs-related red tape, corruption prevalence, and firm exports. In section 4 I describe my econometric

[2] Dutt and Traca's result is related on an earlier theoretical literature that examines the possible trade-increasing effects of using smuggling to evade tariffs (Bhagwati and Hansen, 1973).

strategy while in section 5 I describe my results. Finally, in section 6 I provide a conclusion.

2 A Simple Model of Corruption, Red Tape, and Exports

2.1 Setup

In this section I develop a simple model that examines the effect of customs-related red tape on corruption and exports. The main purpose of the model is to clarify the nature of corruption and exporter-customs official interaction that can allow corruption to have both an export-reducing as well as an export-increasing effect. The model proceeds in two stages. In the first stage, a representative firm's problem is to maximize the following profit function:

$$\pi = (1-\theta)P^*X - bX - c(X) \tag{1}$$

where X is the quantity of the good produced by the firm. For simplicity, I assume that all products that are produced by the firm are intended for export. P^* is the world price for the product, which the firm takes as given. Each firm has a manager that is endowed with a finite amount of time, which I normalize to one. The manager spends a fraction θ of her time waiting at customs for her customs-related documents to be processed, where $0 \leq \theta \leq \theta_H$. $\theta_H < 1$ is the time spent by a manager on customs-related activities when there are documents needed to export and corruption is not possible/optimal. The manager spends the remaining $(1-\theta)$ of her time supervising production.[3] This means that greater customs-related delays cause a reduction in a firm's exports by diverting its manager's time away from supervising production and towards dealing with red tape.

Next, b is the per unit bribe paid by the firm to the customs official. I refer to this as the *bribe rate* from hereon. Finally, $c(X)$ is the total cost function for the firm with $c_X > 0$ and $c_{XX} > 0$.

[3] Dal Bó and Rossi (2007) have a similar model where a manager can exert effort in either supervising production or negotiating a better price for the firm's product. In their model, a manager's reward is a function of firm profits, which in turn are a function of the price that they receive. They show that in corrupt environments, devoting effort to negotiating a higher price is more rewarding. As a result, in such environments, firms are less efficient because a manager's effort is diverted away from supervising production and towards negotiating a higher price.

Thus, the firm's problem is to choose its optimal export quantity, X, given θ and b. This results in the following first-order condition:

$$(1-\theta)P^{*}-b-c_{X}=0 \tag{2}$$

In the second stage, the firm interacts with the customs official to clear its goods through customs. Having produced X units of its product in the first stage, the firm's objective is to pick the bribe rate that allows it to minimize the delay it faces at customs. Its payoff from the interaction with the customs official is then:

$$U_{F}=[1-\theta(D,b)]P^{*}X-bX-(1-\theta_{H})P^{*}X \tag{3}$$

where the third term is the firm's outside option in the event that negotiations with the customs official breaks down. In this setup, the firm must weigh the benefits of paying a bribe (lower θ) against the cost of doing so (higher bX). I assume that θ is a function of the number of documents needed to export (D) with $\theta_D > 0$. I refer to D as red tape from hereon, which the customs official takes as given.[4]

The amount of red tape, D, sets the upper bound on the delay faced by the firm. The customs official has the ability to impose lower delays on a particular shipment in exchange for bribes. One way to think about this is that a customs official requires θ_H units of time to thoroughly check the documents that the firm is required to complete. In exchange for a bribe, the official can agree to lower the thoroughness with which he reviews the firm's documents. In other words, firms pay bribes to encourage customs officials to "shirk" on their duties in order to save time.

The above implies that the delay faced by the firm, θ, will also be a function of the bribe it pays (b), with $\theta_b < 0$. This means that the actual delay faced by the firm will depend both on the

[4]This implicitly assumes that there is a significant hierarchical distance between the government official that determines D and the customs official. Thus, by assumption, these two officials are not able to collude. If this were not the case, then it would be possible for the customs official to pass along some of the bribes to the official that determines D, who will then set D to maximize bribe earnings.

level of D set by the government as well as the bribes paid.[5] Further, I assume that $\theta_{bb} > 0$. This implies that the effectiveness of bribes in lowering delays decreases at higher levels of bribes. It also means that θ will not necessarily go to zero once bribes are paid. Lastly, I assume that $\theta_{bD} \neq 0$. I return to this below where I take a stand on the sign of this effect.

The customs official's payoff from its interaction with the exporter is:

$$U_O = bX - \Omega(bX)F \tag{4}$$

where $\Omega(bX)$ is the probability that the bribe payment will be detected. For a given X, this probability is an increasing function of the bribe rate with $\Omega_b > 0$ and $\Omega_{bb} > 0$. Further, I assume that Ω is independent of red tape (D). Lastly, F represents the fine that a customs official must pay in the event that a corrupt transaction is detected.[6] As with the firm, the customs official must weigh the benefit of corruption (higher bX) against the cost of doing so (higher expected fine).

2.2 Customs-Related Red Tape and Bribes

I solve the model by backward induction. For simplicity I assume that in the second stage, the firm and the customs official pick a bribe rate (b) that maximizes their joint payoffs $(U_J = U_F + U_O)$, which is as follows:

$$U_J = (\theta_H - \theta)P^* X - \Omega(bX)F \tag{5}$$

We can use the first-order condition with respect to b for this problem to generate the following result:

$$\frac{\mathrm{d}b}{\mathrm{d}D} = -\frac{P^* X\theta_{bD}}{P^* X\theta_{bb} + \Omega_{bb}F} \tag{6}$$

[5] The firm can use bribes to lower the delay it faces in three key ways. First, it can use the bribe to move up in the queue. Second, it can maintain its position in the queue but expedite the processing time for its exports. Third, it can use the bribe to both move up in the queue and expedite processing times. The data I use are not rich enough to distinguish between these means of lowering delays. As a result, I abstract from the precise nature in which bribes lower delays in the model.

[6] Here I am not explicitly allowing for the possibility that the customs official may lose his job if a corrupt transaction is detected. However, one can think of F as including both the fine and the present discounted value of earnings losses due to an official losing his job.

The denominator must be positive for the second-order condition to hold. This implies that the the sign of this expression depends on the sign of θ_{bD}. To be consistent with the empirical results described below, I assume that $\theta_{bD} < 0$. That is, I assume that additional red tape leads to a relatively lower increase in delays for a firm that already pays high bribes. This means that higher D will lead to higher corruption $(\mathrm{d}b/\mathrm{d}D > 0)$.

2.3 Customs-Related Red Tape, Bribes, and Exports

Next, from equation (2) we can derive the following expression for the effect of greater red tape on exports:

$$\frac{\mathrm{d}X}{\mathrm{d}D} = \frac{1}{c_{XX}} \left[- \underbrace{P^*\theta_D - b_D}_{\text{Export-Reducing Effect}} - \underbrace{\theta_b P^* b_D}_{\text{Export-Increasing Effect}} \right] \tag{7}$$

The first term inside the square brackets ($P^*\theta_D - b_D$) represents the export-reducing effect of greater red tape (D) and corruption. It simply states that higher D lowers exports in two ways. First, it raises the delay associated with clearing goods through customs ($\theta_D > 0$), which in turn lowers exports. Second, red tape means that a bribe must be paid to the customs official to lower delays ($b_D > 0$). This also lowers exports. On the other hand, the second term inside the square brackets $(\theta_b P^* b_D)$ represents the export-increasing effect of greater corruption. This is due to the fact that higher b will also lower delays ($\theta_b < 0$ by assumption). This effect alone will raise a firm's exports. Thus, the role played by corruption in altering the relationship between customs-related red tape and firm exports is uncertain. Importantly, it is possible for firms to use bribes to attenuate the overall effect of red tape on its exports.

To better understand the implications of this hypothesis for the optimality of trade facilitation, consider the following scenarios. From the firm's perspective, the best-case scenario is one where there is complete trade facilitation, i.e. $D = 0$. Here, the firm does not face a delay, does not have to pay bribes, and is able to export all of its output. The worst-case scenario is one where there is incomplete trade facilitation, i.e. $D > 0$, and where corruption is not possible ($b = 0$). In this scenario, the firm faces red tape and customs delays ($\theta = \theta_H$) but there is no scope for using bribes to lower the delay that it faces. Lastly, the intermediate scenario is one with incomplete trade facilitation, i.e. $D > 0$, but where corruption is possible ($b > 0$). In this scenario, the firm is able to use bribes to lower delays below θ_H. If the value of the reduction in delays bought by the bribe is greater than the total bribe payment, then the firm is better off relative to the worst-case scenario.[7] To put it slightly differently, conditional on there being customs-related red tape, the firm is better off if it can use bribes to lower the delay that it faces due to red tape. Nonetheless, it is still the case that a scenario with complete trade facilitation is the best outcome for the firm.[8]

3 Data

The firm-level data used in this paper are from the 2005 and 2008 *Business Environment and Enterprise Performance Surveys (BEEPS)* conducted jointly by the European Bank for Reconstruction and Development and the World Bank.[9] Similar data has been used to study corruption by Svensson (2003). The goal of these surveys was to capture the main constraints to employment and productivity among firms. For the 25 European and Central Asian countries in my sample, firms for the survey were selected using a random sampling technique.[10,11] Table 1 lists the countries included in the sample.

The surveys were targeted towards firms with at least five or more full-time employees and those that were located in major urban areas. Note that the survey is at the establishment level.

[7]More formally, the intermediate scenario is better than the worst-case scenario if and only if $P^*(\theta_H - \theta) > b$. This condition will hold as long as the firm's payoff from its interaction with the customs official (U_F) is positive. When U_F is zero, the firm is naturally indifferent between the intermediate and worst-case scenario.

[8]Here I am assuming that the firm exports "standard" products as opposed to products whose export is prohibited due to environmental, health, or strategic reasons. In the latter case, complete trade facilitation, while optimal for the firm, need not be socially optimal.

[9]The data are publicly available at www.enterprisesurveys.org. These data were also collected in 2002 for the countries in my sample. However, the 2002 data did not include the industry to which each firm belonged. Further, the data on export red tape that I use in the paper are also not available for this year. As a result, I restrict the sample to 2005 and 2008.

[10]The original sample includes 27 countries. I omit Azerbaijan as there are no firms from this country in the sample in 2005. In addition, I merge Serbia and Montenegro as they first appear in the data as separate countries in 2008.

[11]Similar data are available for a larger number of countries from all continents. However, this global sample does not include a measure of the corruption faced by firms when dealing with customs officials. As described below, this variable is central to my empirical strategy. As a result, I use the sample consisting of European and Central Asian countries instead.

To be included in the survey these establishments must make their own financial decisions and have financial records that are independent of the firm that owns them. Sections of the survey that deal with business environment and business decisions are always administered to the managing director of the establishment. For larger establishments, the sections on finance and productivity are administered to the accounting department. To construct my working sample, I first restrict the sample to firms in the manufacturing sector.[12] I then drop firms that do not report basic information such as sales, value of exports, and its establishment year. I also remove firms that report export values greater than their sales.

The BEEPS data are unique because, in addition to standard information on production, it includes information on each firm's business environment. In particular, the survey collects information on the amount of bribes paid by firms. Surveys that try to elicit such sensitive information must deal with some firms' unwillingness to participate. Several key steps were taken to address this concern. First, in order to ensure maximum participation the surveys were conducted by local consultants (usually in cooperation with local business organizations) hired by the World Bank. This was done to allay fears that the information collected in the survey would be used in future to target particular establishments.

In addition, questions regarding bribery were asked in an indirect manner in order to extract as honest an answer as possible. For example, the key bribery variable used in this paper is an answer to the following question, "thinking now of unofficial payments/gifts that *establishments like this one* (emphasis added) would make in a given year, please tell me how often would they make payments/gifts...to deal with customs/imports." Firms had the choice of selecting one of the six following options: (a) never, (b) seldom, (c) sometimes, (d) frequently, (e) usually, (f) always, and (g) don't know. Notice that the distinction between many of these options is not particularly

[12]The original sample includes 23 two-digit manufacturing industries. However, many of these industries have a very small number of firms. This creates a problem below when I use an industry-level average corruption measure. Calculating this measure for industries with a very small number of firms creates noisy estimates. To address this, I reclassify industries with fewer than 20 firms in both years combined and absorb them into the closest, feasible industry. For instance, the "manufacturing of textiles" industry has only 9 firms in 2005 and 2008 combined. I reclassify this industry and absorb it into the "manufacturing of wearing apparel" industry. I reclassify six industries in this manner, which yields 17 two-digit industries in the final sample. Further details of this reclassification are available upon request.

clear, e.g. "seldom" vs. "sometimes". To ensure a more meaningful delineation between firms that do and do not bribe, I convert the answers provided in the raw data into an indicator variable that captures whether or not a firm pays bribes to customs officials. This indicator variable takes the value of one if a firm answers with any of the options (b)–(f) to the question above. For firms that respond with option (a) to this question, the indicator variable takes the value of zero.

The data suggest that corruption among customs officials was fairly widespread in the sample. Over the two sample years, 33.7 percent of exporters in the sample report paying bribes to a customs official. In fact, 10.4 percent of exporters report paying such bribes either "frequently", "usually", or "always". As Figure 1 illustrates, the prevalence of corruption varies markedly across countries in the sample. For example, 75 percent of Albanian exporters in the sample report paying such bribes whereas 10.3 percent of Slovenian exporters report paying such bribes. Further, the prevalence of corruption among customs officials decreased during the sample period. As Table 2 documents, 36 percent of exporters in the sample reported paying bribes to a customs official in 2005. In 2008, this number had decreased to 29 percent. This is supported by the second row of Table 2, which suggests that fewer firms perceive customs to be an obstacle in 2008. In particular, 58 percent of the sample reported customs as an obstacle in 2005 whereas 49 percent did the same in 2008. Nonetheless, despite this improvement, it is clear that customs and particularly corruption among customs officials is not a trivial barrier to exporters in the sample.

As a robustness check, I also use a more general measure of the extent of corruption that firms in the sample face. This measure is calculated using a firm's response to the following question: "on average, what percent of total annual sales do firm's like yours typically pay in unofficial payments/gifts to public officials?" While this measure provides a quantitative estimate of the extent of corruption, it is not directly related to corruption at customs. This is why I do not treat it symmetrically to the customs-related corruption variable above and instead use it to conduct robustness checks.

In addition to collecting information on institutional constraints faced by firms, the survey also asked firms to report a standard list of variables such as sales, employment, exports, and ownership information. In particular, firms were asked to list the percentage of their sales that were (a) sold domestically, (b) exported directly, and (c) exported indirectly through a distributor. I define a firm as an exporter if it reports exporting directly. These firms represent 35 percent of the sample. The share of exporters in the BEEPS sample falls within the range of numbers reported by Mayer and Ottaviano (2007) for a select list of six European countries.[13] In addition, exports represent approximately 43 percent of sales for the average exporter in the sample. As Table 3 indicates, the exporters in the sample tend to be larger, more productive, older, and have higher levels of foreign investment. Table 3 also reports the means and standard deviations of all variables used in the paper. The typical firm employs 37 permanent workers and has been in business for about 17.9 years. While the average firm was mostly privately owned, approximately 13 percent of firms report having some foreign ownership. Table B.1 in the appendix describes the key variables used in the paper along with their source.

To capture the extent of customs-related red tape I use the number of documents needed to export in each country. These data are from various *Doing Business* reports. These are annual publications from the World Bank that document the constraints to conducting business around the world. One of the constraints documented in these reports is the difficulty of trading across borders. This is essentially an evaluation of the constraints to importing and exporting in various countries. To quantify these constraints, the *Doing Business* reports recorded every official document needed to export a standardized cargo of goods in each country. These documents fall into four broad categories: (a) bank documents, (b) customs clearance documents, (c) port and terminal handling documents, and (d) transport documents.

The information on the documents needed to export was gathered using surveys administered on local freight forwarders, shipping lines, customs brokers, and port officials. To ensure that the data are comparable across countries, each survey respondent was asked to consider traded products that travel in a dry-cargo, 20-foot, full container. They were also asked to consider products that are not hazardous, that do not require refrigeration and meets international

[13] For the three countries in their sample for which they have representative data, the share of exporters ranges from 28 percent in the U.K. to 40 percent in Norway and 48 percent in Hungary. The data for the remaining three countries (France, Germany, and Italy) are skewed towards larger firms. As a result, the share of exporters in these samples are considerably higher.

phytosanitary and environmental safety standards (Djankov et al., 2010). Further, respondents were asked to consider all documents required *per* export shipment. Thus, any documents that are valid for a year or longer or do not have to be acquired for every shipment are not included in these data. For landlocked countries, the data on the documents needed to export also include documents required by the transit countries.

The number of documents needed varies markedly across countries in the sample. For instance, an exporter in the Kyrgyz Republic requires 15 documents to export whereas an exporter in Estonia only requires 3 documents. Table 2 depicts the trend in this measure of red tape between 2005 and 2008. As this table shows, the number of documents needed to export has decreased slightly over this period. In particular, in 2005 the average exporter in the sample needed 7.32 documents to process their goods through customs. On the other hand, in 2008, the average exporter needed of 7.18 documents to process their goods through customs.

As a robustness check, I also use the total number of days needed to process goods through customs to proxy for the extent of customs-related red tape in a country. These data are also collected by the World Bank in its *Doing Business* reports. This alternate measure also suggests that the extent of red tape has decreased over the sample period. In particular, in 2005 the average exporter in the sample needed 32.1 days to process their goods through customs. On the other hand, in 2008, the average exporter needed of 28.1 days to process their goods through customs.

Despite the strong correlation between the number of documents needed to clear goods through customs and the total days needed to do so (correlation coefficient of 0.76), I do not treat these two proxies for red tape symmetrically. This is because, according to the model in section 2, the time needed to clear customs is a function of the extent of red tape mandated by the government as well as the endogenous choices made by customs officials and firms when they agree on the amount of bribes to be paid. On the other hand, the number of documents needed to clear customs is set by the government and is independent of the agreement process between the customs official and the firm. For this reason, I treat the latter as my primary proxy for red tape while I use the former as a test of the robustness of my results. I show later that the key results of the paper are robust to using the number of days needed to clear customs as a proxy for red tape.

Finally, I also use the customs-specific logistics performance index (LPI) for each country as an alternate measure of customs-related red tape. This index was constructed by the World Bank using survey responses from multinational freight forwarders and express carriers and scores the "efficiency of the clearance process by customs and other border agencies" in each country (World Bank, 2007). The index is provided as an overall score for each country as well as for specific logistical aspects. I use the index score that is specific to customs in my analysis. The score is provided on a numerical scale from 1 (worst) to 5 (best). To ensure easier comparison with my primary measure of customs red tape, I use a modified score that is defined as $5 - \text{LPI}$, where LPI is the original index score for each country. The modified score is increasing in logistics inefficiency. [14] These data were first collected in 2007, which is the year I use. Thus, in my analysis, this index varies by country but not year.

4 Econometric Strategy

To examine the total effect of customs-related red tape on the value of firm exports I estimate the following econometric specification:

$$\ln(X_{ijct}) = \gamma_0 + \gamma_1 D_{ct} + \gamma_2 F_{ijct} + \gamma_3 Z_{ct} + \sum_{r=1}^{2} \delta_r + \delta_j \times \delta_t + \varepsilon_{ijct} \quad (8)$$

where X_{ijct} is the total value of exports for firm i in two-digit industry j, country c, and year t.[15] D_{ct} is the total number of documents needed to process export goods through customs in a given country and year. F_{ijct} is a set of firm-level control variables. This includes the natural logarithm of total permanent employees, age, age squared, and an indicator for whether a firm has foreign ownership. Z_{ct} is a set of country-level control variables that includes the natural logarithm of GDP per capita and the growth rate of GDP. δ_r is a fixed effect for region r. I construct these fixed effects by dividing the sample of countries into four regions: (a) European Union (EU), (b) Central Asia and Caucasus (c) Southern Europe and (d) Eastern Europe (non EU). I then include

[14] On average, having a LPI higher by one point means that an exporter has to wait three additional days to export (World Bank, 2007).

[15] I added USD 1 to each firm's exports before taking logs.

the fixed effects for the EU, Central Asia, and Southern Europe in equation (8). The list of countries in each region is listed in Table 1. Given that countries in the same region are likely to have similar geography and factor endowments, these region fixed effects will control for such factors.[16] Finally, $\delta_j \times \delta_t$ are two-digit industry and year interaction fixed effects while ε_{ijct} is a classical error term.

γ_1 above captures the total effect of higher documents needed to export on firm-level exports. As the model in section 2 shows, this total effect has two components: (a) an export-reducing effect and (b) an export-increasing effect. The former captures the fact that higher documents needed to export (customs-related red tape) will lower exports directly by raising delays. Further, by inducing greater corruption, higher documents needed to export will also raise the cost of exporting. Both of these effects will lower exports. On the other hand, section 2 also shows that the bribes induced by greater customs-related red tape will allow firms to lower the delay that it faces. This will increase exports. To separate these two effects, I use the following reduced-form specification:

$$\begin{aligned} \ln(X_{ijct}) &= \beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 F_{ijct} + \beta_5 Z_{ct} \\ &\quad + \sum_{r=1}^{2} \delta_r + \delta_j \times \delta_t + \nu_{ijct} \end{aligned} \tag{9}$$

where B_{jct} is the fraction of firms in a given industry and country that report making unofficial payments when dealing with customs officials (corruption prevalence) and ν_{ijct} is once again a classical error term. All other variables are defined as before. Here β_1 captures the export-reducing effect of higher documents needed to export. On the other hand, β_3 captures the attenuating/exacerbating effect of corruption. A positive β_3 means that, holding other industry characteristics constant, in industries where corruption is more prevalent, the negative effect of a given increase in D_{ct} on exports is relatively smaller. This is consistent with firms using bribes to attenuate the effects of greater customs-related red tape on their exports.[17]

[16] As Figure 2 demonstrates, there is very little time variation in the number of documents needed to export. As a result, including country fixed effects in equation (8) will absorb most of the variation in D_{ct}. Instead, I include country-level controls and region fixed effects to capture country characteristics that are correlated with D_{ct}.

[17] An alternate way of separating the export-reducing and export-increasing effects would be to estimate two simul-

The key identifying assumption here is that there are no unobservable industry characteristics that are correlated with both the prevalence of corruption in an industry (B_{jct}) as well the level of exports by the firm (X_{ijct}). This assumption can be violated for several reasons. For instance, it could be the case that both B_{jct} and X_{ijct} are correlated with unobserved industry-specific demand shocks as well as unobserved changes in industry-specific productivity or technological change. To address such concerns, I add industry and year interaction fixed effects to all specifications estimated in this paper. The inclusion of these interaction fixed effects will flexibly capture any time-varying, unobservable industry characteristic that is correlated with both B_{jct} and X_{ijct}.

A related concern is that in equation (9), I am assuming that any heterogeneous effect of red tape (D_{ct}) is due to variation in the prevalence of corruption in an industry-country pair. However, it could be the case that D_{ct} has heterogeneous effects on exports through other industry characteristics. To address this, I sequentially add a series of alternate industry characteristics to (9) along with its interaction with D_{ct}. I then examine whether the coefficient of my interaction term of interest ($B_{jct} \times D_{ct}$) remains robust. These results are described in greater detail in section 5.2.

Given that a large fraction of firms in the sample are non-exporters, equations (8) and (9) represent a standard corner solution model (Wooldridge, 2010). To account for the large number of zeroes I estimate both equations using Tobit.[18] In particular, I assume that X^* represents a latent variable for exports where

$$
\begin{aligned}
X^*_{ijct} &= \beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 \zeta_{ijct} + \nu_{ijct}, \\
X_{ijct} &= \max(0, X^*_{ijct})
\end{aligned}
$$

where $\nu \sim \mathrm{N}(0, \sigma^2)$ and $\zeta_{ijct} = \beta_4 F_{ijct} + \beta_5 Z_{ct} + \sum_{r=1}^{2} \delta_r + \delta_j \times \delta_t$. Further, I assume that the latent

taneous equations where the dependent variable in one equation is the bribes paid by firms to customs officials and the dependent variable in the other equation is the natural logarithm of exports. To implement this I need an exclusion restriction that is correlated with the bribes that a firm pays at customs but not with exports. Given the interconnectedness of bribes and exports in this setting, finding such an exclusion restriction is difficult. As a result, I use the approach described above.

[18] An alternate is to restrict the sample to firms with positive exports and then use a Heckman-style selection correction. Unfortunately, the lack of an appropriate exclusion restriction makes this option less attractive.

variable X^* has a normal, homoskedastic distribution. Given that Tobit is a nonlinear model, I report the marginal effects of each variable of interest on $\mathrm{E}(X)$. In particular, the marginal effect of D_{ct} that I calculate is:

$$\frac{\partial \mathrm{E}[X]}{\partial D_{ct}} = (\beta_1 + \beta_3 B_{jct})\Phi(\mu) \tag{10}$$

where $\mu = (\beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 \zeta_{ijct})/\sigma$ and $\Phi(\mu)$ is the standard normal cumulative distribution function. Next, the marginal effect of B_{jct} is:

$$\frac{\partial \mathrm{E}[X]}{\partial B_{jct}} = (\beta_2 + \beta_3 D_{ct})\Phi(\mu) \tag{11}$$

Finally, the interaction term in equation (9) does not have an interpretation that is analogous to linear models. As Ai and Norton (2003) point out, the magnitude of the *interaction effect* in non-linear models does not necessarily equal the magnitude of the marginal effect of the *interaction term*. To correctly calculate the interaction effect we need to account for all necessary cross derivatives. For instance, using equation (10), we can derive the following formula for the total interaction effect:

$$\frac{\partial^2 \mathrm{E}[X]}{\partial D_{ct} \partial B_{jct}} = \beta_3 \Phi(\mu) + (\beta_1 + \beta_3 B_{jct}) \left(\frac{\beta_2 + \beta_3 D_{ct}}{\sigma} \right) \phi(\mu) \tag{12}$$

where the first term on the right-hand-side, $\beta_3\Phi(\mu)$, is the marginal effect of the interaction term. From the above expression, we can see that the marginal effect of the interaction term is not equivalent to the overall interaction effect. In fact, even if β_3 is equal to zero, the interaction effect could be non-zero.

To calculate the marginal effects above I replace the β's and σ with their respective Tobit estimates. I also substitute the average value of D_{ct} and B_{jct} where appropriate. I then use STATA's `nlcom` command to calculate the marginal effects in equations (10)$-$(12). This yields both an estimate for each marginal effect along with their respective standard errors, which is calculated using the Delta method.

5 Results

5.1 Baseline Results

In column (1) of Table 4 I present the results from estimating equation (8) using OLS. Recall that the coefficient of the documents needed to export variable captures the total effect of such customs-related red tape on firm exports. In column (1) this coefficient is negative and statistically significant. It suggests that adding a document needed to process export goods through customs lowers firm exports. In column (2) I report the results from estimating equation (9) using OLS. Here I add a time-varying, country and industry specific measure of corruption prevalence. This is simply the fraction of firms in a country, industry, and year cell that report paying bribes to customs officials. I also interact this variable with the number of documents needed to export. The coefficient of this interaction term is positive and statistically significant. This suggests that the impact of greater red tape is attenuated for firms in industries where corruption is more prevalent. This is consistent with firms using bribes to lower the regulatory burden that they face when clearing their goods through customs. To gauge the magnitude of the attenuating effect of corruption, consider two firms. Let the first firm be in an industry that has the median level of corruption prevalence and let the second firm be in an industry with a corruption prevalence at the 75th percentile. The results in column (2) suggest that the adverse impact of one additional document needed to export for the latter firm is 4.41 percentage points lower when compared to the former firm.

In column (3) I report the results from estimating equation (8) using Tobit. The coefficient estimate in the top panel of Table 4 is negative and statistically significant. This confirms that greater customs-related red tape reduces firm exports. To gauge the magnitude of this effect, I report the marginal effects in the lower panel of Table 4. The marginal effect of the documents needed to exports variable in column (3) is calculated using the following

$$\frac{\partial \mathrm{E}[X]}{\partial D_{ct}} = \beta_1 \Phi(\mu)$$

where β_1 is the coefficient of the documents needed to export variable, $\Phi(\mu)$ is the standard normal cumulative distribution function, and μ is defined below equation (10). The estimate confirms that adding a document needed to process export goods through customs lowers firm exports.

In column (4) of Table 4 I report the results from estimating equation (9) using Tobit. The coefficient estimates in the top panel suggest that the level effect of documents needed to export is negative and significant while the coefficient of the interaction term is positive and significant. However, as pointed out in section 4, the magnitude of the *interaction effect* in nonlinear models does not necessarily equal the magnitude of the marginal effect of the *interaction term*. As a result, I report the marginal effects, evaluated at the mean of all variables, in the lower panel of column (4). The marginal effect of the documents needed to export variable is calculated using equation (10). The estimate again suggests that adding a document needed to process goods through customs lowers firm exports. Next, the magnitude of the interaction effect is calculated using equation (12). This estimate suggests that the adverse effect of an increase in the number of documents needed to export is smaller for firms in industries where corruption is more prevalent. As mentioned above, this is consistent with firms using bribes to lower the regulatory burden that they face when clearing their goods through customs.

To gauge the magnitude of the attenuating effect of corruption, again consider two firms. As before, let the first firm be in an industry that has the median level of corruption prevalence while the second firm is in an industry with a corruption prevalence at the 75th percentile. The results in column (4) suggest that the adverse impact of one additional document needed to export for the latter firm is 4.3 percentage points lower when compared to the former firm. To further illustrate the heterogeneous effect of customs-related red tape, I plot the marginal effect (along with the 95 percent confidence interval) of customs-related red tape at various deciles of corruption prevalence in Figure 3. In particular, I calculate the marginal effect in equation (10) at various deciles of corruption prevalence and plot the resulting marginal effects.[19] This figure confirms that customs-related red tape has stronger adverse effects on firm exports in industries where corruption is less

[19] If I were to estimate equation (9) using OLS, then β_1 would be the "level" effect of D_{ct} and $\beta_1 + \beta_3 \overline{B}_{jt}$ would the total effect of D_{ct}. However, when equation (9) is estimated using Tobit, the total effect of D_{ct} is given by equation (10).

prevalent.[20] This suggests that bribes are an effective way for firms to attenuate the adverse effects of customs-related red tape on firm exports.

Table 4 shows that delays are an important impediment to firm exports and that corruption allows firms to attenuate the adverse effect of these delays. The losses due to delays and the importance of corruption should be more important for firms producing time-sensitive products. That is, products which are more susceptible to spoilage, changes in fashion cycles, and technological obsolescence. To examine whether this is the case, I categorize industries as having either time-sensitive or time-insensitive products with the method used by Volpe Martincus et al. (2015).[21] This method relies on the regression results of Hummels (2001), who examines how air shipment costs and ocean shipment times affect the probability of choosing air transport. In particular, he regresses an indicator for whether or not a shipment arrived in to the U.S. by air on the ratio of ocean shipment days and air freight charges (days/rate ratio). He ran these regressions for each two-digit SITC industry in his sample. Following Volpe Martincus et al. (2015), I categorize a two-digit SITC industry as having time-sensitive products if the days/rate ratio coefficient for that industry is positive and statistically significant. All other industries are classified as having time-insensitive products. I then created a cross-walk between the SITC categorization in Hummels (2001) and the ISIC two-digit industries in my sample. Table B.2 in the appendix lists the industries in my sample that I was able to categorize in this manner.[22]

In columns (1) and (2) of Table 5 I restrict the sample to industries with time-sensitive products (time-sensitive industries from hereon). In column (1) I report the results of estimating equation (8) on this restricted sample while in column (2) I report the results of estimating equation (9). When compared to the results in Table 4, these results confirm that delays have stronger effects on firm exports for firms in time-sensitive industries and that the attenuating effect of corruption is also stronger in these industries. Similarly, in columns (3) and (4) of Table 5 I restrict the sample

[20]The estimates suggest that in industries in the highest corruption prevalence decile, adding one more document needed to export *raises* firm exports. However, this estimate is statistically insignificant with a p-value of 0.61.

[21]Djankov et al. (2010) also use a similar method to categorize their industries as having either time-sensitive or time-insensitive products.

[22]Two industries, "printing of recorded media" and "repair of machinery", could not be classified. These two industries did not have equivalent industries in Hummels' analysis.

to time-insensitive industries. In column (3) I report the results of estimating equation (8) on this restricted sample while in column (4) I report the results of estimating equation (9). These results suggest that delays have weaker effects (relative to the baseline sample) on firm exports for firms in time-insensitive industries and that corruption does not have a statistically significant attenuating effect.

The baseline estimates reported in Table 4 combine both the intensive and extensive margins of the effects of customs-related red tape and corruption. I next disentangle these two margins in Table 6. In columns (1)–(2), I estimate the intensive margin. The dependent variable is still the natural logarithm of exports and the coefficients are estimated using equations (8) and (9). However, the marginal effects reported in these columns are the effects of each variable on $\mathrm{E}[X|X > 0]$.[23] In particular, in column (1) I report the following

$$\frac{\partial \mathrm{E}[X|X > 0]}{\partial D_{ct}} = (\beta_1 + \beta_3 B_{jct})\psi(\mu)$$

where $\psi(\mu) = 1 - \lambda(\mu)(\mu + \lambda(\mu))$, $\lambda(\mu) = \phi(\mu)/\Phi(\mu)$ is the inverse Mills ratio, $\phi(\mu)$ is the standard normal density function and μ is defined below equation (10). The estimate again suggests that adding a document needed to process goods through customs lowers firm exports through the intensive margin. In column (2) I report the marginal effects of D_{ct}, B_{jt}, and $B_{jct} \times D_{ct}$. The interaction effect is given by

$$\frac{\partial^2 \mathrm{E}[X|X > 0]}{\partial D_{ct} \partial B_{jct}} = \beta_3 \psi(\mu) - (\beta_1 + \beta_3 B_{jct}) \left(\frac{\beta_2 + \beta_3 D_{ct}}{\sigma} \right) [\lambda(\mu) + (\psi(\mu) - 1)(\mu + 2\lambda(\mu))]$$

In columns (3) and (4) of Table 6 I report the extensive margin effects. The dependent variable is an indicator for exporting firms. That is, it takes the value of one if a firm exports and zero if it does not. The resulting model is estimated using probit. In column (3) I report the marginal effect of documents needed to export on the probability of exporting. The estimate suggests that adding a document needed to process goods through customs lowers the probability of exporting.

[23]These marginal effects below are derived in the appendix.

In column (4) I once again report the marginal effects of D_{ct}, B_{jt}, and $B_{jct} \times D_{ct}$.[24] These estimates suggest that, for a firm in an industry with the median level of corruption prevalence, adding a document needed to process goods through customs lowers the probability of export by an additional 0.01 percentage points relative to a firm in an industry at the 75th percentile of corruption prevalence. In other words, corruption does not attenuate the effect of red tape on the decision to export in a meaningful way. Instead, the key attenuating effect of corruption occurs through the intensive margin of exports.

5.2 Alternate Industry Characteristics

The econometric strategy I use assumes that any heterogeneous effect of red tape on firm exports is due to variation in the prevalence of corruption in an industry-country pair. However, it could be the case that corruption prevalence is correlated with other industry characteristics and that these alternate characteristics are the source of the heterogeneous effects of red tape. To address this, I sequentially add various industry characteristics along with its interaction with red tape to my baseline specification. The marginal effects from these modified specifications are reported in Table 7.[25]

In column (1) I re-state my baseline estimates from column (4) of Table 4 for ease of comparison. In column (2) I add the average sales (in natural logarithm) in an industry, country and year cell along with its interaction with customs-related red tape to my baseline specification. This average sales variable is calculated using the firm-level, BEEPS data used in this paper and will control for the fact that in industries where the average firm is large, firms might be able to devote more resources to negotiating with customs officials and thereby minimize the adverse effects of red tape on their exports. To the extent that the average firm size in an industry is correlated with the prevalence of corruption, the coefficient of the interaction term of interest might be picking up the heterogeneous effects based on average firm size rather than corruption prevalence. However, as the results in column (2) demonstrate, the inclusion of average firm size and its interaction

[24] The interaction effect is calculated using the derivations in Ai and Norton (2003).
[25] All marginal effects reported from this table onwards are calculated using equations (10)−(12).

with customs-related red tape does not alter the key results of the paper. I still find that adding a document needed to process goods through customs lowers the value of goods exported for the average firm and that this effect is attenuated for firms in industries where corruption is more prevalent.

Next, I add proxies for the average productivity of firms in an industry as well as its interaction with customs-related red tape to my baseline specification. This addresses the following concern. Suppose that in high-productivity industries firms are more efficient in preparing the necessary documents needed for export. This will allow them to minimize the delay-increasing effects of customs-related red tape. This also means that the heterogeneous effects of red tape that I have documented thus far could be driven by differences in average firm productivity in an industry rather that corruption prevalence.

To address this I use two proxies for average firm productivity in an industry. In column (3) of Table 7 I add the skill intensity of an industry, country, and year cell along with its interaction with red tape to my baseline specification. Skill intensity is defined as the ratio of nonproduction to production workers and is first calculated at the firm level using the BEEPS data. I then aggregated this to the industry, country, and year level by calculating a simple average. As before, the inclusion of these two variables in the baseline specification does not alter the key results of the paper. As the results in column (3) demonstrate, the coefficient of interest remains highly robust after I allow customs-related red tape to have heterogenous effects on firm exports through variation in the average skill intensity of an industry. In column (4) I include the average labor productivity in an industry, country and year cell along with its interaction with red tape. Labor productivity is defined as the natural logarithm of a firm's sales to permanent employment ratio. I aggregated this to the industry, country, and year level using a simple average. Once again I find that the coefficient of interest remains highly robust.

In column (5) I allow customs-related red tape to have heterogeneous effects on firm exports through variation in the fraction of an industry's products that are shipped by air. This will address the fact that the impact of red tape on delays and firm exports may depend on the extent to which alternate, faster transport is available. For instance, suppose a firm's product is sufficiently lightweight such that air shipment is feasible. In this case, firms may attenuate the effect of greater customs-related red tape on delays and exports by increasingly using air shipment. This could also explain the heterogenous effects of red tape that I have documented thus far. I use data from Hummels and Schaur (2013) to calculate each industry's fraction of air shipment. In particular, for each industry, I calculate the fraction of imports (by value) arriving in to the U.S. by air over Hummels and Schaur's sample period of 1991–2005. I then include the interaction between this variable and customs-related red tape to my baseline specification.[26] As the results in column (5) demonstrate, my key results are robust to the inclusion of this additional interaction term.

Lastly, in column (6) I allow customs-related red tape to have heterogeneous effects on firm exports through variation in the fraction of an industry's products that are differentiated. Products that are more differentiated are ones for which it is harder to assess the actual value of a shipment (Sequeira and Djankov, 2014). As a result, these are also products where there is relatively greater intentional misclassification to avoid tariffs (Fisman and Wei, 2004). Thus, the difficulty of assessing the true value of a shipment may mean that, for a given level of red tape, firms with differentiated products will face greater delays. To examine whether this matters, I calculate each industry's fraction of differentiated products using the Rauch (1999) classification. I then add the interaction between this fraction and customs-related red tape to my baseline specification.[27] The results are reported in column (6) of Table 7. As these results show, the inclusion of this additional interaction term does not appreciably change my baseline results.

5.3 Alternate Country Characteristics

Next, I examine the extent to which my primary results are robust to the inclusion of other country characteristics. Recall that due to a lack of inter-temporal variation in customs-related red tape, my baseline specification does not include country fixed effects and instead includes a set of country-level controls and region fixed effects. These controls are the natural logarithm of

[26]Because the fraction of air shipment variable that I calculate is time-invariant, its level effect will be captured by the industry and year interaction fixed effects.

[27]Once again, this fraction of differentiated products is time-invariant and its level effect is captured by the industry and year interaction fixed effects.

GDP per capita and the growth rate of GDP. One omitted country characteristic that might raise concerns is the export intensity of a country. It could be the case that countries that are highly export-oriented will already have streamlined its customs-related red tape and also put in place measures to limit corruption by customs officials. Further, we would expect the export behavior of firms in a country to be correlated with the export intensity of the country itself. To the extent that this is the case, omitting a country's export intensity might confound my regression estimates. To address this I use data from the World Bank's *Worldwide Governance Indicators* to measure each country's ratio of merchandise exports to GDP to capture its export intensity. I then include this variable in my baseline specification. As the results in column (1) of Table 8 indicate, my primary results remain highly robust to the inclusion of this additional variable.

In column (2) I include instead an indicator for whether a country is landlocked to my baseline specification. Firms in a landlocked country face an additional layer of customs-related bureaucracy as they have to clear customs in their own country as well as in the country whose port it uses to transport its goods. Further, given the transportation costs associated with this added travel, a firm's exports will be directly correlated with whether or not it is in a landlocked country. I use the data created by Mayer and Zignago (2011) to classify a country in my sample as either being landlocked or not. As the results in column (2) suggest, the inclusion of a landlocked indicator does not alter the key results in the paper.

In the paper thus far, I have assumed that it is red tape faced when clearing goods through customs that adversely affect a firm's exports. However, it could be the case that the red tape that is most important is faced by firms earlier in the export process. For example, firms may be hindered by regulations that distort their day-to-day activities or by regulations that make it more difficult to invest or start a business. To the extent that such regulations are correlated with customs-related red tape, my results might be picking up the effects of broader regulations. To address this, I include a regulatory quality index to my baseline specification in column (4). This index is from the *Worldwide Governance Indicators* that are maintained by the World Bank. It "captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development." According to the estimates reported in column

(4), the primary results of the paper are robust to the inclusion of this additional variable. In column (5) I add a measure of the ease of starting a new business in a country to my baseline specification. These data are part of the *Doing Business Report* and are collected by the World Bank and capture the number of procedures an entrepreneur needs to undertake to incorporate and register a new firm. Once again, the primary results of the paper are robust to the inclusion of this additional variable.

5.4 Robustness Checks

In Table 9 I subject the primary results of this paper to a series of robustness checks. In column (1) I use a time-invariant measure of corruption prevalence. This version of corruption prevalence still captures the fraction of firms in a given industry and country that report making unofficial payments when dealing with customs officials. However, it only varies by industry and country and not by year. The results in column (1) suggests that using this time-invariant version does not change the primary results in a significant manner. In column (2) I replace the default measure of red tape (number of documents needed to process goods through customs) with the natural logarithm of the number of days needed to process goods through customs. Recall that according to the model in section 2, the number of days needed to clear customs will be a function of the extent of red tape mandated by the government as well as the endogenous choices made by customs officials and firms. For this reason, I use this alternate measure to test the robustness of my results and do not treat it symmetrically to my primary measure of customs-related red tape. Nonetheless, it is reassuring that the estimates in column (2) of Table 9 strongly support my primary results.

Next, in column (3) I use the customs-specific logistics performance index (LPI) for each country as an alternate measure of customs-related red tape. This index was constructed by the World Bank and scores the "efficiency of the clearance process by customs and other border agencies" in each country on a scale of 1 to 5. I have modified this index so that a higher score represents greater logistical inefficiency. As mentioned in section 3, these data were first collected in 2007, which is the year I use. Thus, the index I use varies by country but not year. As the results in column (3) demonstrate, the key results of the paper are robust to using this alternate measure of customs-related red tape.

In column (4) I use each firm's export intensity as the dependent variable. This is defined as the ratio of each firm's exports to sales. As the estimates in this column confirm, the primary results of the paper are robust to the use of export intensity as the dependent variable. Next, as mentioned in section 3, when measuring a firm's exports I have used their direct exports only and ignored any indirect exports that they may have. These indirect exports represents a firm's sales overseas through the use of a distributor. To examine whether the key results of the paper are robust to the inclusion of indirect exports, I use the natural logarithm of all exports as the dependent variable in column (5) of Table 9. In particular, the dependent variable is the sum of direct and indirect exports (in natural logarithm). As these estimates indicate, using all exports in place of only direct exports does not change the key conclusions of the paper.

6 Conclusion

This paper contributes to a growing literature documenting the adverse effects of customs-related red tape on exports. For instance, OECD (2005) reports that trade transaction costs represent between 1–15 percent of total trade value while Djankov et al. (2010) find that an additional day spent prior to shipment lowers trade volume by more than 1 percent. In theory, the adverse effect of such red tape could be exacerbated in countries where corruption is prevalent. As Krueger (1974) argues, government regulations provided the opportunity for bureaucrats to engage in rent-seeking behavior. This means that the presence of customs-related red tape may provide an opportunity for customs officials to extract bribes from exporting firms. It follows that the effect of customs-related red tape on firm exports will depend on the level of corruption faced by firms.

I examined this issue by first developing a simple model where an exporting firm and a customs official agree on the bribes that need to be paid before an exporter's shipment can be processed through customs. This model highlighted three channels through which customs-related red tape will affect exports. First, such red tape will increase the delay faced by firms. Second, such red tape will provide customs officials with increased rent-seeking opportunities, which they can exploit to extract bribes from exporters. Both of these channels will lower exports. However, the model also shows that the higher bribes induced by customs-related red tape will allow firms to lower the delays that they face. In other words, in this context, corruption has an important benefit as it allows firms to lower their regulatory burden. This third channel raises exports. It follows that firms may be able to use corruption to attenuate the adverse effect of red tape on exports.

I tested this hypothesis using firm-level data from the *Business Environment and Enterprise Performance Surveys*. These surveys were conducted jointly by the European Bank for Reconstruction and Development and the World Bank and provided information on firm exports as well as the prevalence of corruption at custms. I also used data from the World Bank's *Doing Business* reports to measure the number of documents needed to process goods through customs for each country in my sample. This was my primary measure of customs-related red tape. I used these data to examine whether the adverse effects of red tape on firm exports was lower for a firm in an industry with a comparatively greater prevalence of corruption. My results indicated that this was indeed the case. This result is consistent with firms using bribes to lower the regulatory burden that they face when clearing their goods through customs.

The key take-away message from the paper is that in a second-best world with incomplete trade facilitation, i.e. a world in which customs-related red tape exists, corruption may enhance exports by allowing firms to use bribes to lower their regulatory burden. As the model in section (2) highlighted, the first-best scenario from the firm's perspective is for their to be complete trade facilitation, i.e. no customs-related red tape.[28] The results in this paper suggest that if trade facilitation is incomplete, then exporting firms will be better off if corruption is possible.

[28]As mentioned earlier, this statement applies to products for which export does not have any adverse effects on public health or the environment. It also applies to products for which export does not cause any strategic concerns.

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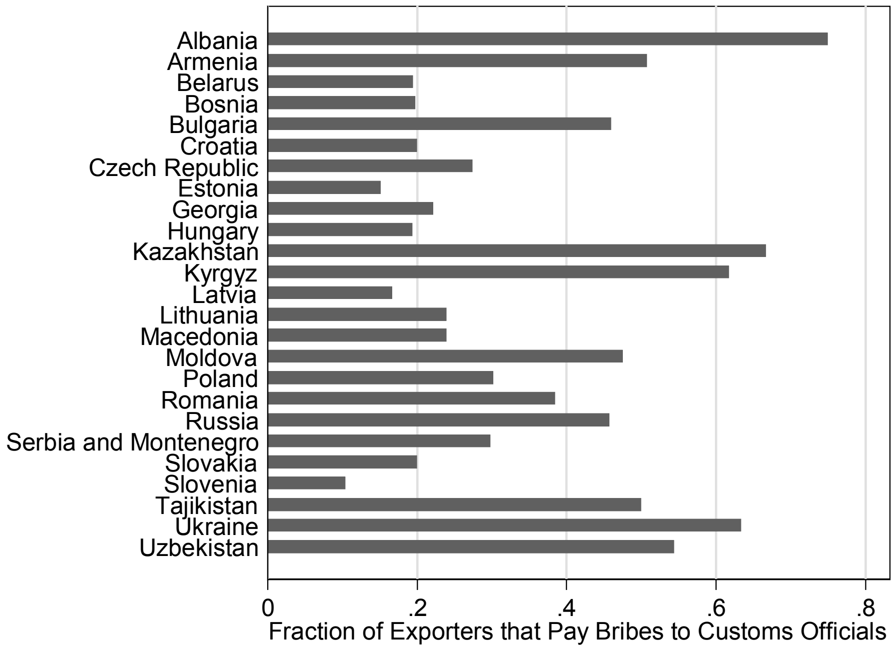

Figure 1: Variation in Bribes Paid by Exporters Across Countries

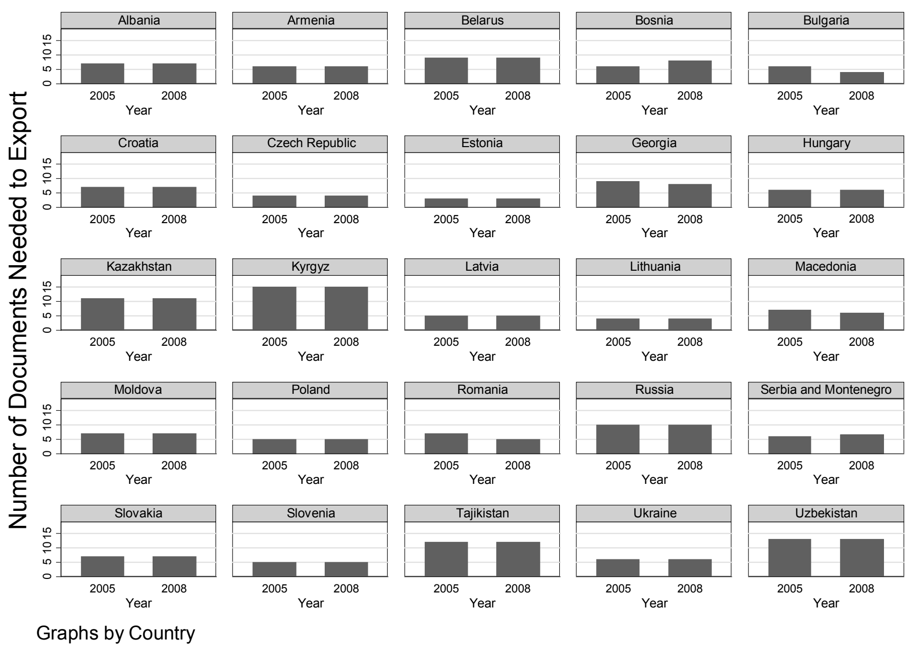

Figure 2: Trends in Customs-Related Red Tape by Country

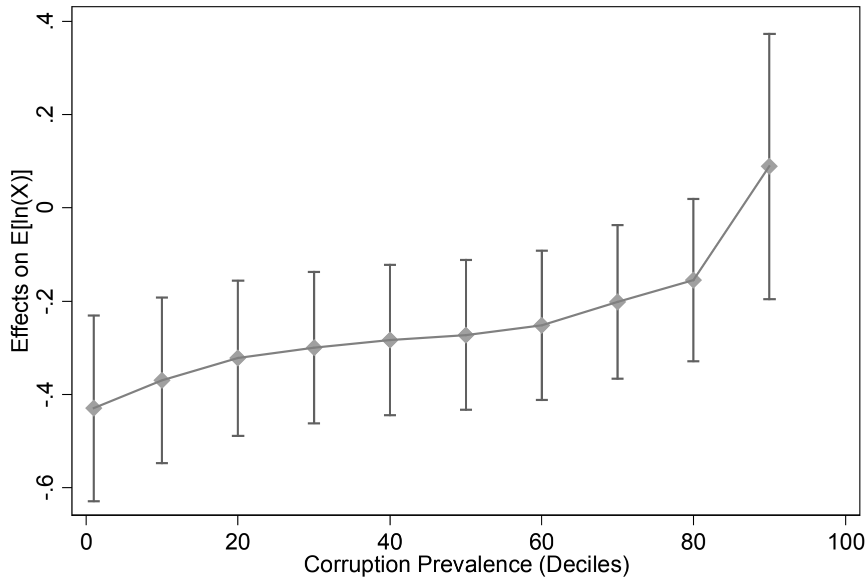

Figure 3: Marginal Effect and 95% Confidence Interval of Documents Needed to Export at Various Deciles of Corruption Prevalence

Table 1: Countries in the Sample by Region

Central Asia
Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan
European Union
Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia
Eastern Europe
Belarus, Moldova, Russia, Ukraine
Southern Europe
Albania, Bosnia, Macedonia, Serbia and Montenegro

Notes: The original sample includes 27 countries. I omit Azerbaijan as there are no firms from this country in the sample in 2005. In addition, I merge Serbia and Montenegro as they first appear in the data as separate countries in 2008.

Table 2: Corruption and Customs as Barriers to Firms

	2005	2008
Fraction of firms that		
Pay bribes to customs officials	0.36	0.29
Consider customs and trade regulations to be an obstacle	0.58	0.49
Average number of		
Documents needed to export	7.32	7.18
Days needed to process exports through customs	32.12	28.10

Notes: The first two rows use firm-level data from the Business Environment and Enterprise Performance Surveys while the last two rows use country-level data from the Doing Business reports.

Table 3: Summary Statistics

	All	Exporters	Non-Exporters
Ln(exports)	4.73	13.54	–
	[6.63]	[2.53]	–
Ln(permanent employment)	3.62	4.43	3.19
	[1.54]	[1.45]	[1.42]
Age	17.91	22.64	15.37
	[20.16]	[24.81]	[16.61]
Foreign Ownership	0.13	0.27	0.06
	[0.34]	[0.44]	[0.24]
Corruption Prevalence		0.28	
		[0.20]	
Documents Needed to Export		7.35	
		[2.70]	
Days Needed to Process Exports		31.50	
		[23.08]	
Observations	5,424	1,893	3,531

Notes: For each variable above, we report the mean and standard deviation (in brackets). Corruption prevalence is defined as the fraction of firms in an industry and country that pay bribes to customs officials. All monetary values are in constant 2005 U.S. dollars.

Table 4: Baseline Results

	(1)	(2)	(3)	(4)
Dependent Variable	Ln(exports)			
Estimation Method	OLS		Tobit	
Coefficient Estimates:				
Documents Needed to Export	-0.272***	-0.465***	-0.688***	-1.174***
	(0.075)	(0.097)	(0.231)	(0.276)
Corruption Prevalence		-4.863***		-11.041***
		(1.559)		(3.707)
Documents Needed to Export × Corruption Prevalence		0.545***		1.429***
		(0.203)		(0.510)
Constant	-4.457***	-2.819**	-22.286***	-18.932***
	(2.372)	(2.416)	(6.737)	(6.953)
Marginal Effects:				
Documents Needed to Export			-0.252***	-0.280***
			(0.085)	(0.082)
Corruption Prevalence				-0.195
				(0.523)
Documents Needed to Export × Corruption Prevalence				0.529***
				(0.180)
Observations	5,424	5,424	5,424	5,424
R-squared/Log likelihood	0.349	0.351	-8981.00	-8973.93

Notes: The marginal effects reported in columns (3) and (4) is the effect of each variable on $E[\ln(X)]$ where X represents exports. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis in the upper panel are robust and clustered at the industry-country level. The standard errors in parenthesis in the lower panel are calculated using the delta method. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Time-Sensitive vs. Time-Insensitive Industries - Marginal Effects

	(1)	(2)	(3)	(4)
Dependent Variable	Ln(exports)			
Sample	Time-Sensitive Industries		Time-Insensitive Industries	
Documents Needed to Export	-0.326**	-0.375***	-0.206**	-0.217**
	(0.134)	(0.133)	(0.101)	(0.102)
Corruption Prevalence		-0.817		-0.298
		(0.924)		(0.625)
Documents Needed to Export		0.973**		0.169
× Corruption Prevalence		(0.326)		(0.206)
Observations	2,077	2,077	2,537	2,537
Log likelihood	-3895.06	-3889.06	-3890.74	-3890.13

Notes: The marginal effects reported in all columns is the effect of each variable on $E[\ln(X)]$ where X represents exports. In columns (1) and (2) the sample is restricted to time-sensitive industries while in columns (3) and (4), the sample is restricted to time-insensitive industries. Industries are placed into these categories using the results from Hummels (2001). This categorization is described in greater detail in section 5.1. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis are calculated using the delta method. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6: Intensive and Extensive Margin - Marginal Effects

	(1)	(2)	(3)	(4)
Dependent Variable	Ln(exports)		Export Indicator	
Estimation Method	Tobit		Probit	
Documents Needed to Export	-0.203***	-0.227***	-0.025***	-0.041***
	(0.068)	(0.066)	(0.007)	(0.009)
Corruption Prevalence		-0.158		-0.367**
		(0.424)		(0.129)
Documents Needed to Export		0.425**		0.048***
× Corruption Prevalence		(0.147)		(0.017)
Observations	5,424	5,424	5,424	5,424
Log likelihood	-8981.00	-8973.93	-2644.08	-2637.88

Notes: The dependent variable in columns (3) and (4) is an indicator that is one if a firm is an exporter and zero otherwise. The marginal effects reported in columns (1) and (2) represent the effect of each variable on $\mathrm{E}[X|(X) > 0]$ where X represents exports. The marginal effects reported in columns (3) and (4) represent the effect of each variable on $\Pr(X > 0)$. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis are calculated using the delta method. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Additional Industry Characteristics - Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Ln(exports)					
Additional Industry Characteristic Included	Baseline	Sales	Skill Intensity	Labor Productivity	Fraction Air-Shipped	Fraction Differentiated
Documents Needed to Export	-0.280***	-0.256***	-0.223***	-0.295***	-0.284***	-0.286***
	(0.082)	(0.066)	(0.066)	(0.066)	(0.008)	(0.084)
Corruption Prevalence	-0.195	0.097	-0.086	0.073	-0.291	-0.244
	(0.523)	(0.352)	(0.434)	(0.407)	(0.514)	(0.558)
Documents Needed to Export	0.529***	0.342***	0.440**	0.321**	0.527**	0.558***
× Corruption Prevalence	(0.180)	(0.122)	(0.147)	(0.143)	(0.247)	(0.207)
Observations	5,424	5,424	5,399	5,424	5,424	5,312

Notes: The marginal effects reported in all columns is the effect of each variable on $E[\ln(X)]$ where X represents exports. Columns (2)–(4) each include an additional industry characteristic along with its interaction with the number of documents needed to export. In column (5) I include the interaction between the number of documents needed to export and the fraction of an industry's exports to the U.S. that are shipped by air. As my measure of air shipment is time invariant, it's level effect is absorbed by the industry and year interaction fixed effects. In column (6) I include the interaction between the number of documents needed to export and the fraction of an industry's products that are differentiated according to the Rauch (1999) classification. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis are calculated using the delta method. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8: Other Country Characteristics - Marginal Effects

	(1)	(2)	(3)	(4)
Dependent Variable		Ln(exports)		
Additional Country Characteristic Included	Exports/GDP	Landlocked	Regulatory Quality	Starting a Business
Documents Needed to Export	-0.291***	-0.286***	-0.198**	-0.268***
	(0.082)	(0.082)	(0.085)	(0.082)
Corruption Prevalence	0.019	-0.178	-0.193	-0.151
	(0.525)	(0.525)	(0.518)	(0.531)
Documents Needed to Export	0.417***	0.521***	0.497***	0.518***
$\times$ Corruption Prevalence	(0.169)	(0.178)	(0.184)	(0.178)
Observations	5,424	5,424	5,424	5,424
Log likelihood	-8961.90	-8973.22	-8970.58	-8971.65

Notes: The marginal effects reported in all columns is the effect of each variable on $\mathrm{E}[\ln(X)]$ where X represents exports. Column (1) adds each country's ratio of merchandize exports to GDP to the baseline specification. Columns (2)–(4) adds an indicator for whether a country is landlocked, each country's regulatory quality score, and the number of procedures needed to start a new business respectively to the baseline specification. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis are calculated using the delta method. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 9: Robustness Checks - Marginal Effects

	(1)	(2)	(3)	(4)	(5)
Dependent Variable		Ln(exports)		Export/Sales	Ln(all exports)
Documents Needed to Export	-0.267***			-1.150***	-0.358***
	(0.082)			(0.312)	(0.098)
Corruption Prevalence	0.570				
(Time Invariant)	(0.517)				
Documents Needed to Export	0.487***				
× Corruption Prevalence	(0.160)				
(Time Invariant)					
Corruption Prevalence		-0.097	0.098	-0.688	0.291
		(0.533)	(0.515)	(1.985)	(0.592)
Documents Needed to Export				1.658**	0.791***
× Corruption Prevalence				(0.683)	(0.214)
Ln(Days Needed to Process Exports)		-0.997***			
		(0.386)			
Ln(Days Needed to Process Exports)		2.274***			
× Corruption Prevalence		(0.835)			
LPI Index - Customs			-2.821***		
			(0.646)		
LPI Index - Customs ×			3.781***		
Corruption Prevalence			(1.405)		
Observations	5,424	5,424	5,315	5,424	5,424
Log likelihood	-8972.42	-8978.76	-8773.73	-11523.39	-9790.68

Notes: The dependent variable in columns (1)–(2), which is the default measure, includes only direct exports. This is also the case for the dependent variable in column (3). In column (4) the dependent variable includes both direct exports as well as indirect exports. The marginal effects reported in all columns is the effect of each variable on $E[\ln(X)]$ where X represents exports. The corruption prevalence variable in column (1) is time invariant. In the remaining columns, the corruption prevalence variable is the default one. LPI Index - Customs is the customs-specific logistics performance index score for each country. A higher value of this score represents less efficient customs. All regressions include controls for the natural logarithm of total permanent employees, firm age, age squared, an indicator for whether a firm has foreign ownership, the natural logarithm of GDP per capita and the growth rate of GDP. All regressions also include region as well as industry and year interaction fixed effects. The standard errors in parenthesis are calculated using the delta method. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendix

A Marginal Effect Derivations

Consider again the Tobit model introduced below equation (9):

$$\begin{aligned} X^*_{ijct} &= \beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 \zeta_{ijct} + \nu_{ijct}, \\ X_{ijct} &= \max(0, X^*_{ijct}) \end{aligned}$$

where $\nu \sim \mathrm{N}(0, \sigma^2)$ and $\zeta_{ijct} = \beta_4 F_{ijct} + \beta_5 Z_{ct} + \sum_{r=1}^{2} \delta_r + \delta_j + \delta_t$. X^* represents a latent variable for exports. This implies that the observed export variable, X, equals X^* when $X^* > 0$ and equals 0 when $X^* \leq 0$. Further, I assume that the latent variable X^* has a normal, homoskedastic distribution. McDonald and Moffitt (1980) show that the expected value of X conditional on X being greater than zero can be written as:

$$E[X|X > 0] = \beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 \zeta_{ijct} + \sigma\lambda(\mu) \tag{13}$$

where once again $\mu = (\beta_0 + \beta_1 D_{ct} + \beta_2 B_{jct} + \beta_3 B_{jct} \times D_{ct} + \beta_4 \zeta_{ijct})/\sigma$ and $\lambda(\mu) = \phi(\mu)/\Phi(\mu)$ is the inverse Mills ratio with $\phi(\mu)$ and $\Phi(\mu)$ being the standard normal density and cumulative distribution functions respectively. Given that D_{ct} is a continuous variable, we can use equation (13) to derive the marginal effect of D_{ct} on $\mathrm{E}(X|X > 0)$ as follows:

$$\begin{aligned} \frac{\partial \mathrm{E}[X|X > 0]}{\partial D_{ct}} &= (\beta_1 + \beta_3 B_{jct}) + (\beta_1 + \beta_3 B_{jct}) \frac{\mathrm{d}\lambda}{\mathrm{d}\mu} \\ &= (\beta_1 + \beta_3 B_{jct})[1 - \lambda(\mu)\mu - \lambda(\mu)^2] \end{aligned}$$

where I've used the fact that $\mathrm{d}\Phi/\mathrm{d}(\mu) = \phi(\mu)$ and $\mathrm{d}\phi/\mathrm{d}\mu = -\mu\phi(\mu)$. Next, with $\psi(\mu) = 1 - \lambda(\mu)(\mu + \lambda(\mu))$, we can rewrite the above to yield the expression in equation (10)

$$\frac{\partial \mathrm{E}[X|X > 0]}{\partial D_{ct}} = (\beta_1 + \beta_3 B_{jct})\psi(\mu)$$

The expression in equation (11) can be derived in an analogous manner. Next, to derive equation (12) we can take the derivative of equation (10) with respect to B_{jct}. Doing so yields:

$$\begin{aligned}
\frac{\partial^2 \mathrm{E}[X|X>0]}{\partial D_{ct} \partial B_{jct}} &= \beta_3 \psi(\mu) + (\beta_1 + \beta_3 B_{jct}) \frac{\mathrm{d}\psi(\mu)}{\mathrm{d}B_{jct}} \\
&= \beta_3 \psi(\mu) + (\beta_1 + \beta_3 B_{jct}) \left(\frac{\beta_2 + \beta_3 D_{ct}}{\sigma} \right) \left[-\lambda(\mu) - (\mu + 2\lambda(\mu)) \frac{\mathrm{d}\lambda(\mu)}{\mathrm{d}\mu} \right]
\end{aligned} \tag{14}$$

Lastly, using the fact that $\mathrm{d}\lambda / \mathrm{d}\mu = -\lambda(\mu)\mu - \lambda(\mu)^2$, the above simplifies to:

$$\begin{aligned}
\frac{\partial^2 \mathrm{E}[X|X>0]}{\partial D_{ct} \partial B_{jct}} &= \beta_3 \psi(\mu) + (\beta_1 + \beta_3 B_{jct}) \left(\frac{\beta_2 + \beta_3 D_{ct}}{\sigma} \right) \times \\
&\quad \left[-\lambda(\mu) - (\mu + 2\lambda(\mu))(-\lambda(\mu)\mu - \lambda(\mu)^2) \right] \\
&= \beta_3 \psi(\mu) - (\beta_1 + \beta_3 B_{jct}) \left(\frac{\beta_2 + \beta_3 D_{ct}}{\sigma} \right) [\lambda(\mu) + (\psi(\mu) - 1)(\mu + 2\lambda(\mu))]
\end{aligned}$$

B Additional Tables

Table B.1: Description and Source of Key Variables

Variable	Description	Source
Ln(exports)	The natural logarithm of 1 plus total firm exports.	Enterprise Surveys
Export Indicator	An indicator that is 1 if a firm has positive exports	
Corruption Prevalence	The fraction of firms in any given year that report providing unofficial payments or gifts when dealing with customs.	
Documents Needed to Export	Total number of official documents needed to export goods in each country.	Doing Business
Days Needed to Process Exports	Total time (in days) needed to process goods through customs.	
Ln(permanent employment)	The natural logarithm of a firm's permanent, full-time employees.	Enterprise Surveys
Age	Current year minus the year a firm began operations.	
Foreign Ownership	Indicator variable that is one if more than 10% of the firm is owned by private foreign entities.	
ln(GDP per capita)	The natural logarithm of GDP per capita	World Development Indicators
GDP growth rate	The natural logarithm of annual GDP growth rate	
Time Sensitivity	An indicator that is one if an industry has time-sensitive products.	Hummels (2001)

Notes: All monetary values are in constant 2005 U.S. dollars.

Table B.2: All Industries by Time-Sensitivity Status

Code	Industry Description	Code	Industry Description
	Time-Sensitive Industries		*Time-Insensitive Industries*
14	Wearing Apparel	15	Leather
20	Chemicals	17	Paper
26	Computer & Related Products	19	Coke and Refined Petroleum
27	Electrical Equipment	21	Pharmaceuticals
28	Machinery n.e.c	22	Rubber
29	Motor Vehicles	24	Basic Metals
32	Other Manufacturing	25	Fabricated Metal Products
		31	Furniture

Notes: Industries are placed into these categories using the results from Hummels (2001). This categorization is described in greater detail in section 5.1. Two industries, "printing of recorded media" and "repair of machinery", could not be classified. These two industries did not have equivalent industries in Hummels' analysis.