CORRUPTION AND BILATERAL TRADE FLOWS: EXTORTION OR EVASION?

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Abstract—We analyze the impact of corruption on bilateral trade, highlighting its dual role in terms of extortion and evasion. Corruption taxes trade, when corrupt customs officials in the importing country extort bribes from exporters (extortion effect); however, with high tariffs, corruption may be trade enhancing when corrupt officials allow exporters to evade tariff barriers (evasion effect). We derive and estimate a corruption-augmented gravity model, where the effect of corruption on trade flows is ambiguous and contingent on tariffs. Empirically, corruption taxes trade in the majority of cases, but in high-tariff environments (covering 5% to 14% of the observations) their marginal effect is trade enhancing.

I. Introduction

AWARENESS is growing of the crippling effect of corruption on economic development. Corruption has been shown to reduce economic growth (Mauro, 1995; Knack & Keefer, 1995), distort governmental expenditures (Mauro, 1998; Tanzi & Davoodi, 1997), retard investment (Wei, 2000), and reduce the effectiveness of foreign aid (Princeton Survey Research Associates, 2003). These results contrast sharply with earlier notions advanced by Leff (1964) and Huntington (1968) that corruption can be efficiency enhancing, because it removes government-imposed rigidities that impede investment and interfere with other economic decisions favorable to growth. This view is succinctly captured in the notion that corruption "greases the wheels of trade" (Rose-Ackerman, 1997). In a country rife with onerous regulations, the opportunity to offer bribes allows firms to circumvent unproductive government control. Similar to deregulation, this can welfare improving (see Lui, 1985; Beck & Maher, 1986, for theoretical models).[1]

Bardhan (2006) argues that the impact of corruption must interact with the extent of regulations in the economy and defines two types of corrupt behavior: bureaucrats request bribes to do what they are supposed to do, empowered by their status as gatekeepers, or they are bribed to do what they are not supposed to do, allowing firms to avoid regulations. From our perspective, it is useful to call the first type of behavior *extortion* and the second *evasion*.

This paper looks at the effect of corruption of customs officials on bilateral trade flows, stressing this dichotomy between extortion and evasion. Rose-Ackerman (1997) argues that customs officials are particularly likely to engage in corruption of both types. Extortion emerges because customs clearance procedures offer officials control over something that firms value: access to and from the outside world. Evasion arises as payoffs to officials are used to reduce tariffs and other regulatory barriers to trade. It augments the rents to be shared by exporters and officials.

In reality, country case studies have documented that corruption in customs facilitates both extortion and evasion. Parayno (1999) describes both forms of corrupt behavior in the Philippines, where businesses became accustomed to giving small bribes for customs services and it was necessary to pay to "facilitate" even fully legitimate transactions, while misdeclaration, misclassification, and undervaluation in formal entry declaration processing were common ways by which firms could circumvent official trade barriers, in cooperation with corrupt custom officials. Arduz (2000) describes a system in Bolivia, where most goods go through a system of "parallel customs," in which customs officers levied their own taxes rather than the official trade taxes.[2] A series of papers has documented the pervasiveness of evasion in individual countries.[3] Fisman and Wei (2004) find strong evidence for mislabeling and misclassifying imports (reporting imports in a lower-tax category), in the context of trade between Hong Kong and China, but no evidence of underreporting of imported quantities. Mishra, Subramanian, and Topalova (2008) find a robust and positive elasticity of evasion with respect to tariff rates, looking at the effects of reforms in India in 1991. Finally, Yang (2008b) finds that increased enforcement following the 1990 reform in the Philippines led to an alternative duty-avoidance method (shipping through duty-exempt export-processing zones), particularly for products with higher tariff rates.

This paper studies the scope for extortion and evasion, using data on bilateral trade. It begins by deriving a corruption-augmented version of the gravity model of trade. We view corruption as an institutional facilitator of the extraction of bribes by customs officials. It has a trade-taxing extortion effect because with more corruption, the magnitude of the bribe (as a proportion of the import rents) increases, reducing the incentives for the exporter. On the other hand, there is a trade-enhancing evasion effect, which captures the notion that in more corrupt environments, incentives for customs officials to permit tariff evasion increase, since they can appropriate a higher share of the ensuing rise in import rents. The evasion effect is increasing in the level of nominal tariffs, since a higher tariff increases the marginal gain from evasion and vanishes when the nominal tariff is 0.

Hence, our empirical model augments the gravity equation with terms for the importing country's measures of corruption and tariffs, as well as their interaction. An expected negative

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[1] Kaufmann and Wei (1999) argue that this view is true only in a very narrow sense—when the bad regulation and official harassment are taken as exogenous. They show that in Uganda, managers of the firms that pay more bribes on average spend more rather than less time negotiating with government officials.

[2] Younas (2000) describes an elaborate system of bribes in Pakistan where money was levied for every customs transaction.

[3] The exception is Yang (2008a), who shows that countries that hired private firms to conduct preshipment inspection of imports subsequently experienced large increases in customs revenue. His data set covers 104 countries, 19 of which adopted preshipment inspections.

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coefficient on the stand-alone term for *corruption* captures the trade-taxing extortion effect, while an expected positive coefficient on the (*corruption* × *tariffs*) interaction term captures the trade-enhancing evasion effect. The implication of these conflicting signs is that the marginal effect of corruption is ambiguous and becomes positive (that is, trade enhancing) when the level of tariffs rises above a certain threshold tariff.

We estimate this corruption-augmented version of the gravity model using bilateral trade flows data at both the sectoral and aggregate (country) levels. In both cases, our empirical analysis lends strong support to the notion that the effect of corruption is ambiguous and mediated by the level of tariff protection. Corruption works as a deterrent to trade, but the effect is much weaker as the level of protection, as measured by nominal tariffs, rises. The other side of the coin is that tariffs work as a deterrent to trade, but their effect is weaker in countries where corruption is large. For the vast majority of our observations, the extortion component dominates, and corruption acts as a tax on trade. However, in our benchmark specification, our estimates for the threshold tariff (above which corruption enhances trade) lie in the range of 0.19 to 0.43 (depending on the data set used), which implies that for 5% to 14% of the observations, we find a positive relationship between corruption and trade.

The effect of social institutions on trade flows was first addressed by Anderson and Marcouiller (2002) in the context of the gravity equation.[4] They show that trade expands dramatically when supported by strong institutions—specifically, by a legal system capable of enforcing commercial contracts and by transparent and impartial formulation and implementation of government economic policy. More recently, François and Manchin have (2007) shown that variations in North-South trade depend on institutional quality and access to well-developed transport and communications infrastructure much more than on variations in tariffs. In a related paper, Lambsdorff (1999) shows that some countries have a significantly lower market share in corrupt countries and that these differences can be explained by differences in exporters' willingness to offer bribes.

To the best of our knowledge, this paper is the first to look at the role of corruption on bilateral trade flows for a broad set of countries and sectors, spanning twenty years of trade flows, while emphasizing the dichotomous effects of extortion and evasion. It contributes more broadly to the emerging literature on the effects of corruption by stressing the interaction of corruption with the regulatory constraints in the economy. In doing so, we bring together the two perspectives on the effects of corruption (outlined in the first paragraph), showing not only that they are both valid but also the conditions under which each will dominate.

II. A Corruption-Augmented Gravity Model

To examine the relationship between trade flows and corruption, we extend the gravity model to include a corruption tax. The gravity model has enjoyed empirical success in its ability to explain a relatively large fraction of variation in the observed volume of bilateral trade.[5] Microfoundations for the gravity model have been provided by a variety of papers, including Anderson (1979), Bergstrand (1989), Deardorff (1998), and Anderson and Van Wincoop (2003). Both monopolistic competition and Heckscher-Ohlin market structures have been employed to derive the gravity equation. We follow the monopolistic competition approach pursued by Anderson and Van Wincoop (2003).

A. *Firm-Level Exports*

We depart from the traditional approach by focusing on the procedure that an exporter must undergo to clear customs and how the relationship between the exporter and the self-interested customs official affects the exporter's profit-maximizing decisions. The actions of the customs official affect the exporter through two types of behavior. First, officials can exert more or less zeal in making sure that the merchandise has complied with all regulatory barriers. For example, the customs official may overlook underinvoicing, allow for a wrongful classification of the merchandise into categories with lower tariffs, exonerate the merchandise from time-consuming inspections, or ignore some documentation requirements. Second, the official may abuse his role as a gatekeeper to extract bribes from the exporter in order to allow the merchandise to transit through customs.

Both behaviors are risky for the customs official. Exerting lower zeal and allowing evasion carries the risk of being punished by the supervisor, while the extortion of bribes carries the risk of being caught and punished by the authorities. In fact, both behaviors are related, since it is through a higher bribe, made possible by the rise in import rents, that the customs official is rewarded for the risks of allowing tariff evasion. Our working assumption is that a high level of institutional pervasiveness of corruption in the country reduces the probability of getting caught in extorting bribes or the associated social or pecuniary penalty. This in turn increases the marginal utility of the bribe to the customs official.

In the appendix, we model the interaction between the exporter and the customs official and the implications for the volume of trade. Following the monopolistic competition paradigm, each good l is produced by a sole firm from country o (origin), so that x_l is the volume of exports of the firm to country d (destination). When exporting to d, firm

[4] There is an extensive literature on the determinants of bilateral trade, looking at the effect of borders (McCallum, 1995), bilateral or multilateral trade agreements (Frankel, 1997; Rose, 2004; Subramaniam & Wei, 2007), currency unions (Frankel & Rose, 2000; Glick & Rose, 2002; Rose, 2000; Persson, 2001), conflict (Martin, Mayer, & Thoenig, 2008), and infrastructure (François & Manchin, 2007).

[5] Empirically, the gravity model has been used to analyze border effects (McCallum, 1995), the effects of regional trade blocs (Frankel, 1997), the effect of GATT and WTO on trade flows (Rose, 2004; Subramaniam & Wei, 2007), the effect of currency unions on trade (Frankel & Rose, 2000; Glick & Rose, 2002; Rose, 2000; Persson, 2001), the effect of violence and wars (Blomberg & Hess, 2006; Martin et al., 2008) and the size of home market effects (Davis & Weinstein 2003).

l incurs constant unit production cost w_o, iceberg transport costs (λ_{od}), and a nominal tariff denoted by T_{od}, and faces a traditional CES-based demand function:

$$x_{ld} = p_{ld}^{-\varepsilon} P_d^{\varepsilon-1} E_d \quad \text{with} \quad P_d^{1-\varepsilon} = \int_l p_{ld}^{1-\varepsilon}, \varepsilon > 1,$$

where x_{ld} is the demand, p_{ld} is the price, and E_d is the expenditure, in country d. The appendix shows that the institutional pervasiveness of corruption in the importing country, ψ_d, affects the equilibrium value of exports through a corruption tax, Δ_{od}, given by

$$\Delta_{od} = \Lambda_x \psi_d + \Lambda_v T_{od} \psi_d \quad \Lambda_x > 0, \Lambda_v < 0, \tag{1}$$

such that the corruption-augmented expression for the value of exports of good l to country d is given by

$$X_{lod} = p_{ld} x_{ld} = (1 - T_{od})^{\varepsilon-1} \times (1 + \Delta_{od})^{1-\varepsilon} \lambda_{od}^{1-\varepsilon} P_d^{\varepsilon-1} E_d \left(\frac{\varepsilon w_o}{\varepsilon - 1} \right)^{1-\varepsilon}. \tag{2}$$

Λ_x and Λ_v are parameters (which in the appendix are expressed in terms of fundamentals). Λ_x captures the extortion effect (hence, the subscript x) and is trade taxing. With more corruption, the magnitude of the bribe (as a proportion of the import rents) increases, reducing the incentives for the exporter to ship goods to country d. Meanwhile, Λ_v depicts the evasion effect (hence, the subscript v) and is trade enhancing. It captures the notion that in more corrupt environments, the incentives for customs officials to permit tariff evasion increase, since they now appropriate a higher share of the ensuing rise in import rents due to the higher bribe (as a share of import rents). The interaction of tariff with corruption captures the evasion effect. The latter exists only when the nominal tariff (T) is positive, since otherwise there is no space for tariff evasion. Evasion is also increasing in the level of nominal tariffs, since a higher tariff increases the marginal gain from allowing evasion.

Note that the conflicting signs of Λ_v and Λ_x imply that the marginal effect of corruption (Δ'_ψ) can be positive or negative and is more likely to be positive at higher values of T. We can thus define a threshold tariff, $-\Lambda_x/\Lambda_v$, above which the marginal effect of corruption is positive, that is, trade enhancing. An implication is that the corruption tax (Δ) can be negative at high levels of the tariff.

B. *Estimable Equation*

Next, let the unit cost be the same for all producers from o, that is, w_o. Then we can define the output (global sales) of all firms in country o as $Y_o = \sum_d \int_{l \in o} X_{lod}$, where the summation is over all countries including o. Using equation (2), we can write

$$\left(\frac{\varepsilon}{\varepsilon - 1} w_o \right)^{1-\varepsilon} = Y_o / \Upsilon_o^{1-\varepsilon} Y_w,$$

where Y_w is global income and Υ_o is an exporter price index defined by[6]

$$\Upsilon_o^{1-\varepsilon} = P_o^{\varepsilon-1} E_o / Y_w + \sum_{d \neq o} \lambda_{od}^{1-\varepsilon} P_d^{\varepsilon-1} \times \int_{l \in o} [(1 + \Delta_{odl})/(1 - T_{odl})]^{1-\varepsilon} E_d / Y_w. \tag{3}$$

Substituting in equation (2), we obtain an expression that augments the traditional gravity equation to include border costs (corruption and tariffs),

$$X_{odlt} = \left(\frac{1 + \Delta_{odlt}}{1 - T_{odlt}} \right)^{1-\varepsilon} \lambda_{od}^{1-\varepsilon} \frac{E_{dt} Y_{ot}}{Y_{wt} P_{dt}^{1-\varepsilon} \Upsilon_{ot}^{1-\varepsilon}}, \tag{4}$$

where we have added time subscripts to the variables. The expression shows that the impact of corruption on firm-level export decisions can be translated to the country-level bilateral relationship, provided proper attention is given to the competitiveness of country o's firms, measured by its output and (exporter) price index.

The price indices P_{dt} and Υ_{ot} are often addressed as multilateral trade resistance terms (Anderson & Van Wincoop, 2004; Baldwin, 2006). The multilateral trade resistance terms reflect both the openness of the importing nation to all goods and the openness of the world to the exporter's goods (not simply the openness of a pair of exporter and importer). Trade between any pair of countries depends on their bilateral trade costs (including transport and border costs) relative to average trade costs with all trade partners (measured by the multilateral trade resistance terms).[7]

From equation (1) and the log linearization of equation (4), we obtain an equation that can be estimated using bilateral trade data at the industry level:

$$\ln X_{odlt} = a_1 \psi_{dt} + a_2 \psi_{dt} T_{odlt} + a_3 T_{odlt} + \boldsymbol{\Theta} \mathbf{Z}_{odt} + b_1 \ln E_{dt} + b_2 \ln Y_{ot} + b_3 D_t + c_1 \ln \Upsilon_{ot} + c_2 \ln P_{dt} + C + \epsilon_{odt}. \tag{5}$$

The coefficients denoted by a are our main coefficients of interest. Our model's predictions imply $a_1 = (1 - \varepsilon)\Lambda_x < 0$, $a_2 = (\varepsilon - 1)\Lambda_v > 0$, and $a_3 = (1 - \varepsilon) < 0$. The threshold tariff, above which corruption is trade enhancing, can now be written as $-a_1/a_2$. Note that while the corruption measure

[6] When using equation (2) to obtain the sales of a firm, we must take into account the notion that a country's own production is not subject to trade costs.

[7] As discussed at length in the literature (see Feenstra, 2002; Baldwin, 2006), the multilateral resistance term raises an important caveat for the role of bilateral trade costs on trade flows. If trade costs are reduced among a set of countries that already trade a lot with each other, multilateral trade resistance will drop a lot, and relative trade resistance will fall little. The drop in multilateral-resistance countries reduces the impact of the reduction of bilateral trade costs on trade between any pair of countries. Hence, the omission of a control for these multilateral trade resistance terms biases estimates of the trade costs toward 0.

is a country variable, the tariff measure is a country-pair or industry-specific variable.[8]

The term $\mathbf{\Theta Z}_{odt} \equiv (1-\varepsilon) \ln \lambda_{odt}$ captures the implications of traditional gravity variables that are related to transport costs, such as geographical, cultural, and linguistic distance. The b coefficients look at the impact of expenditure in the importing country and output in the exporting country. Traditional applications of the gravity model using aggregate trade flows, take the two nations' nominal GDP. Baldwin, Skudelny, and Taglioni (2005) argue that when using sectoral trade data, one should use the corresponding sector's gross value added on the export side and sector consumption (which is equal to the value added of the sector, minus exports plus imports) on the import side.[9] Baldwin et al. (2005) also suggest that since sectoral value-added measures are often not readily available and typically fraught with many measurement problems, one should also consider using the real GDP of the exporter and the importer. In either case, following the traditional gravity literature, our expectations are that $b_1 = b_2 = 1$. Also following the gravity literature, b_3, which depicts the effect of global GDP (Y_w), can be proxied by time dummies.

The coefficients c_1 and c_2 capture the multilateral trade resistance terms. Accounting for the multilateral trade resistance terms has proved challenging, and various papers employ different fixes for the problem. A series of papers uses country-specific fixed effects for source and destination country to control for the multilateral trade resistance terms (see Harrigan, 1996; Hummels, 1999; Rose & Van Wincoop, 2001). Using fixed effects in this manner also dramatically reduces the scope for omitted variables and mismeasurement that may plague our estimates, as the intercepts take out all variation that is not specific to bilateral pairs. Baldwin (2006) argues that time-invariant country-specific fixed effects may not suffice, since omitted terms reflect factors that vary every year, so the country dummies need to be time varying.[10] Using a time-varying, import-country-specific fixed effect is not feasible in our paper, since then we would not be able to identify the coefficient of corruption in the importing country, which is country specific (see also François & Manchin, 2007). Therefore, we follow Anderson and Marcouiller (2002) and Baier and Bergstrand (2001) and use measures of the price level such as GDP deflators and Tornquist trade price indices as proxies for multilateral trade resistance terms. In addition, to capture other country-specific factors, we also include time-invariant fixed effects in the regressions. We include fixed effects of two types: at the country level, for exporters and importers, and at the level of unidirectional country pairs (for example, one dummy for exports from the United States to Canada and a separate dummy for exports from Canada to the United States).[11]

III. Data

A. Trade and Protection Data

Sectoral-level data. At the sectoral level, our key data set comes from Mayer and Paillacar (2008). They use COMTRADE, from the U.N. Statistical Department, to construct data on bilateral trade flows for the manufacturing sector. Information on bilateral trade is disaggregated at the three-digit industry level for 28 industrial sectors (ISIC Rev. 2) over the period 1980 to 2004. They complement these data with bilateral protection for the period 1989 to 2001. Tariffs, available at the HS six-digit product level, are matched to the ISIC Rev. 2 classification using world imports as weights. The tariff data are from Jon Haveman's treatment of TRAINS data for the period 1989 to 2000. For the year 2001, they use tariff data from CEPII's data set MAcMap (Market Access Map). The result is a data set that spans the years 1989 to 2001 and covers 122 countries.

One of the shortcomings of the Manufacturing sector data is that the data ignore trade in agricultural products and include only bilateral tariffs as the measure of protection. An alternative is the MAcMap database, developed jointly by ITC (UNCTAD-WTO, Geneva) and CEPII (Paris). This database, in addition to manufacturing sector data, also provides trade and protection data for the agricultural and food processing sectors.[12] Furthermore, it has a much more comprehensive measure of formal trade barriers.[13]

[8] We assume that T is set by trade policy and ignore the political economy of setting tariffs, including the role of corruption. To the extent that (grand) corruption affects trade policy, there might be some collinearity in the empirical estimates in the next sections, which does not bias our results.

[9] At the sectoral level, Baldwin et al. (2005) argue that sectoral value added in the exporting country may be used as a proxy for the size of endowments used in that sector. However, since the import demand for, say, chemicals arises from many sectors other than the chemicals sector, they recommend using apparent consumption in the importing country in that sector (measured as value added for that sector minus exports plus imports.)

[10] Feenstra (2002) argues that the fixed-effects method provides consistent estimates of the average border effect across countries and recommends this as the preferred empirical method given the simplicity in its implementation. However, Frankel (2006) argues that the trade diversionary role of the multilateral trade resistance indices may be overemphasized in the literature and that adding a plethora of dummies (for time- and country-specific fixed effects) entails eliminating a lot of variation in the data, with a consequent, unwarranted loss in statistical significance.

[11] It seems reasonable that exports of Canada to the United States face a different demand function than do US exports into Canada and that US export prices are determined by different factors than are Canadian export prices.

[12] To facilitate comparison between the MAcMap and the manufacturing sector data, we use data that are aggregated according to the GTAP 6 sectoral classification. Similar to the manufacturing sector data, the GTAP sectors are defined by reference to ISIC Rev. 2. The agricultural and food processing sectors follow the Central Product Classification (CPC), developed by the Statistical Office of the United Nations to serve as a bridge between the ISIC and other sectoral classifications.

[13] The MAcMap computes an exhaustive and consistent ad valorem equivalent (AVE) measure of applied protection across the world, at the detailed product level. The methodology takes into account preferential trade arrangements (PTAs) between pairs of countries, calculates the AVE of specific duties, acknowledging the differential impact of such duties across exporters (which depends on their export unit values), and incorporates tariff rate quotas (TRQs) through both the AVE of the resulting protection at the margin, and the calculation of quota rents. By contrast, the TRAINS data suffer from an incomplete coverage of preferential agreements and do not perform AVE calculations of specific duties and tariff rate quotas. See Bouët et al. (2005) for more details.

We supplemented the MAcMap trade protection data with COMTRADE data on bilateral trade flows between countries available from GTAP. The strength of this data set is that it takes into account a myriad of trade restrictions between pairs of countries. However, the data are available for a single year (2001) and spans 43 sectors for 67 countries, so we present results with this measure in the robustness section.

Country-level data. As in the traditional gravity literature, we also look at aggregate trade flows using the value of imports (cost including freight) to measure bilateral trade. These data are from the IMF's Direction of Trade Statistics. The country and time coverage for this data set is the most comprehensive, covering 128 exporters and 126 importers over the period 1982 to 2000. Out of all possible trade flows between pairs of countries, 29.4% exhibit no trade. Although more comprehensive data are available for bilateral imports, as a robustness check, we also present results using bilateral exports. As suggested by the gravity model, all data are in current US dollars.

The country-specific legal tariff rate is obtained from two measures of trade policy: total import duties collected as a percentage of total imports from the World Development Indicators,[14] and the unweighted average external tariff data recently made available by the World Bank. Although none of these measures is perfect, Rodriguez and Rodrik (2000) argue that these are the most direct measures of trade restrictions, that there is little evidence for the existence of serious biases in these indicators, and that they represent a fairly accurate ranking of countries according to the restrictiveness of their trade regimes. Since the tariff data are importing country specific, and not country pair specific, we multiply each of these measures by $(1-\gamma_{od})$, where $\gamma_{od}=1$ if countries o and d have a preferential trading agreement at time t and 0 otherwise. The data on preferential trade agreements are obtained from Rose (2004).

B. Corruption Measures

We use the *International Country Risk Guide* (ICRG) survey-based index of corruption. The measure, used previously and described in detail in Knack and Keefer (1995), codes corruption in different countries on a scale of 0 to 6, where low scores indicate high levels of corruption. For ease of interpretation of the coefficients, we recoded the ICRG as 6 minus the original corruption index, so that higher numbers indicate higher corruption.

The ICRG index measures the likelihood that government officials demand special payments and that illegal payments are generally expected throughout lower levels of government in the form of bribes connected with import and export licenses, customs, exchange controls, tax assessment, policy protection, and loans. While we are concerned with corruption in customs in this paper, there is no measure of corruption available across countries and over time that exactly captures corruption in customs. The ICRG measure has the most extensive coverage, across countries and over time (1982–2004). Since the ICRG measure uses a single methodology, cross-country and over-time comparisons using this measure are likely to be valid.[15] However, as with all other research that employs corruption data, we must recognize these are subjective assessments of corruption and subject to measurement error.

C. Gravity Variables and Price Indices

We use traditional gravity variables such as geographical distance, contiguity, colonial links, and linguistic similarities to capture factors that facilitate or impede trade. Data on these variables are obtained from the CEPII bilateral distance database (www.cepii.fr). We also include a dummy for membership in GATT or WTO from Rose (2004).[16] Measures of sectoral value added and sectoral consumption (defined as value added minus exports plus imports in each sector) are obtained from the UNIDO database, which provides annual data on value added, exports, and imports for the 28 manufacturing sectors. We use the World Development Indicators (WDI) for data on nominal GDP. The value-added data are much smaller, in terms of country coverage, than the GDP data. We also include a variable to control for the broader institutional characteristics of a country since this could influence both trade flows and corruption levels. Exclusion of this may lead to a potential omitted variable bias. Specifically, we use the Polity measure of democracy (Polity IV project), which ranges from -10 to 10, with higher numbers indicating more democratic political institutions.[17] As an additional control, we also include corruption in the exporting country.

As mentioned earlier, accounting for the multilateral trade resistance terms is important in the context of our model estimation. For the manufacturing sector data, we use Tornquist import and export price indices, a geometric mean of the geometric Paasche and Laspeyres indices. Empirically it has been shown that the Laspeyres and Paasche indices are upper and lower bounds of the real price evolution and that computing a geometric mean of these indices is a good way to approach the unobserved real price index (Feenstra, 2002). The Trade-Prices database from CEPII is the source for these data, which

[14] Note that the import duty measure is a weighted average of import duties on each good where the weights are the share of imports of that good in total imports.

[15] One way to examine whether the ICRG is a good proxy for corruption in customs is to examine its correlation with the German exporter corruption index (available for a single year for 43 countries from Neumann, 1994), which measures the total proportion of deals involving kickbacks, according to German exporters. Neumann's measure has the advantage that it captures corruption in customs and that it can be given a cardinal interpretation. This measure has a correlation of 0.9 with the ICRG measure.

[16] One variable is coded as 1 if both trading partners are members of GATT or WTO, and a second variable is coded as 1 if at least one of the trading partners is in GATT or WTO.

[17] This measure and its subcomponent, "constraints on the executive," are the most commonly used variables in the literature on the role of institutions in economic development.

TABLE 1.—SUMMARY STATISTICS

Variable	*N*	Mean	s.d.
Bilateral manufacturing sector data (28 sectors; 1989–2001)			
Bilateral manufacturing trade flows (1,000s of $US)	177,559	54,879	585,431
Bilateral industry-level sector tariffs	177,559	0.10	0.24
Sector valued added (exporter), logged	177,559	12.53	2.48
Sector consumption (importer) , logged	177,559	13.76	2.01
Manufacturing Tornquist price index (exporter), logged	177,559	4.68	0.16
Manufacturing Tornquist price index (importer), logged	177,559	4.67	0.23
Bilateral MAcMap Data (43 sectors; single year—2001)			
Bilateral trade flows (millions of $US)	179,112	19.389	344.59
Bilateral effective applied tariff (reference group weighted)	179,112	0.133	0.344
Sectoral Tornquist price index (exporter), logged	179,112	4.64	0.21
Sectoral Tornquist price index (importer), logged	179,112	4.66	0.23
Bilateral aggregate trade data (aggregate; 1982–2000)			
Import dummy	601,055	0.57	0.49
Aggregate bilateral trade flow (imports, millions of $US)	601,055	150.8	1953.33
Tariff (import duty)	345,239	0.08	0.12
Tariff (unweighted)	316,905	0.15	0.13
Corruption (importer)	434,130	2.75	1.43
Corruption (exporter)	435,866	2.75	1.44
GDP (exporter), logged	565,338	23.33	2.33
GDP (importer) , logged	566,996	23.31	2.34
Distance, logged	618,533	8.72	0.8
Contiguous	618,533	0.02	0.14
Common official language	618,533	0.18	0.38
Linguistic similarity	618,533	0.17	0.38
Colonial link	618,533	0.01	0.12
Common colonizer	618,533	0.12	0.32
Same country	618,533	0.01	0.1
Both in GATT/WTO	546,087	0.5	0.5
One in GATT/WTO	600,648	0.93	0.25
Polity (exporter)	444,823	1.57	7.49
Polity (importer)	442,878	1.62	7.49
Exporter GDP deflator, logged	574,977	3.86	0.61
Importer GDP deflator, logged	574,919	3.87	0.61
Exporter unit value, logged	110,456	4.62	0.28
Importer unit values, logged	84,956	4.64	0.28
Common religion	629,185	0.35	0.33
Regulation costs (exporter)	478,796	54.07	38.59

uses unit values (on 5,000 items of the Harmonized System) from COMTRADE to compute the international trade price indices. For the MAcMap and aggregate trade data, we use GDP deflators as proxies for the multilateral trade indices, data on which are obtained from the World Development Indicators. Table 1 presents the summary statistics for all variables.

IV. Results

This section looks at the empirical support for our theoretical predictions and tries to provide estimates of the corruption tax and the implied threshold tariffs, based on the corruption-augmented gravity model. We show results with multiple measures of bilateral trade flows at various levels of aggregation, control for selection bias, and examine the robustness of our results to various subsamples and an alternate empirical methodology. For all estimates, standard errors are adjusted for clustering on the importing country.[18]

A. *Sectoral-Level Data*

Traditionally gravity model estimates use aggregate data on bilateral trade flows and tariffs. However, bilateral tariffs mask a significant amount of variation in sectoral-level tariffs. For instance, if we look at the tariffs imposed by the United States on imports from India, the tariff rate ranges from 0 (on printing and publishing) to 24% (on tobacco products). This within-country variation in tariffs across products should allow us to identify more precisely the evasion effect of corruption on trade flows, which are conditional on the level of tariffs.

Tables 2 presents estimates of equation (5), using disaggregated data for the manufacturing sector on bilateral trade flows and bilateral industry-level tariffs. Following Baldwin, Skudelny, and Taglioni (2005) we use two approaches to the market size variables for the importing and exporting country. Panel A of table 2 presents estimates using sectoral data for value added and sector consumption, while panel B presents

[18] Since corruption varies only at the level of country rather than pairs of countries, clustering standard errors on country pairs are likely to lead to underestimated standard errors. See Bertrand, Duflo, and Mullainathan (2004) for further discussion. We thank an anonymous referee for highlighting this issue.

TABLE 2.—EFFECT OF CORRUPTION AND BILATERAL TARIFFS ON SECTORAL BILATERAL IMPORTS

	(1)	(2)	(3)	(4)
A. Manufacturing Industry Data				
Corruption (importer)	−0.070***	−0.114***	−0.032*	−0.036**
	(0.024)	(0.022)	(0.018)	(0.015)
Bilateral industry-level tariff	−2.572***	−2.370***	−2.180***	−2.143***
	(0.303)	(0.305)	(0.377)	(0.404)
Tariff × Corruption (importer)	0.468***	0.408***	0.365***	0.355***
	(0.074)	(0.075)	(0.090)	(0.097)
Corruption (exporter)	−0.100	−0.126	0.055	0.058
	(0.098)	(0.096)	(0.040)	(0.036)
Sector valued added (exporter)	0.928***	0.927***	0.500***	0.501***
	(0.051)	(0.051)	(0.050)	(0.051)
Sector consumption (importer)	0.637***	0.639***	0.423***	0.423***
	(0.026)	(0.026)	(0.025)	(0.025)
Distance	−1.238***	−1.224***	−1.468***	
	(0.063)	(0.064)	(0.065)	
Contiguous	0.903***	0.910***	0.254*	
	(0.162)	(0.164)	(0.144)	
Common official language	0.277	0.279	0.571***	
	(0.234)	(0.236)	(0.166)	
Linguistic similarity	0.633***	0.632***	0.411***	
	(0.234)	(0.235)	(0.147)	
Colonial link	0.936***	0.932***	0.427***	
	(0.170)	(0.168)	(0.114)	
Common colonizer	0.410*	0.355	0.491**	
	(0.227)	(0.229)	(0.230)	
Same country	0.113	0.168	0.780**	
	(0.284)	(0.295)	(0.334)	
Both in GATT/WTO	0.339	0.351	−0.186	−0.158**
	(0.529)	(0.533)	(0.126)	(0.077)
One in GATT/WTO	0.359	0.362	−0.345	1.880
	(0.480)	(0.481)	(0.543)	(862,427)
Polity (exporter)	0.038	0.033	0.008	0.007
	(0.029)	(0.029)	(0.010)	(0.007)
Polity (importer)	0.046***	0.037***	−0.033***	−0.034***
	(0.010)	(0.009)	(0.009)	(0.009)
Tornquist index (exporter)	0.007	0.501***	0.676***	0.680***
	(0.146)	(0.135)	(0.107)	(0.106)
Tornquist index (importer)	0.514***	0.632***	0.405***	0.403***
	(0.176)	(0.175)	(0.124)	(0.122)
Observations	177,559	177,559	177,559	177,559
R^2	0.6	0.6	0.71	0.76
Time dummies	No	Yes	Yes	Yes
Exporter + importer dummies	No	No	Yes	No
County pair dummies	No	No	No	Yes

estimates using the GDP of the exporter and importer countries. Note that the much smaller coverage of the first data set implies a dramatic increase by a factor of 2.5 in the sample size when we substitute sectoral valued added and sectoral consumption (table 2, panel A) with export and import country GDP (panel B). In the table panels, column 1 shows the pooled OLS results, column 2 adds time dummies, column 3 adds importer and exporter country dummies, and column 4 uses country-pair dummies. In column 4, distinct dummies are used for exports from i to j and for exports from j to i.[19]

In column 1 of panel A, as expected, we find negative and significant coefficients on corruption and tariff and a significant positive coefficient on Tariff × Corruption. The results continue to hold in column 2, our benchmark specification, when we add time dummies to the specification in column 1. Column 3 adds country-specific fixed effects (one set of dummies for the exporting countries and another for the importing countries). The coefficient estimate for corruption in the importing country declines in magnitude but remains significant, while tariffs and the interaction term remain strongly significant. Column 4 includes time and country-pair fixed effects, and once again we find that all three terms are significant and have the predicted sign. In panel A, we can see that the results are qualitatively unaffected by the market size measures we use. Across all specifications, we observe negative and significant signs on the corruption and tariff terms, along with a positive and significant coefficient on the interaction term.

All models are jointly significant at the 1% level and account for over 58% of the variation in trade flows. The traditional gravity variables affect trade flows as expected:

[19] In column 4, time-invariant country-pair specific variables like distance and colonial links cannot be estimated.

TABLE 2.—(CONTINUED)

	(1)	(2)	(3)	(4)
B. Manufacturing Industry Data: GDP as Measure of Size				
Corruption (importer)	−0.058***	−0.073***	−0.069***	−0.056***
	(0.019)	(0.019)	(0.013)	(0.013)
Bilateral industry-level tariff	−2.616***	−2.523***	−2.707***	−2.793***
	(0.374)	(0.376)	(0.433)	(0.461)
Tariff × Corruption (importer)	0.420***	0.391***	0.482***	0.505***
	(0.087)	(0.087)	(0.099)	(0.106)
Corruption (exporter)	−0.109	−0.117	0.011	0.012
	(0.074)	(0.075)	(0.025)	(0.017)
log GDP (exporter)	1.182***	1.183***	0.093	−0.025
	(0.055)	(0.055)	(0.073)	(0.067)
log GDP (importer)	0.743***	0.744***	0.605***	0.627***
	(0.028)	(0.028)	(0.051)	(0.047)
Distance	−1.164***	−1.163***	−1.453***	
	(0.058)	(0.058)	(0.051)	
Contiguous	0.884***	0.887***	0.510***	
	(0.162)	(0.162)	(0.159)	
Common official language	0.216	0.214	0.275**	
	(0.207)	(0.208)	(0.124)	
Linguistic similarity	0.502**	0.502**	0.347***	
	(0.194)	(0.194)	(0.110)	
Colonial link	0.920***	0.923***	0.754***	
	(0.130)	(0.129)	(0.096)	
Common colonizer	0.847***	0.852***	0.644***	
	(0.186)	(0.186)	(0.190)	
Same country	0.971***	0.968***	1.058***	
	(0.304)	(0.304)	(0.281)	
Both in GATT/WTO	0.417	0.421	0.149*	−0.014
	(0.262)	(0.262)	(0.079)	(0.043)
One in GATT/WTO	0.292**	0.274**	0.056	0.003
	(0.131)	(0.131)	(0.192)	(0.108)
Polity (exporter)	0.032**	0.031*	0.008**	0.002
	(0.016)	(0.016)	(0.004)	(0.004)
Polity (importer)	0.010	0.006	−0.028***	−0.027***
	(0.007)	(0.007)	(0.005)	(0.005)
Tornquist index (exporter)	0.373***	0.503***	0.633***	0.625***
	(0.081)	(0.087)	(0.074)	(0.074)
Tornquist index (importer)	0.046	0.083	0.070	0.081
	(0.086)	(0.085)	(0.070)	(0.070)
Observations	448,695	448,695	448,695	448,695
R^2	0.58	0.58	0.64	0.7
Time dummies	No	Yes	Yes	Yes
Exporter + importer dummies	No	No	Yes	No
County pair dummies	No	No	No	Yes

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1% The data on trade flows and protection are from CEPII Trade, Production and Bilateral Protection Database, which provides bilateral trade data and bilateral tariff data for the manufacturing sector. It covers 28 industrial sectors according to the ISIC classification Revision 2 and spans the time period 1989–2001. Sectoral consumption in importing country equals (value added − exports + imports) in that sector. All columns include a constant (not shown).

positive for contiguity, colonial links, and linguistic similarity and negative for distance. The coefficients on market size for the export and import country are positive and significant, as predicted by the gravity equation. Corruption in the exporting country has no effect.

Our results indicate the presence of both extortion and evasion. The specification in column 2 of panel A (pooled OLS with time dummies) is closest to our estimating equation (5). Taking this as the benchmark, the threshold value of the tariff is 0.28. Above this tariff, the evasion component dominates, and corruption is trade enhancing. In our sample, 5.4% exhibit tariff rates in excess of 0.28. They span 53 countries, although 10 (highly protectionist) countries (Brazil, Argentina, Colombia, Mexico, India, Ecuador, Morocco, Uruguay, Jordan, and China) account for 55% of them. Moreover, these observations cover all 27 three-digit manufacturing sectors, with Beverages, Tobacco and Footwear in the top three.[20] Meanwhile, in the regressions where we used GDP as the measure of market size (table 2B), the threshold tariff is 0.19, and 14.7% of the observations exhibit tariff rates in excess of this critical value. Overall our results are similar regardless of the size measure we use.[21]

[20] Since we use the relatively broad three-digit ISIC sectoral classification, we are unable to infer the relative importance of differentiated versus homogeneous goods in facilitating evasion. Both Mishra, Subramanian, and Topolova (2008) and Fisman and Wei (2004) use six-digit sectoral codes, which are easier in making these distinctions. We also estimated the augmented gravity equation sector by sector. For eight sectors, we find strong evidence for the presence of both extortion and evasion. For nine more sectors, the signs are as predicted, but the coefficients are marginally insignificant (p-value between 0.1 and 0.15).

[21] On the other hand, for the gravity estimates that include time and country-pair fixed effects, in column 4 in Tables 2A and 2B, the threshold level of the tariffs falls to 0.10 and 0.11, respectively.

TABLE 3.—EFFECT OF CORRUPTION AND IMPORT DUTY ON AGGREGATE BILATERAL IMPORTS

	(1)	(2)	(3)	(4)
Corruption (importer)	−0.151***	−0.136***	−0.028***	−0.035*
	(0.052)	(0.049)	(0.010)	(0.021)
Tariff (import duty)	−2.384*	−3.149**	−0.464*	−0.899*
	(1.248)	(1.324)	(0.261)	(0.506)
Tariff × Corruption (importer)	0.505*	0.519*	0.103*	0.184*
	(0.279)	(0.295)	(0.058)	(0.107)
Corruption (exporter)	−0.188***	−0.171***	0.008	−0.002
	(0.018)	(0.018)	(0.008)	(0.010)
log GDP (exporter)	1.011***	1.033***	0.754***	0.680***
	(0.015)	(0.014)	(0.029)	(0.044)
log GDP (importer)	0.914***	0.938***	0.700***	0.707***
	(0.026)	(0.024)	(0.033)	(0.092)
Log distance	−0.933***	−0.965***	−1.159***	
	(0.047)	(0.047)	(0.009)	
Contiguous	0.467***	0.387***	0.160***	
	(0.137)	(0.138)	(0.035)	
Common official language	−0.017	−0.004	0.223***	
	(0.121)	(0.122)	(0.028)	
Linguistic similarity	0.504***	0.474***	0.235***	
	(0.119)	(0.116)	(0.028)	
Colonial link	0.956***	0.896***	1.003***	
	(0.113)	(0.112)	(0.034)	
Common colonizer	0.757***	0.852***	0.619***	
	(0.124)	(0.123)	(0.026)	
Same country	0.684***	0.626**	0.549***	
	(0.241)	(0.243)	(0.052)	
Both in GATT/WTO	0.110*0.132**	−0.101***	−0.044	
	(0.059)	(0.059)	(0.021)	(0.044)
One in GATT/WTO	−0.058	−0.106	−0.249***	0.068
	(0.115)	(0.118)	(0.039)	(0.100)
Polity (exporter)	−0.007	0.002	−0.002	−0.005***
	(0.005)	(0.005)	(0.002)	(0.002)
Polity (importer)	−0.018**	−0.012	0.012***	0.011
	(0.008)	(0.008)	(0.002)	(0.007)
Exporter GDP deflator	−0.034	−0.128***	−0.228***	−0.219***
	(0.040)	(0.041)	(0.027)	(0.036)
Importer GDP deflator	−0.032	−0.140	−0.091***	−0.137
	(0.090)	(0.094)	(0.033)	(0.092)
Observations	102,270	102,270	102,270	102,270
R^2	0.68	0.69	0.76	0.91
Time dummies	No	Yes	Yes	Yes
Exporter + importer dummies	No	No	Yes	No
County pair dummies	No	No	No	Yes

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. The data on aggregate bilateral trade flows are from the Direction of Trade Statistics, IMF. Import duty from the World Development Indicators are the measure of tariffs. All columns include a constant (not shown).

B. *Country-Level Data*

Table 3 presents OLS estimates of equation (5), using aggregate, country-level bilateral trade flows, and import duties as a measure of the nominal tariff rate, and GDP deflators as a proxy for the multilateral trade resistance terms. Column 2 adds time fixed effects, which should pick up an across-the-board increase in trade flows across all countries. Columns 3 and 4 estimate the model by adding country-specific and country-pair dummies, respectively.

Looking at our variables of interest, in column 1, we obtain negative and significant coefficients on both corruption and tariff. Moreover, as predicted, we obtain a positive and significant sign on Tariff × Corruption. Adding time dummies in column 2 does not affect either the sign or the significance of each of these three terms. Column 4 adds the export and import country-specific, time-invariant dummies, which control for omitted country characteristics. We observe a decline in the magnitude of the coefficients on tariff and corruption and their interaction, although all three remain significant. Column 4 replaces the importer and exporter dummies with country-pair dummies (distinct dummies are used for exports from i to j and for exports from j to i), so that the coefficient estimates are within estimates. Once again, with negative coefficients on tariffs, corruption in the importing country, and a positive coefficient on the interaction term, we find that the effect of corruption on trade is contingent on the prevalent levels of trade protection.

All models are jointly significant at the 1% level and account for at least 68% of the variation in trade flows. Overall, the traditional gravity variable estimates are in line with the literature: positive for contiguity, colonial links, and linguistic similarity and negative for distance. The coefficients on GDP are close to unity, as established by other researchers. Corruption in the exporting country has a negative sign, although it becomes statistically insignificant when country and country-pair dummies are included (columns 3 and 4).

The negative coefficient on corruption and the positive one on corruption interacted with tariffs indicate the presence of both extortion and evasion. Corruption has the potential to increase trade for countries that are highly protectionist. Based on the pooled OLS estimates with time dummies (column 2 in table 3), the threshold tariff is 0.26, and only 5% of our sample have tariff rates in excess of 0.26. These observations, where the evasion component dominates, cover 20 of the 113 countries in our sample. These numbers are remarkably close to the value obtained with sectoral trade data in the previous section. For the within estimates, the threshold tariff falls to 0.19. For 11% of our observations, spanning 38 countries, an increase in corruption over time in that country can actually induce an increase in aggregate bilateral trade.

In sum, the empirical results in this section confirm our predictions that the marginal effect of corruption is ambiguous and mediated by the level of nominal tariffs. This ambiguity, predicted by our model, is based on the notions of a trade-taxing extortion effect and a trade-enhancing evasion effect. For the vast majority of our observations, corruption acts as a tax on trade at the margin, since tariff levels are low enough that the extortion effect dominates. The threshold level of tariffs beyond which the evasion effect dominates is estimated to be in the range of 0.19 to 0.28, depending on the data set used. Moreover, 5% to 15% of the observations, concentrated in a few countries, have tariff levels higher than the threshold. In these cases, reducing corruption may not increase trade flows unless formal trade barriers are reduced.[22]

V. Selection Bias

A recent criticism of the traditional gravity model is that it includes only observations with strictly positive bilateral trade flows.[23] For the aggregate bilateral trade data, 43% of all possible bilateral trade flows show a zero value. These observations drop from the regression automatically since we use the logarithm of trade flows as our dependent variable. Therefore, the presence of zero trade flows may create a sample selection bias.

Silva and Tenreyro (2006) argue that log linearization of the gravity model is not only incompatible with zero trade flows between countries but also yields inconsistent estimates in the presence of heteroskedasticity. They suggest a Poisson pseudo-maximum likelihood (PPML) method. Martin and Pham (2008) use Monte Carlo simulations to show that while the PPML method deals satisfactorily with the heteroskedasticity issue, it yields severely biased estimates when zero trade values are frequent. In their simulations, Heckman maximum likelihood estimators appear to perform well, if valid exclusion restrictions are available—a strategy first pursued by Helpman, Melitz, and Rubinstein (2008).

The model in Helpman et al. (2008) suggests that trade barriers that affect fixed costs of exporting but not variable trade costs are valid exclusion restrictions, affecting only the probability of trade. The two variables that they use as exclusion restrictions are a common religion index and the fixed cost of starting a firm (measured as the number of days and the number of procedures required to start a firm). They also provide evidence that these are valid exclusion restrictions.

While our theoretical model examines only positive trade flows, it is relatively simple to extend our model and show that the probability of trade between any pair of countries is affected in a similar fashion by corruption and by nominal tariffs and their interaction. Assuming that the exporter in o faces a fixed cost of exporting, associated, for example, with starting a firm or with the maintenance costs of distribution and service networks in the importing countries (see Melitz, 2003), we can predict that an increase in the corruption tax Δ (by reducing the potential profits to the exporter) reduces the probability of trade between country pairs. From this perspective, the econometric model addressing the effect of corruption on the probability of trade should be similar to the model used to explain the volume of trade, including stand-alone terms for corruption and tariffs along with their interaction. Hence, following Helpman et al. (2008), we estimate a Heckman selection model, with country-level trade data.[24] We are particularly interested in two questions. First, are the results of the previous section, on the impact of corruption and tariffs on trade flows, robust to the correction for selection bias? Second, are the effects of corruption on the probability of trade also conditional on the level of nominal tariffs?

We use the exclusion restrictions suggested in Helpman et al. (2008): the cost of starting a firm and a common religion index.[25] The common religion index for a country pair (o, d) at time t is constructed as

$$\sum_k \left(\text{proportion of religion}_{ot}^k\right) \times \left(\text{proportion of religion}_{dt}^k\right),$$

[22] As a robustness check, we added an interaction term between corruption in the exporting country and tariffs in the importing country. Based on the notion that exporters from more corrupt countries are more willing to cooperate with corrupt officials in the importing country to evade tariffs, we predict a positive coefficient for this term. However, we did not find evidence for such an effect. In the aggregate trade data, the coefficient is significant but has a negative sign, while in the product-level trade data, the coefficient has the predicted sign but is only marginally significant. One possibility may be that corruption in the exporting country is not the most accurate proxy for the propensity to pay bribes by exporters. At the same time, the coefficients on our key variables of interest were unaffected by the inclusion of this interactive term. We thank an anonymous referee for suggesting this additional robustness test.

[23] Anderson and Van Wincoop (2004), Evenett and Venables (2002), and Haveman and Hummels (2004) also highlight the prevalence of zero bilateral trade flows. Theoretical underpinnings for zero trade are provided in Baldwin and Harrigan (2007) and Helpman et al. (2008).

[24] For the manufacturing industry data, we are unable to run the same procedure because we lack valid exclusion restrictions at the industry-country level.

[25] While the first variable is somewhat ad hoc, its main advantage is that it is available for all countries. The cost of starting a firm more plausibly satisfies the requisite exclusion restrictions. It reflects fixed regulation costs that should not affect an exporting firm's volume of exports to a particular country. However, this measure is available for fewer countries, with 2004 the earliest when these data are available.

TABLE 4.—EFFECT OF CORRUPTION AND TARIFFS ON AGGREGATE BILATERAL IMPORTS: HECKMAN MODEL ESTIMATES

	(1)		(2)		(3)	
	$Prob_{ij}$	M_{ij}	$Prob_{ij}$	M_{ij}	$Prob_{ij}$	M_{ij}
Corruption (importer)	−0.177***	−0.133***	−0.014	−0.025**	−0.171***	−0.159***
	(0.046)	(0.049)	(0.012)	(0.010)	(0.048)	(0.051)
Tariff (import duty)	−4.972***	−3.067**	−1.166***	−0.471*	−4.527***	−2.543**
	(1.044)	(1.313)	(0.258)	(0.263)	(1.000)	(1.195)
Tariff × Corruption (importer)	1.021***	0.502*	0.233***	0.108*	0.987***	0.547**
	(0.223)	(0.293)	(0.056)	(0.058)	(0.240)	(0.268)
Corruption (exporter)	−0.095***	−0.169***	−0.029***	0.005	−0.069***	−0.195***
	(0.010)	(0.019)	(0.009)	(0.008)	(0.011)	(0.019)
log GDP (exporter)	0.436***	1.026***	0.013	0.751***	0.426***	1.010***
	(0.016)	(0.016)	(0.028)	(0.029)	(0.016)	(0.018)
log GDP (importer)	0.333***	0.933***	0.073**	0.671***	0.315***	0.905***
	(0.031)	(0.025)	(0.030)	(0.033)	(0.031)	(0.026)
Log distance	−0.569***	−0.959***	−0.742***	−1.112***	−0.495***	−0.916***
	(0.050)	(0.046)	(0.012)	(0.009)	(0.048)	(0.046)
Contiguous	0.057	0.393***	0.203***	0.175***	0.117	0.453***
	(0.135)	(0.136)	(0.055)	(0.034)	(0.141)	(0.138)
Common official language	0.368***	−0.013	0.427***	0.235***	0.390***	−0.001
	(0.112)	(0.122)	(0.029)	(0.029)	(0.122)	(0.123)
Linguistic similarity	−0.101	0.477***	−0.005	0.280***	−0.099	0.518***
	(0.143)	(0.115)	(0.029)	(0.028)	(0.152)	(0.122)
Colonial link	0.373	0.896***	−0.313***	0.944***	0.459**	0.913***
	(0.252)	(0.111)	(0.103)	(0.034)	(0.223)	(0.107)
Common colonizer	0.342***	0.848***	0.268***	0.552***	0.276***	0.699***
	(0.084)	(0.123)	(0.024)	(0.027)	(0.078)	(0.119)
Same country	0.338	0.614**	0.218***	0.627***	0.421*	0.777***
	(0.249)	(0.240)	(0.078)	(0.053)	(0.250)	(0.237)
Both in GATT/WTO	0.208***	0.129**	0.159***	−0.125***	0.197***	0.081
	(0.058)	(0.059)	(0.021)	(0.022)	(0.058)	(0.059)
One in GATT/WTO	0.227***	−0.114	0.095***	−0.278***	0.253***	−0.074
	(0.084)	(0.118)	(0.031)	(0.039)	(0.083)	(0.119)
Polity (exporter)	0.019***	0.002	−0.004**	−0.004**	0.015***	−0.005
	(0.003)	(0.005)	(0.002)	(0.002)	(0.003)	(0.005)
Polity (importer)	0.016**	−0.013	0.009***	0.011***	0.013**	−0.017**
	(0.006)	(0.008)	(0.002)	(0.002)	(0.006)	(0.008)
Exporter GDP deflator	−0.167***	−0.125***	0.055**	−0.255***	−0.112***	−0.039
	(0.028)	(0.041)	(0.024)	(0.027)	(0.027)	(0.038)
Importer GDP deflator	−0.126	−0.138	−0.174***	−0.038	−0.042	−0.010
	(0.096)	(0.095)	(0.029)	(0.033)	(0.095)	(0.091)
Common religion	0.154*		0.172***		0.184**	
	(0.087)		(0.023)		(0.090)	
Regulation costs (exporter)					−0.002***	
					(0.000)	
Observations		137,391		137,391		126,281
Observations (censored)		35,121		35,121		30,300

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. Each model shows estimates both the probability of a trading relationship ($Prob_{ij}$) and the Heckman corrected trade flows (M_{ij}) between country pairs. Regulation costs refer to the costs of starting a business in terms of number of procedures and number of days in the exporting country. Column 1 includes time fixed effects; column 2 includes time, exporter, and importer fixed effects. All columns include a constant (not shown).

where k is an index for a particular religion.[26] The cost of starting a firm is the sum of the number of days and procedures required to start a firm in the exporting country, from the World Bank's Doing Business 2004 Database. Unfortunately, data are available for a limited number of countries.

Table 4 presents estimates for both the probability of trade (selection equation) and the Heckman-corrected bilateral trade flows (regression equation). Columns 1 and 2 use only the common religion index as the exclusion restriction. Column 1 shows pooled OLS estimates with time fixed effects, and column 2 adds importer and exporter fixed effects. In both, the common religion index significantly affects the probability of trade. In the selection equation, we observe negative and significant coefficients on corruption and tariffs and a positive and significant coefficient on their interaction, so that the impact of corruption on the probability of trade is also conditional on the level of tariffs. More important, for the regression equation with trade flows as the dependent variable, coefficients on our variables of interest are similar, in terms of sign, significance, and magnitude, to our previous estimates (compare to columns 2 and 3 in table 3).[27]

[26] The set of religions we use is more comprehensive than that of Helpman et al. (2008). These include Bahais, Buddhist, Chinese Universist, Christianity, Confucian, ethnoreligionist, Hinduism, Jainism, Judaism, Islam, Shinto, Sikhism, Taoists, and Zoroastrian. The data are from Association of Religion Data Archives. Moreover, if we include the common religion index in the trade volume equation, it fails to be significant.

[27] In column 2 of table 3, the sample size equals 102,770. This is simply the number of uncensored observations from columns 1 and 2 in table 4 (equal to 137,391 − 35,121) so the two estimates are comparable.

The specification in column 3 adds the costs of starting a firm in the exporting country as a second exclusion restriction. While the sample size declines, we find that cost of starting a firm strongly affects the probability of trade, with the expected sign. Once again, we see that Corruption and Tariff reduce both the probability and the volume of trade and that, at high levels of Tariff, an increase in corruption has the potential to raise both the probability and the volume of trade. For all specifications, the inverse Mills ratio (not reported) is significant at the 1% level, so that the hypothesis of independence of the selection and regression equations for both measure of tariffs is easily rejected.

Based on the estimates from column 1, we find that in countries where tariffs are higher than 0.26, the evasion effect dominates, and corruption enhances trade flows. At the same time, an increase in corruption raises the probability of trade, provided tariffs are higher than 0.17. In sum, our results give positive answers to the questions raised: the impact of corruption and tariffs on trade flows shown in the previous section are robust to controlling for selection bias, and they affect the probability of trade with the same type of nonlinearity.

VI. Robustness Checks

This section performs a series of robustness checks. First, we use the unweighted nominal tariff (instead of import duties) computed by the World Bank as an alternate measure of protection; second, we use sectoral-level trade flows from MAcMap available for a single year; third, we look at the validity of our results for different subsamples of countries; fourth, we apply an alternative methodology used in the gravity literature that runs the regressions in ratios to account for the price level in exporting countries; and fifth, we use bilateral export fob (free-on-board) data to account for the possibility that evasion may undermine the validity of the import data used before.

A. *Alternative Measures of Trade Flows and Tariffs*

In table 5, columns 1 and 2 replicate the regressions in table 3, but replace import duties with an unweighted average tariff rate. Column 1 presents the pooled OLS estimates with time fixed effects, and column 2 presents the within estimates with time and country-pair fixed effects. For both specifications, tariffs, corruption, and their interaction are significant and have the predicted signs.[28]

Column 3 of table 5 uses the MAcMap data, which cover trade in both the agricultural and manufacturing sectors and have perhaps the most comprehensive measure of trade protection, taking into account ad valorem and specific tariffs, quota rents, and the prevalence of preferential trade arrangements. This measure is available for a single year, which means that we cannot use time or import or export country dummies due to the obvious collinearity with corruption. In this sample, the impact of corruption and tariffs emerges solely from the cross-country-industry variation in the data. Our predictions are strongly supported for this measure of tariffs in terms of sign and significance. Six percent of our sample has an ad valorem equivalent tariff higher than the threshold where the evasion effect dominates.

[28] We used another aggregate measure of tariffs: the weighted average tariff rate from Barro and Lee (1994), where tariffs in each import category is weighted by the fraction of world trade in that category. This measure is available for a single year in the 1980s. Our predictions are supported for this measure as well.

TABLE 5.—EFFECT OF CORRUPTION AND TARIFFS ON TRADE FLOWS: ALTERNATE MEASURES OF TARIFFS AND TRADE FLOWS

	(1) *Aggregate Trade Flows*	(2) *Aggregate Trade Flows*	(3) *Sectoral Level Trade Flows*
Corruption (importer)	−0.115***	−0.045*	−0.127**
	(0.021)	(0.027)	(0.056)
Tariff	−2.382***	−0.827**	−1.857***
	(0.354)	(0.409)	(0.566)
Tariff × Corruption (importer)	0.217**	0.147*	0.291*
	(0.086)	(0.088)	(0.163)
Corruption (exporter)	−0.179***	−0.022**	−0.268**
	(0.049)	(0.011)	(0.133)
log GDP (exporter)	1.081***	1.272***	1.224***
	(0.037)	(0.070)	(0.075)
log GDP (importer)	0.967***	0.796***	0.860***
	(0.018)	(0.140)	(0.054)
Log distance	−1.001***		−0.703***
	(0.046)		(0.177)
Contiguous	0.672***		0.579
	(0.124)		(0.628)
Common official language	0.092		−0.200
	(0.153)		(0.351)
Linguistic similarity	0.407***		1.480***
	(0.147)		(0.324)
Colonial link	0.851***		1.759***
	(0.123)		(0.392)
Common colonizer	0.876***		0.758**
	(0.157)		(0.326)
Same country	0.471*		2.521***
	(0.238)		(0.777)
Both in GATT/WTO	0.190	−0.056	−0.661
	(0.118)	(0.047)	(0.480)
One in GATT/WTO	0.020	0.039	0.019
	(0.144)	(0.098)	(0.259)
Polity (exporter)	0.005	−0.007***	−1.509***
	(0.011)	(0.002)	(0.321)
Polity (importer)	−0.011***	0.005	−0.575***
	(0.004)	(0.007)	(0.145)
Exporter GDP deflator	0.807***	0.155***	0.001
	(0.116)	(0.044)	(0.035)
Importer GDP deflator	0.695***	0.418***	0.006
	(0.033)	(0.119)	(0.006)
Observations	87,933	87,933	163,433
R^2	0.69	0.92	0.20

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. Columns 1 and 2 use the unweighted tariff measure available for the years 1982–2000. Columns 1 and 2 include time fixed effects; column 2 also includes country-pair fixed effects. Column 3 uses MAcMap data, which provide ad valorem equivalent measures of applied protection across the world, at the detailed product level. The data incorporate specific, ad valorem and mixed tariffs, quantitative measures of protection, and preferential trade arrangements between country pairs. The tariff measure is at the bilateral level. Data are for the year 2001. All regressions include a constant (not reported).

B. *Country Subsamples*

Table 6 presents regression results, taking various permutations in the choice of exporting countries in the sample. The first two columns use the manufacturing data, and the last two

TABLE 6.—EFFECT OF CORRUPTION AND IMPORT DUTIES ON BILATERAL IMPORTS: SUBSAMPLE ROBUSTNESS CHECKS

	(1) *Bilateral Manufacturing Trade, OECD Exporters*	(2) *Bilateral Manufacturing Trade, Non-OECD Exporters*	(3) *Bilateral Aggregate Trade, OECD Exporters*	(4) *Bilateral Aggregate Trade, Non-OECD Exporters*
Corruption (importer)	−0.144***	−0.061**	−0.167***	−0.162**
	(0.035)	(0.025)	(0.047)	(0.063)
Tariff	−3.105***	−2.294***	−1.914*	−2.993*
	(0.500)	(0.384)	(1.053)	(1.553)
Tariff × Corruption (importer)	0.585***	0.409***	0.388*	0.632*
	(0.121)	(0.094)	(0.221)	(0.360)
Corruption (exporter)	0.013	0.179	−0.184***	−0.149***
	(0.115)	(0.166)	(0.018)	(0.019)
Observations	54,484	123,075	29,693	72,577
R^2	0.48	0.44	0.83	0.57

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. Columns 1 and 2 use bilateral manufacturing sector trade at the three digit level; columns 3 and 4 use aggregate trade flows. Import duty is the tariff measure used in columns 3 and 4. All regressions include a constant, and all other gravity variables (not reported).

TABLE 7.—EFFECT OF CORRUPTION AND TARIFFS ON BILATERAL IMPORTS: ALL VARIABLES IN RATIOS, WITH THE UNITED STATES AS THE BASE COUNTRY

	(1) Import Ratio	(2) Import Ratio	(3) Import Ratio	(4) Import Ratio	(5) Import Ratio
Corruption (importer)	−0.658***	−0.710***	−0.334***	−0.358***	−0.331***
	(0.212)	(0.217)	(0.105)	(0.095)	(0.105)
Tariff (import duty)	−3.192***	−3.163***	−1.437**	−1.568***	−1.417**
	(0.990)	(0.979)	(0.547)	(0.479)	(0.551)
Tariff × Corruption (importer)	0.529***	0.523***	0.271***	0.289***	0.267***
	(0.178)	(0.174)	(0.091)	(0.082)	(0.091)
log GDP (importer)	0.934***	0.930***	0.654***	0.661***	0.652***
	(0.028)	(0.028)	(0.131)	(0.125)	(0.130)
Log distance	−1.124***	−1.125***	−1.097***		−1.091***
	(0.041)	(0.041)	(0.034)		(0.036)
Contiguous	0.279*	0.280*	0.465***		0.482***
	(0.142)	(0.142)	(0.144)		(0.140)
Common official language	0.155*	0.147*	0.205***		0.190**
	(0.085)	(0.084)	(0.076)		(0.080)
Linguistic similarity	0.781***	0.788***	0.762***		0.771***
	(0.110)	(0.110)	(0.102)		(0.102)
Colonial link	0.637***	0.638***	0.517***		0.535***
	(0.196)	(0.194)	(0.176)		(0.186)
Common colonizer	0.670***	0.661***	0.363**		0.370**
	(0.229)	(0.227)	(0.183)		(0.183)
Same country	0.589	0.589	0.824**		0.799**
	(0.375)	(0.374)	(0.362)		(0.357)
Both in GATT/WTO	0.123	0.128	−0.007	0.157	−0.006
	(0.202)	(0.201)	(0.186)	(0.145)	(0.188)
One in GATT/WTO	−0.259	−0.250	−0.350	0.114	−0.370
	(0.243)	(0.242)	(0.236)	(0.200)	(0.239)
Polity	−0.157	−0.173*	0.049	0.066	0.048
	(0.098)	(0.100)	(0.078)	(0.084)	(0.078)
Importer price	−0.130	−0.174	−0.017	−0.082	−0.015
	(0.107)	(0.109)	(0.120)	(0.121)	(0.120)
Observations	113,476	113,476	113,476	113,476	176,680
Observations (censored)					63,204
R^2	0.51	0.51	0.54	0.86	
Time dummies	No	Yes	Yes	Yes	Yes
Importer dummies	No	No	Yes	No	Yes
Country pair dummies	No	No	No	Yes	No

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. All variables are calculated relative to the United States as base. Import duty is the tariff measure used. Column 5 presents Heckman corrected gravity estimates where we use the common religion variable as the exclusion restriction. The selection equation is not shown. All columns include a constant (not shown).

columns use aggregate trade data. Columns 1 and 3 restrict the sample to exports from OECD countries; columns 2 and 4 focus on non-OECD exporters.[29] Our results are remarkably consistent across these subsamples: all exporters (OECD and non-OECD) seem to have a similar reaction to tariffs and corruption in the importing country. This stands in contrast to the results of Lambsdorff (1999), who shows that only a small subset of exporting countries experiences trade diversion due to import country corruption and that these differences can be explained by differences in their low willingness to offer bribes (as measured by the Bribe Payers Index).

[29] We get similar results when we use a high- versus low-income classification, or when we restrict the sample to all exports by the United States. Restricting the sample on the basis of importing country would mean that there would be not enough variation in levels of corruption for us to make inferences.

TABLE 8.—EFFECT OF CORRUPTION AND IMPORT DUTY ON BILATERAL EXPORTS

	(1) *Exports*	(2) *Exports*	(3) *Exports*	(4) *Exports*	(5) *Probability of Export*	(6) *Exports*
Corruption (importer)	−0.122**	−0.102*	−0.020	−0.037**	−0.126***	−0.117**
	(0.055)	(0.053)	(0.019)	(0.018)	(0.026)	(0.051)
Tariff (import duty)	−3.195***	−3.826***	−0.674	−0.989*	−3.259***	−3.827***
	(1.179)	(1.293)	(0.556)	(0.570)	(0.775)	(1.242)
Tariff × Corruption (importer)	0.746***	0.733**	0.203*	0.259**	0.651***	0.738***
	(0.273)	(0.285)	(0.110)	(0.115)	(0.162)	(0.273)
Corruption (exporter)	−0.210***	−0.193***	0.012	0.001	−0.135***	−0.195***
	(0.019)	(0.019)	(0.011)	(0.009)	(0.008)	(0.019)
log GDP (exporter)	1.018***	1.043***	0.740***	0.705***	0.503***	1.026***
	(0.016)	(0.015)	(0.045)	(0.046)	(0.015)	(0.017)
log GDP (importer)	0.881***	0.906***	0.768***	0.807***	0.367***	0.886***
	(0.030)	(0.028)	(0.077)	(0.076)	(0.021)	(0.026)
log distance	−0.921***	−0.954***	−1.14***		−0.643***	−0.937***
	(0.044)	(0.043)	(0.052)		(0.042)	(0.042)
Contiguous	0.522***	0.441***	0.237		0.128	0.459***
	(0.140)	(0.141)	(0.163)		(0.147)	(0.137)
Common official language	−0.116	−0.097	0.157*		0.377***	−0.112
	(0.114)	(0.117)	(0.095)		(0.123)	(0.115)
Linguistic similarity	0.571***	0.536***	0.273***		−0.023	0.531***
	(0.114)	(0.111)	(0.074)		(0.143)	(0.109)
Colonial link	1.004***	0.946***	1.022***		0.735***	0.928***
	(0.126)	(0.125)	(0.121)		(0.279)	(0.122)
Common colonizer	0.688***	0.790***	0.520***		0.417***	0.755***
	(0.125)	(0.126)	(0.122)		(0.071)	(0.125)
Same country	0.712***	0.656**	0.677***		0.296	0.653**
	(0.257)	(0.263)	(0.247)		(0.229)	(0.257)
Both in GATT/WTO	0.037	0.057	−0.062	−0.032	0.279***	0.043
	(0.074)	(0.073)	(0.055)	(0.050)	(0.042)	(0.072)
One in GATT/WTO	−0.099	−0.154	−0.205	0.273*	0.233***	−0.133
	(0.155)	(0.162)	(0.145)	(0.157)	(0.068)	(0.159)
Polity (exporter)	−0.012**	−0.004	0.000	−0.001	0.029***	−0.006
	(0.005)	(0.005)	(0.002)	(0.002)	(0.003)	(0.005)
Polity (importer)	−0.012	−0.005	0.010*	0.008	0.005	−0.004
	(0.008)	(0.008)	(0.006)	(0.006)	(0.004)	(0.008)
Exporter GDP deflator	−0.039	−0.131***	−0.179***	−0.203***	−0.222***	−0.124***
	(0.038)	(0.039)	(0.041)	(0.039)	(0.028)	(0.040)
Importer GDP deflator	0.073	−0.029	−0.218**	−0.236***	−0.104*	0.012
	(0.097)	(0.099)	(0.085)	(0.089)	(0.057)	(0.097)
Common religion					0.079	
					(0.063)	
Observations	99,650	99,650	99,650	99,650	133,879	
Observations (censored)					37,238	
R^2	0.68	0.68	0.76	0.92		
Time dummies	No	Yes	Yes	Yes	Yes	
Exporter + importer dummies	No	No	Yes	No	No	
County pair dummies	No	No	No	Yes	No	

Standard errors adjusted for clustering on importing country. *Significant at 10%. **Significant at 5%. ***Significant at 1%. Column 4 presents estimates of the selection equation and uses the common religion variable as the exclusion restriction. Column 5 presents Heckman-corrected gravity estimates. All columns include a constant (not shown).

C. *Ratios to Exports to the United States*

In table 7, we follow the estimation strategy of Anderson and Marcouiller (2002), who modify the gravity model by using the dependent variable X_{od}/X_{oUS} (exports to d relative to exports to the *US*).[30] This specification has the advantage that all exporter country-specific terms (including any time-variant, export-country-specific multilateral trade resistance) cancel out, allowing us to focus on import-country and pair-specific terms. Column 1 reports pooled OLS estimates, column 2 adds time dummies, columns 3 and 4 include country fixed effects, and column 5 presents the Heckman corrected estimates.[31]

Once again, our predictions are supported. All regressions show a negative coefficient on Corruption and the Tariff measures, and a positive coefficient for their interaction: Tariff × Corruption, all of which are significant. The threshold tariff in the benchmark specification of column 2 is now 1.35, which means that the marginal effect of corruption becomes positive when the tariff rate is 35% higher than in the United States. We find that at least 7% of the observations exhibit a positive relationship between corruption, confirming the results of the previous sections.

[30] The formulation implies that the independent variables are also in ratios to the United States. For example, $corruption_d$ becomes $corruption_d/corruption_{USA}$.

[31] Here we also correct for the case where $X_{oUS} = 0$. For brevity, the selection equations are not reported.

D. Exports as Dependent Variable

Given that tariff evasion is an integral part of our story and that one of the ways to evade tariffs is through systematic underreporting of imports, there may be a discrepancy between reported bilateral imports and actual bilateral imports. In such a scenario, bilateral exports from country *o* to country *d* as reported by country *o* (rather than imports reported by *d* from *o*) may be a more accurate measure of the volume of trade flows. Bhagwati (1964) notes these discrepancies in reporting of trade flows by source and destination countries and suggested that evasion of tariffs and other controls could be a potential explanation. Fisman and Wei (2004) find evidence that in the context of Hong Kong–China trade, the evasion gap is higher for sectors that face higher tariffs and VAT. However, others have generally taken these discrepancies to be measurement errors (Feenstra & Hanson, 2000). Therefore, as a final robustness check, we use fob exports as the dependent variable.[32]

Table 8 uses import duty as the measure of tariffs, and shows that our results are robust to using exports as the dependent variable. Column 1 shows the pooled OLS results, column 2 adds time dummies, column 3 adds export- and import-specific dummies, column 4 presents the within-estimates and column 5 and 6 present the Heckman estimates of the selection and regression equations, respectively. In all but one specification, the one with importer- and exporter-specific dummies, the coefficients are significant and have the predicted signs.

Overall, our results survive a series of robustness checks, and we obtain consistent evidence that the effect of corruption on trade flows is contingent on the level of nominal tariffs.

VII. Conclusion

This paper has looked into the theory and evidence on the role of corruption as a barrier to trade. Our results have stressed the nonlinear relationship between corruption and trade and the key role of the interaction with the level of legal protectionism, as set by trade policy. The main implication is that corruption taxes trade when protection is low, but beyond a certain level of protection, it becomes trade enhancing at the margin. Underlying this are the conflicting roles of corruption in facilitating extortion by customs officials, while simultaneously creating an environment prone to the evasion of restrictive regulations. Our empirical estimates, which are robust to a variety of estimation techniques and data sets, show that corruption impedes trade for the vast majority of countries, but when the level of tariffs is high, corruption can produce a trade-enhancing effect. Hence, the paper highlights the interrelationship of the effect of corruption and the extent of regulatory barriers, consolidating the various strands of the intellectual history on the effects of corruption.

[32] The data on fob exports are much more comprehensive than data on cost including freight exports.

Our results have implications for trade and institutional reforms around the world. In fact, the impact of corruption on trade has recently come to the forefront of the trade policy debate, as successive rounds of trade negotiations have reduced traditional trade barriers, such as tariffs and quotas. Trade facilitation discussions have been undertaken at the Doha Round in an effort to promote transparency, reduce red tape, and diminish the scope for arbitrary decision making and cheating. The WTO strongly believes that agreements on trade facilitation will provide a significant boost to world trade. At the same time, countries like Indonesia and the Philippines have recognized the problem of customs corruption and have undertaken serious efforts to eradicate the same.

In this context, our results provide some support to that effort, showing that reducing the scope for corruption, reduces the impediments to trade in the majority of cases. However, the results also show that with countries that are highly protected, the right policy is to reduce the level of tariffs, and, more important, that efforts to reduce corruption might have a detrimental effect on trade. An important caveat is raised by Rose-Ackerman (1997), who points out that "tolerating corruption as a way around restrictive trade policies leads to widespread inequities and inefficiencies." Moreover, Kaufmann and Wei (1999) argue that we must also account for the impact of corruption on the regulation itself. Addressing these issues remains a challenge for future work.

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APPENDIX

Microfoundations of the Corruption Tax

A.1. Model

In this appendix, we probe more deeply into the analysis of the corruption tax in section II, developing a model of the interaction between the exporter and a corrupt customs official. Our goal is to provide microfoundations of the corruption tax introduced in equation (1).

Following up on the model introduced in section 2, we assumed that the sole producer of good l, from country o, faces the demand in country d:

$$x_l = p_l^{-\varepsilon} P_d^{\varepsilon-1} Y_d \quad \text{with} \quad P_d^{1-\varepsilon} = \int_l p_l^{1-\varepsilon}, \tag{A1}$$

where $\varepsilon > 1$. The unit production cost of l is w_o, iceberg transport costs are λ, and the nominal tariff in d is $T \in (0, 1)$.

In addition to transport costs and tariffs, the exporter has to interact with a customs official to clear customs. The official may demand a bribe (b) from the exporter—the extortion effect. She also chooses the zeal z with which to implement the nominal tariff. As previously discussed, a lower zeal implies facilitating evasion mechanisms such as the misclassification or underreporting of merchandise. We define the effective tariff paid by the exporter as zT, where $0 < z \leq 1$ is the zeal of the customs official and $z < 1$ captures the evasion effect. Hence, the profit of the exporter is given by

$$\Pi = \pi - \lambda c x_l \qquad \pi = p_l x_l (1 - zT) - b, \tag{A2}$$

where $p_l x_l (1 - zT)$ are the import rents. By lowering zeal, the official raises the import rents, while the bribe transfers rents from the exporter to the official.

Income from bribes increases the utility of the customs official but carries the risk of being caught and punished by the authorities. Likewise, lowering zeal carries an additional risk of punishment for the customs official. Our working assumption is that a high institutional pervasiveness of corruption increases the marginal utility of income from bribes because it reduces the probability of getting caught and the associated penalties. To capture this, we impose the following expression for the utility of the official,

$$U = b^{\psi} \exp \delta \left(\frac{z^{1-\alpha}}{1-\alpha} - z \right) \qquad 0 < \psi < 1;\ \delta > 0;\ \alpha > 0, \tag{A3}$$

where ψ denotes the level of corruption. It implies that the marginal utility from the bribe is positive ($U'_b > 0$) and increases with the level of corruption ($U''_{b\psi} > 0$), while the marginal utility from zeal is also positive ($U'_z > 0$) and increases with δ, the degree of supervision.[33]

We model the decision of the exporters and the customs official in two stages. In stage 1, the exporter decides the quantity to export, and the shipment makes its way to the customs of d, incurring the transport costs. In stage 2, when reaching country d, the merchandise must go through customs. At this stage, the customs official must decide the zeal with which she will implement the nominal tariff, taking into account the implications for the bribe she will be able to extract from the exporter. Finally in stage 3, at the final step of the customs clearance procedure, the customs official engages in extortion and requires a bribe to allow the merchandise through.

A.2. *Bribes and zeal*

We begin with the negotiation of the bribes, modeled here as the outcome of a Nash-bargaining game between the official and the exporter, contingent on the zeal.[34] For simplicity, we assume that the reservation utility for the official is zero (no bribe). For the exporter, the reservation profit ($\hat{\pi}$) is determined by the alternative customs procedure (such as finding a nonextortionary official), which entails delays and costs captured by the discount factor (φ):

$$\hat{\pi} = \overline{p_l x_l} \varphi (1 - T);\ \varphi < 1.$$

Taking z as given, for a moment, the solution to the Nash-bargaining problem that determines the bribe emerges from $\max_b \ln U + \ln(\pi - \bar{\pi})$,

$$\max_b \left[\psi \ln b + \delta \left(\frac{\bar{z}^{1-\alpha}}{1-\alpha} - \bar{z} \right) \right] + \ln \left(\overline{p_l x_l} \left(1 - \bar{z}T\right) - b - \varphi \, \overline{p_l x_l} \left(1 - T\right) \right).$$

Solving the first-order condition entails

$$b = \frac{\psi}{1+\psi} \overline{p_l x_l} \left[1 - \bar{z}T - \varphi(1-T)\right] \tag{A4}$$
$$\pi = (1+\psi)^{-1} \overline{p_l x_l} \left[(1 - \bar{z}T) + \psi \varphi (1-T)\right].$$

Here an increase in corruption raises the share of the customs official, since the rise in impunity increases the marginal utility of asking for a higher bribe.

Now we look at the choice of zeal by the customs official, who takes into account the effect her choice has on the bribe she will extract. Given equation (A4), the official's problem can be written as

$$\max_z \left[\psi \ln \left(\frac{\psi}{1+\psi} \overline{p_l x_l} \left[(1 - zT) - \varphi(1-T)\right] \right) + \delta \left(\frac{z^{1-\alpha}}{1-\alpha} - z \right) \right],$$

with the solution emerging from the first-order condition as follows:

$$\delta(\tilde{z}^{-\alpha} - 1) = \psi \frac{T}{1 - \tilde{z}T - \varphi(1-T)}, \tag{A5}$$

where for $\psi = 0$, the solution entails $z = 1$. Here an increase in corruption (ψ) leads to a decline in the equilibrium level of zeal, because the official appropriates a larger share of the returns from lowering zeal through the higher bribe (as a share of import rents). Moreover, an increase in T lowers z, although the effective tariff (zT) increases.

A.3. *Exports*

Next, we solve for the exporter's decision on the volume to ship to d, given the likely actions of the country's customs officials, as the solution to

$$\max_{x_l} \pi = p_l x_l \frac{(1 - \tilde{z}T) + \psi \varphi (1-T)}{1+\psi} - w_o x_l \lambda,$$

where $\tilde{z}$ is the optimal effort deployed by the customs official (see equation A5). Given the demand function outlined above, the profit maximization yields the traditional expression for the price in terms of the elasticity of substitution (ε)[35]

$$p_l = \frac{\varepsilon}{\varepsilon - 1} (1-T)^{-1} (1+\Delta) \lambda w_o, \tag{A6}$$

which in turn yields the expression for exports given in equation (2). Δ is the corruption tax, given by

$$\Delta = \frac{(1+\psi)(1-T)}{(1 - \tilde{z}T) + \psi\varphi(1-T)} - 1 \tag{A7}$$
$$\text{with } \tilde{z}:\ (\tilde{z}^{-\alpha} - 1)^{-1} \psi - \delta T^{-1} (1 - \tilde{z}T - \varphi(1-T)) = 0.$$

A.4. *The Corruption Tax*

The corruption tax is the tariff equivalent of the trade costs imposed by corruption. In the absence of corruption ($\psi = 0$), zeal is maximal ($\tilde{z} = 1$), and the corruption tax is zero ($\Delta = 0$). The net effect of corruption on the corruption tax can be decomposed into the extortion and evasion component as follows,

$$\Delta_{\psi} = \overset{\text{Extortion}}{\Delta_{\psi}} + \overset{\text{Evasion}}{\Delta_{\tilde{z}} \tilde{z}_{\psi}},$$

which, evaluated at low levels of corruption ($\psi = 0$), can be written as[36]

$$\Delta_{\psi=0} = \overbrace{(1-\varphi)}^{\text{Extortion}>0} + \overbrace{-\alpha^{-1}\delta^{-1}(1-\varphi)^{-1}(T^{-1}-1)^{-2}}^{\text{Evasion}<0} \tag{A8}$$

[33] This utility function ignores other income or the wealth of the official, and thus cannot capture some important determinants of corruption, such as low salaries. On the other hand, by positing that an increase in zeal raises the official's utility ($U'_z > 0$), we are assuming that the decline in expected sanctions outweighs the potential costs of a higher effort. We also ignore the notion that in a more corrupt environment, supervision (δ) might also decline.

[34] Rose-Ackerman (1997) argues that "bribery . . . seldom occurs under competitive market conditions. Instead, a bargaining framework is often appropriate."

[35] For simplicity, we assume that imports, X, are valued at a price that includes the border cost.

[36] When evaluated at $\bar{\psi} \to 0$, which implies $\bar{z} \to 1$, we must take into account that $\bar{\psi}(\bar{z}^{-\alpha} - 1)^{-1} = \delta T^{-1}(1 - zT - \varphi(1-T)) \to \delta(1-\varphi)(T^{-1}-1)$ (see equation (A5).)

This expression highlights the ambiguous nature of the effect of an increase in corruption. On the one hand, the tax rises due to increased corruption; on the other, it declines, due to increased evasion, with an undetermined net effect. Moreover, it highlights the role of tariffs in allowing the empirical identification of the evasion component, since the trade-enhancing effect of corruption exists only at positive levels of tariffs and is increasing in the level of nominal tariffs, T. One implication is that for very high levels of tariffs, when the potential for evasion is large, the corruption tax can become negative. In addition, equation (A8) shows that extortion is stronger when the additional costs of looking for a noncorrupt official are high (φ is low), while evasion is stronger if supervision (δ) is low.

Finally, to obtain the linear version of the corruption tax in equation (1), we can use a Taylor decomposition of equation (A7) around $\hat{\psi} = 0$ to obtain

$$\Delta \approx \underset{\text{Extortion}}{\Lambda_x} \psi + \underset{\text{Evasion}}{\Lambda_v} \hat{T}\psi, \tag{A9}$$

where $\Lambda_x \equiv 1 - \varphi > 0$ and $\Lambda_v \equiv -\alpha^{-1}\delta^{-1}(1 - \varphi)^{-1} < 0$, and $\hat{T} \equiv (T^{-1} - 1)^{-2}$ is an increasing, convex transformation of T. In equation (1), to simplify the estimation, we have ignored the convex transformation and use T instead of $\hat{T}$ in the corruption tax specification.