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# Corruption, Trade Costs, and Gains from Tariff Liberalization: Evidence from Southern Africa†

*By* Sandra Sequeira*

*This paper exploits quasi-experimental variation in tariffs in southern Africa to estimate trade elasticities. Traded quantities respond only weakly to a 30 percent reduction in the average nominal tariff rate. Trade flow data combined with primary data on firm behavior and bribe payments suggest that corruption is a potential explanation for the observed low elasticities. In contexts of pervasive corruption, even small bribes can significantly reduce tariffs, making tariff liberalization schemes less likely to affect the extensive and the intensive margins of firms' import behavior. The tariff liberalization scheme is, however, still associated with improved incentives to accurately report quantities of imported goods, and with a significant reduction in bribe transfers from importers to public officials.* (*JEL* D22, D73, F13, H83, O17, O19, O24)

Trade elasticities play a central role in standard models of trade by determining the effects of policy interventions and the calculation of gains from trade (Hillberry and Hummels 2013; Arkolakis, Costinot, and Rodriguez-Clare 2012). Yet in practice, we still lack reliable estimates of this elasticity. Approaches that rely mostly on time-series variation in trade costs tend to estimate elasticities in the range of one or smaller, while cross-sectional analyses estimate elasticities of five or higher (Baier and Bergstrand 2001; Broda and Weinstein 2006; Romalis 2007; Hillberry and Hummels 2013; Caliendo and Parro 2015). The standard explanations for this discrepancy range from attenuation bias due to measurement challenges and the endogeneity of trade costs (Trefler 1993), to the fact that the two approaches exploit different sources of variation: the time-series work exploits short-run adjustments to changes in trade costs, while the cross-sectional studies reflect more long-run effects of differential levels of trade costs across industries or countries (Goldberg

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and Pavcnik 2016). Moreover, trade elasticities are seldom estimated from actual trade policy changes that affect trade costs (Goldberg and Pavcnik 2016). This paper attempts to fill this gap. I first exploit quasi-experimental variation in import tariff costs associated with a long-standing trade agreement in southern Africa to estimate trade elasticities. I then collect a novel dataset on bribe payments to provide suggestive evidence on how corruption in the import process can potentially affect tariff costs and help interpret the observed elasticities.

The main source of exogenous variation in trade costs exploited in this study results from a trade agreement between South Africa and Mozambique (under the Southern African Development Community Agreement), which dictated the pace and scope of tariff reductions occurring between 2001 and 2015. This Trade Protocol was signed in 1996, in the aftermath of major political and economic upheaval in South Africa, and as Mozambique exited a protracted civil war. More recently, both countries have rebuilt their economies and a different set of economic interests have come to the fore.[1] Despite these changes, the scheduled tariff reductions were strictly followed, with the largest reduction in the average nominal tariff rate (of 5 percentage points) occurring in 2008. It is thus plausible to assume that the sequence and the magnitude of the tariff changes were not driven by specific industries or lobbies operating in either country today. Note that this trade agreement also significantly reduced trade policy uncertainty, and should, as a result, lead to sizable changes in traded quantities (Handley and Limao 2015; Handley 2014). The analysis covers the time period between 2006 and 2014 to ensure enough time for firms to adjust their import behavior in response to the tariff change.

The empirical analysis proceeds in three steps and yields the following findings. First, to estimate reduced-form trade elasticities, I match data on tariffs from the Mozambican Customs Authority to aggregate trade flow data from the United Nations Commodity Trade Statistics Database (COMTRADE) for trade between South Africa and Mozambique, during the period 2006–2014.[2] I find that trade elasticities are close to the lower range of elasticities identified in the literature for time-series analysis (0.1). I conduct several robustness checks to test for strict exogeneity and to account for measurement error.

Second, I examine the micro-foundations of these elasticities by directly observing firm-level import behavior in the region, before and after the main tariff change in 2008. I collect data for a panel of 190 firms operating in the trade corridor linking South Africa to Mozambique, eliciting information on import behavior and general firm-level characteristics. This survey suggested that the tariff changes were inframarginal: incumbent firms did not adjust the extensive or intensive margins of import behavior in response to changes in nominal tariff costs.

Third, I conduct a detailed analysis of corruption patterns by measuring bribe payments along the trade corridor linking South Africa to Mozambique, between 2007 and 2013, for a random sample of over 1,000 shipments imported into

[1] The South African economy has diversified from mining into the manufacturing sector and the Mozambican economy is now specializing in industries associated with the recent natural resource boom.

[2] No data are available for earlier years.

Mozambique.[3] The first finding is that prior to the tariff change, bribe payments were high and mostly directed at tariff evasion. Approximately 80 percent of the random sample of shipments tracked were associated with a bribe payment during the clearing process. While bribes were sizable in absolute terms (mean bribes were US$128 per tonnage),[4] they were small relative to the magnitude of the tariff evasion rent. Consistent with a long-standing puzzle in the literature, the Tullock paradox, bribes represented only about 7 percent of the total tariff duties saved by the average importer.

The exogenous change in tariffs induced by the trade agreement provided an opportunity to examine the impact of changes in tariffs on corruption patterns, through a difference-in-differences design. Several products did not experience a change in tariff rates during this period and as such, constitute a credible control group for those that did. This heterogeneity in exposure to the tariff changes allows me to isolate a causal relationship between tariffs and corruption. The removal of tariffs significantly reduced the probability of bribe payments (by 30 percent) and the average amount of bribes paid (by 20 percent). These results are robust to the standard tests for the validity of a difference-in-differences approach and to a detailed analysis of potential displacement effects of corruption onto other products or other stages of the delivery of the public service. Consistent with the corruption hypothesis, I also observe that the removal of tariffs reduced the incentive for Mozambican importers to misrepresent the quantity of imports, and that these figures converge to those reported by the South African exporters once tariffs are removed.

Artificially low estimates of trade elasticities then pose a challenge to estimating welfare gains from tariff reductions. Following the Arkolakis, Costinot, and Rodriguez-Clare (2012) formula, the gains from the tariff reduction are implausibly high at 87 percent. This is an artifact of the excessively low estimated trade elasticities and as such, do not represent actual gains from the change in tariffs.

Taken together, these findings suggest that the impact of a reduction in tariffs on trade flows depends on whether tariffs represent a significant cost to firms in the first place. This paper presents new evidence on how in environments with pervasive corruption, substantial tariff liberalization can potentially translate into small changes in trade costs, and consequently, low estimates of trade elasticities and incorrect measures of the gains associated with tariff liberalization. Tariff liberalization schemes can, however, still be associated with the reduction of bribe transfers from private agents to public officials and with improved incentives for the accurate reporting of trade flows.

These findings contribute to several strands in the literature on trade and development. First, they directly address knowledge gaps identified in the trade survey literature (Hillberry and Hummels 2013; Goldberg and Pavcnik 2016). They contribute to an extensive literature attempting to estimate and interpret trade elasticities (Baier and Bergstrand 2001; Broda and Weinstein 2006; Romalis 2007; Caliendo and Parro 2015) and to measure the effect of tariff changes on imported volumes (Amiti and

[3] The trade corridor connecting Mozambique to South Africa consists of a land border located 60 miles from the Mozambican capital and 250 miles from the South African capital, and a main port in Maputo, Mozambique, which is linked by cabotage shipping to the main port of Durban, in South Africa, at a distance of 288 nautical miles.

[4] Equivalent to 129 percent of port usage fees and 14 percent of the overall cost of importing a standard 20-foot container from the Far East into Mozambique.

Konings 2007; Goldberg et al. 2010). The findings also add to a related literature aimed at calculating gains from trade (Arkolakis, Costinot, and Rodriguez-Clare 2012) and helps contextualize discussions on the effect of trade policies on trade growth (Deardorff and Stern 1986; Frankel and Romer 1999; Harrison and Hanson 1999; Baier and Bergstrand 2001; Rodriguez and Rodrik 2001; Anderson and Wincoop 2003; Rose 2004).

Second, this paper provides a methodological contribution to a growing body of empirical work attempting to measure corruption and trade costs. While the common approach in the literature is to rely on an indirect measure of tariff evasion—the trade gap—the approach followed in this paper allows for more direct and precise measures of the overall level, distribution, and type of corruption associated with the movement of goods across borders, while accounting for any potential displacement effects associated with trade policy changes.

Third, the corruption analysis also contributes to an extensive theoretical and empirical debate examining the relationship between tariff rates and tariff evasion. The literature is divided on whether higher tariff rates increase incentives for tariff evasion to occur (Allingham and Sandmo 1972; Clotfelter 1983; Panagaryia 1996; Poterba 1987; Gatti 1999; Fisman and Wei 2004; Mishra, Subramanian, and Topalova 2008; Sequeira and Djankov 2014) or if lower tariffs increase private agents' ability to pay higher bribes through an income effect (Feinstein 1991; Slemrod and Yitzhaki 2002). The findings in this paper lend support to the hypothesis that higher tariffs are associated with higher tariff evasion, with limited income effects.

Finally, these findings relate to a growing literature in law and economics that measures the potential for policy reform to trigger the displacement of corruption across different types of illicit activities (Reppetto 1976; Chaiken, Lawless, and Stevenson 1974; McPheters, Mann, and Schlagenhauf 1984; Ayres and Levitt 1998; Levitt 1998; Di Tella and Schargrodsky 2004). With the exception of Yang (2008a, b), displacement effects of corruption in the context of trade policy and trade costs have remained largely unexplored. Because I observe the entire chain of public service delivery in a critical public bureaucracy for a long enough time horizon of five years, I am able to provide new evidence on how the demand and supply side of bribes adjust to policy reforms that change opportunities for certain, but not all, corrupt transactions to take place. It also allows me to test a central prediction in Yang (2008a): that displacement is low when the fixed and variable costs of alternative methods of bribe extraction are high.

The paper is organized as follows: Section I describes the tariff liberalization scheme that generated the variation in tariff prices used in the empirical analysis; Section II discusses the estimation of trade elasticities based on the tariff liberalization schedule, using aggregate trade flow data and firm-level data; Section III examines the role of corruption in determining actual tariff prices through a combination of indirect and direct measures of bribes; Section IV discusses several robustness checks; and Section V concludes.

## I. The SADC Tariff Liberalization Scheme

Mozambique joined the Southern African Development Community (SADC) in 1992, committing to the SADC Trade Protocol in 1996, which required the complete

Table 1—Comparability of Trade Patterns and Product Characteristics across Treatment and Control Products, Prior to the 2008 Tariff Change

| | Treatment products | | Comparison products | | Difference $t$-test/$\chi^2$ $p$-value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| *Panel A. Patterns of trade* ($N = 4{,}660$) | | | | | |
| Share of imports (quantities) | 38.1 | 492.5 | 241.2 | 5244.4 | 0.20 |
| Share of imports (value) | 22.2 | 237.2 | 33.84 | 341.2 | 0.19 |
| Unit value | 4.82 | 53.7 | 6.21 | 83.3 | 0.51 |
| *Panel B. Product characteristics* ($N = 265$) | | | | | |
| Shipment value per ton (USD) | 44,027 | 179,869 | 410,508 | 2,959,621 | 0.25 |
| Number of containers per shipment | 7.99 | 2.606 | 7.4 | 3.173 | 0.10 |
| Bulk cargo (non-containerized) | | | | | 0.94 |
| Rauch product classification | | | | | 0.01 |

*Notes:* In panel A, the share of imports corresponds to the share of imports into Mozambique from South Africa relative to imports from the Rest of the World. Treatment products are all products affected by the tariff change and comparison products are all products that did not experience a change in tariffs. $p$-values are for $t$-tests of equality of means of continuous variables, assuming unequal variances. In panel B, the data correspond to the sample of shipments captured in the audit study conducted by the author in 2007.

*Sources:* United Nations COMTRADE database, Mozambican customs tariff code, and audit study conducted by the author

phaseout of tariff rates for South African imports by 2015. The agreed timeline for the reduction in tariff rates in Mozambique was similar to the reforms adopted by other SADC member countries such as Malawi, Tanzania, Angola, Zambia, and Zimbabwe, and the goal was to harmonize regional tariff regimes. In terms of the magnitude of tariff changes, the most significant reduction took place in 2007–2008, reducing the average nominal tariff rate by approximately 5 percentage points (corresponding to a 30 percent decline in the average tariff rate). In all cases, treated products went from a positive tariff rate to zero tariffs.[5]

Since the schedule for the tariff phaseout was set in the mid-1990s, it is unlikely to have been driven by import patterns in the region today, thus mitigating the possibility of reverse causality. There were no deviations from the agreed tariff phaseout schedule, suggesting that there was no strategic behavior to sustain longstanding patterns of trade protection. Moreover, the tariff schedule is unlikely to reflect entrenched private sector interests today given the dramatic change in the composition of the private sector in Mozambique between the end of the civil war in the early 90s and the inflow of investment associated with the recent resource boom, and in South Africa since the fall of Apartheid.

Table 1 presents further evidence of the comparability of trade patterns and product characteristics between products experiencing a reduction in tariffs and products that remained in the same tariff grouping throughout the period under analysis. Trade patterns are measured in terms of the share of value and quantities imported by each product grouping (treatment versus control) from South Africa prior to the tariff change, as well as their unit value. Product characteristics include the value per tonnage of the shipments, the number of containers shipped per product category,

[5] Prior to that, the Mozambican Tariff Scheme followed a standard bimodal structure with higher protection on agricultural products, followed by manufacturing and mining. The highest tariff rate in 2007 was 20 percent.

and whether cargo was containerized or shipped in bulk given that containerized cargo is potentially easier to misreport. The table also includes a test of whether a product has an internationally set reference price given evidence in the literature suggesting that this is an important determinant of tariff evasion (see Section IIIB for a discussion of this hypothesis). Products that experienced a tariff change in 2008 are similar in all dimensions to products that did not change tariff in 2008.[6]

## II. Tariff Liberalization and Import Behavior

### A. *Tariffs and Import Volumes: Aggregate Trade Flow Data*

Trade elasticities are of central importance in the quantitative analysis of the impact of tariffs on trade. There is, however, considerable disagreement over the magnitudes of trade elasticities in the literature. Caliendo and Parro (2015) estimate sectoral elasticities that range between 0.37 (s.e. 1.08) and 51.8 (s.e. 18.05); Hummels (2001) estimates elasticities ranging between 5.3 and 7.3; Broda and Weinstein (2006) present median elasticities of 3.7 with significant skewness in sectoral averages; Romalis (2007) estimates average elasticities ranging between 6.2 (s.e. 0.80) and 10.9 (s.e. 1.16) and Simonovska and Waugh (2014) estimate an average elasticity of 4.14 (s.e. 0.09). Studies relying on time-series variation in trade costs tend to estimate elasticities closer to 1 or lower (Bergstrand 1989; Greenhalgh, Taylor, and Wilson 1994; Shiells and Reinert 1993; Hillberry and Hummels 2013; Goldberg and Pavcnik 2016). These discrepancies are often justified in the literature as the result of attenuation bias due to measurement error and to the endogeneity of trade costs (Trefler 1993). Moreover, studies that exploit time-series variation in trade costs are often seen as capturing short-run adjustments to trade costs, which could also explain the smaller elasticities.

In this section, I use secondary data on aggregate import flows to examine the impact of changes in tariff rates on Mozambican imports from South Africa during the period for which data are available from the United Nations Statistical Division's (UNSD) Commodity Trade Statistics Database (COMTRADE): 2006–2014. Commodities are defined using the Harmonized Commodity Description and Coding System (HS) at the six-digit level of aggregation. Tariff rates are obtained directly from the Customs Authority in Mozambique (Alfandegas de Mocambique). I estimate foreign-foreign substitutions resulting from quasi-experimental changes in tariffs for imports from South Africa into Mozambique, as a share of imports into Mozambique from the Rest of the World. To do so, I rely on data reported by exporters as these have, in theory, a reduced incentive to misreport the volume or the value of traded goods (Bhagwati 1964). The main specification corresponds to

$$\text{(1)} \qquad log\, Import\, Share_{it} = \alpha_0 + \alpha_1 log\, Tariff\, Rate_{it} + \mu_t + \gamma_i + \epsilon_{it},$$

where $log\, ImportShare_{it}$ represents the total volume of imports of product $i$ from South Africa in period $t$, as a share of total imports from the Rest of the World,

[6] The only exception is whether a product has an internationally set price and as such, this will be an important variable to control for in the analysis.

Table 2—Tariff Liberalization and Import Volumes, 2006–2014: Aggregate Import Flows

| | log share import volumes | | | |
|---|---|---|---|---|
| | Fixed effects (1) | First differences (2) | Long differences (3) | Instrumental variable (4) |
| *Panel A. 2 SLS Estimate* | | | | |
| log tariff rate | −0.016 | | | −0.097 |
| | (0.027) | | | (0.050) |
| Δ log tariff rate | | −0.010 | −0.076 | |
| | | (0.019) | (0.018) | |
| *Panel B. First stage dep. var. log tariff rate* | | | | |
| Lagged log tariff rate (one period) | | | | 0.841 |
| | | | | (0.042) |
| Lagged log tariff rate (two periods) | | | | −0.085 |
| | | | | (0.011) |
| Baseline tariff rate 2006 | | | | −0.040 |
| | | | | (0.002) |
| Kleibergen-Paap Wald *F*-statistic | | | | 207.09 |
| Observations | 21,520 | 16,353 | 13,022 | 15,326 |
| Mean of dependent variable | 1.094 | 1.051 | 1.055 | 1.130 |

*Notes:* log share import volumes corresponds to the quantity of imports from South African as a share of the total quantity of imports from the rest of the world into Mozambique, in logarithmic form. Robust standard errors clustered at the level of the product's four-digit HS code.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code.

in logarithmic form. $log\,Tariff\,Rate_{it}$ corresponds to the tariff rate of product $i$ in period $t$, also in logarithmic form. $\mu_t$ and $\gamma_i$ represent year and product-level fixed effects defined at the four-digit level of the harmonized system (HS) classification. These fixed effects control for nontariff barriers, unobservable trade costs, as well as other year-specific impacts on macroeconomic conditions that can condition firms' import behavior. $\alpha_1$ represents the coefficient of interest measuring the elasticity of imports to changes in tariff rates.[7]

Trade elasticities reported in column 1 of Table 2 are close to 0.02 but insignificant. Given the extended period under analysis and uncertain priors as to how quickly one would expect the effects of the tariff change to be reflected in aggregate import behavior, column 2 presents estimates from a model in first-differences that compares outcomes just prior to, and just after, the change in tariffs, while column 3 presents estimates for a model in long-differences, which compares results well before and well after the policy change took place. These different specifications test the robustness of the results and mitigate outstanding concerns with unobserved, time-variant product or market heterogeneity. The long-differences model further mitigates the problem of serial correlation.

[7] This specification follows from Caliendo and Parro (2015) since trade elasticities are retrieved from import and tariff data only, under the assumption that the error term $\epsilon_{it}$ is uncorrelated with the tariff changes across time.

Table 3—Tariff Liberalization and Unit Value of Imports, 2006–2014: Aggregate Import Flows

| | log share unit value | | | |
|---|---|---|---|---|
| | Fixed effects (1) | First differences (2) | Long differences (3) | Instrumental variable (4) |
| *Panel A. 2 SLS Estimate* | | | | |
| log tariff rate | 0.001 | | | 0.002 |
| | (0.011) | | | (0.013) |
| Δ log tariff rate | | −0.008 | 0.080 | |
| | | (0.012) | (0.011) | |
| *Panel B. First stage dep. var. log tariff rate* | | | | |
| Lagged log tariff rate (one period) | | | | 0.841 |
| | | | | (0.042) |
| Lagged log tariff rate (two periods) | | | | −0.085 |
| | | | | (0.011) |
| Baseline tariff rate 2006 | | | | −0.040 |
| | | | | (0.002) |
| Kleibergen-Paap Wald *F*-statistic | | | | 207.09 |
| Observations | 21,520 | 16,353 | 12,977 | 15,326 |
| Mean of dependent variable | 0.706 | 0.673 | 0.664 | 0.667 |

*Notes:* log share import volumes corresponds to the unit value of South African imports as a share of the unit value of imports from the rest of the world into Mozambique, in logarithmic form. Robust standard errors clustered at the level of the product's four-digit HS code.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code

Estimates for the fixed effects specification and for the model in first-differences are very similar suggesting that strict exogeneity is not violated. All estimates confirm that a reduction in tariff rates is associated with an increase in import volumes and values, though the coefficients are small (lower than 0.1).

A possible concern with these results is that models of fixed effects and first or long-differences exacerbate attenuation bias due to measurement error in the independent variable of interest. To mitigate this concern, column 4 presents results based on an instrumental variable approach, instrumenting tariff rates with the lagged tariff rate and the baseline tariff in 2006 (Griliches and Hausman 1986). The first stage is strong and the Kleibergen Paap *F*-statistic is well above the conventional threshold of ten. This preferred specification reveals slightly larger elasticities than the previous specifications but still close to the lower range of the estimates obtained in the literature (0.1). This is surprising given the permanent nature of the tariff shock, the fact that the tariff removal was well-known in advance to firms and the long time horizon of the analysis for which substitution possibilities would, in theory, be higher.

To examine the possibility that firms responded to the tariff change by upgrading the quality of their imports as opposed to expanding the quantity imported, Table 3 shows the impact of the tariff change on the unit value of imports from South Africa into Mozambique, normalized by the unit value of imports into Mozambique from the Rest of the World. Most coefficients are again small, including the estimates resulting from the preferred instrumental variable specification. This suggests that firms did not respond to the tariff change by upgrading quality.

Trade elasticities are a central parameter in the calculation of the impact of trade policy on welfare. To estimate the change in real income associated with the tariff liberalization policy, I follow the formula derived in Arkolakis, Costinot, and Rodriguez-Clare (2012): $\hat{W} = \frac{\lambda'^{\frac{1}{\epsilon}}}{\lambda}$, which relies on two sufficient statistics to estimate welfare gains associated with trade shocks: $\lambda$ representing the share of expenditures on domestic goods and $\epsilon$ representing a measure of the elasticity of imports with respect to variable tariff costs. Changes in import penetration rates between 2007 (34 percent) and 2014 (38 percent as the median import penetration rate between 2008 and 2014) and an estimated elasticity of $-0.1$ (identified above), suggest an estimated 87 percent gain in real income associated with the tariff reduction.[8] This figure is implausibly high, and is an artifact of extremely small estimated trade elasticities.

## B. *Tariffs and Import Volumes: Firm-Level Data*

To examine the micro-foundations of the trade elasticities estimated in the previous section, I observe the import behavior of firms affected by the tariff change through a two-wave survey of 190 formal Mozambican firms, in 2006 and 2010, before and after the main tariff change took place in 2007–2008. The sample was drawn from firms established in the direct hinterland of the trade corridor linking South Africa to Mozambique. The survey elicited the percentage of the main input each firm imported, information on the tariff grouping the input belonged to and several firm-level characteristics such as firm size, industry grouping, and the gender and ethnicity of the manager of the firm.[9]

Tariffs can potentially affect both the extensive and intensive margins of import behavior by limiting a firm's entry into international markets, but also by restricting the average volume imported by each firm. I begin by looking at the impact of tariff changes on the extensive margin of import behavior through the following specification:

$$D.Import\,Status_k = \alpha_0 + \alpha_1 D.Tariff_k + \alpha_3 \mathbf{X}_k + \omega_i + \epsilon_k, \tag{2}$$

where $D.Import\,Status_k$ captures whether a firm stopped importing, continued to source domestically, or began importing its main input between 2006 and 2010, and $D.Tariff_k$ captures the change in the tariff level experienced by firm $k$'s main input. $\mathbf{X}_k$ is a vector of firm-level characteristics such as the size of the firm, its

[8] This corresponds to $\hat{W} = \frac{0.62}{0.66}^{\frac{1}{-0.1}}$. Data on import penetration rates are obtained from the World Bank Indicators for Mozambique and verified against input-output tables produced by the National Institute of Statistics in Mozambique.

[9] A clear limitation is that I lack an indicator of total expenditures on imported inputs or the number of total inputs imported. While this is a concern, the existing literature suggests that firms' import spending tends to be concentrated in a few core products (Halpern, Koren, and Szeidl 2015), thus partially mitigating concerns with measurement error.

Table 4—Tariff Liberalization and Import Volumes, 2006–2010: Firm-Level Data

| | Extensive margin change in import status | | | Intensive margin change in pctg of imp. input | | |
|---|---|---|---|---|---|---|
| | Ordered probit | | | Ordinary least squares | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Δ log tariff rate | −0.113 | −0.106 | −0.091 | −0.738 | 0.689 | 1.681 |
| | (0.079) | (0.136) | (0.160) | (2.306) | (3.927) | (4.936) |
| Firm size | | 0.539 | 0.534 | | 10.127 | 9.355 |
| | | (0.229) | (0.238) | | (7.212) | (7.154) |
| Ethnicity of owner | | 0.188 | 0.187 | | 7.388 | 5.681 |
| | | (0.187) | (0.178) | | (7.430) | (6.839) |
| Foreign firm | | 0.456 | 0.436 | | 15.155 | 14.250 |
| | | (0.329) | (0.269) | | (14.330) | (12.665) |
| Age of establishment | | −0.016 | −0.018 | | −0.400 | −0.431 |
| | | (0.009) | (0.009) | | (0.251) | (0.242) |
| log baseline tariff 2006 | | 0.046 | 0.036 | | 7.059 | 5.170 |
| | | (0.170) | (0.174) | | (4.933) | (5.223) |
| *Controls* | | | | | | |
| Industry fixed effects | No | No | Yes | No | No | Yes |
| Observations | 160 | 117 | 117 | 160 | 117 | 117 |
| *p*-value of joint significance of FE | | 0.000 | | | 0.000 | |

*Notes:* Change in import status corresponds to $-1$ if the firm stopped importing, 0 if the firm did not change its import status, and 1 if the firm started to import.

*Source:* Enterprise Surveys conducted by the author in 2006 and 2010

length of establishment, ownership structure (foreign or domestic), as well as several owner-level characteristics such as ethnicity, given previous evidence in the literature of the importance of ethnic-based trade networks (Rauch 2001). $\omega_i$ denotes industry fixed effects that account for any structural, time-invariant heterogeneity across industries.

To investigate the impact of changes in tariffs on the intensive margin of import behavior, I rely on the following specification:

$$(3) \qquad D.\,Pctg\,Imported\,Input_k = \alpha_0 + \alpha_1 D.\,Tariff_k + \alpha_3 \mathbf{X}_k + \omega_i + \epsilon_k,$$

where $D.\,Pctg\,Imported\,Input_k$ represents the change in the percentage of firm $k$'s inputs that are imported between 2006 and 2010. The remainder of the specification is identical to equation (3).

The results in Table 4 are consistent with the elasticities estimated in Section IIA. Despite the sizable tariff change that occurred in 2007–2008, firms importing the inputs affected by the tariff reductions did not appear to significantly adjust either the extensive or intensive margins of import behavior, at least in the short run.

An important caveat in this analysis, and one that does not apply to the results in the previous section, is that it is restricted to incumbent firms. The lack of an adequate industrial census in Mozambique prevents an analysis of patterns of entry and exit during the tariff liberalization episode. However, the fact that the sample consists exclusively of incumbent firms should, if anything, introduce an upward bias in the estimates. In theory, incumbent firms should face lower search costs for new or enhanced sources of supply and as such, would be more capable of adjusting import volumes in the short run.[10]

The inclusion of industry fixed effects, the fact that we can reject that they are jointly zero, and the inclusion of a control group of products unaffected by the tariff change suggests that low import demand elasticities cannot be fully explained by the standard hypotheses discussed in the literature such as imperfect competition or other forms of time-invariant nontariff barriers like transport costs. The next section explores an alternative hypothesis: that low import demand elasticities may result from pervasive corruption that enables firms to circumvent high tariffs in the first place. Corruption could effectively dampen the impact of tariff liberalization on actual trade costs, and consequently, on traded quantities.

## III. The Import Process, Tariffs, and Opportunities for Corruption

Each firm-level import goes through several steps in order to clear through an international border. For analytical purposes, I define two broad stages in the import process that are managed by public officials who differ in their administrative authority and in their discretion to stop cargo and generate opportunities for bribe payments: customs and port operations.

Sequeira and Djankov (2014, p. 282) discuss, in detail, the role of the different agents involved in the import process and how bribery can occur: "customs' officials are in charge of validating clearance documentation and collecting all tariff payments due." As a result, they have "more discretionary power to extract bribes relative to regular port operators, given their broader bureaucratic mandate and the fact that they can access full information on each shipment, and each shipper, at all times." In particular, customs officials can allow a firm to engage in tariff evasion through three different channels: "by misreporting physical quantities of imported products, by misrepresenting prices, or by misclassifying products from high to low tariff categories." Customs officials have an additional set of tools they can deploy to extract bribes, namely the threat of conducting "a physical inspection of the shipment (which can delay clearance for up to four days), or citing irregularities (real or fictitious) with the documentation of the shipment."

While customs officials have a broad toolkit of bribe extraction methods to draw on, "selling" tariff evasion is likely to be the most cost-effective method. Associating the bribe with tariff evasion combines the desirable "features of reducing both the informational costs of bribe-setting and the risk associated with the illicit transaction" (Sequeira and Djankov 2014, p. 289). The tariff grouping a good falls under is a reasonable predictor of a shipper's willingness to pay a bribe. From the perspective of the customs official, a common assumption is that shippers benefit from evading tariff duties so willingness to pay a bribe should be an "increasing function of the

[10] Note that these estimates contrast with the results in Section IIA where I identify a small but positive response of imports to the tariff decline. This discrepancy might be explained by the relatively small sample of firms included in the firm analysis, the more limited time horizon, and the fact that it covers incumbent firms only.

tariff rate. All other bribe extraction tools can potentially yield lower bribe revenue, as they rely on observing shipment characteristics that carry coarse information on a shipper's willingness to pay a bribe. This informational asymmetry can then force customs officials to engage in a costly, risky, and time-consuming exercise to elicit information on the time-sensitivity of the shipment, or on the shipper's ability to pay a bribe." For example, the size of the shipment may not be a good predictor of a shipper's willingness to pay a bribe: "large shipments could signal a firm carrying higher than average inventories with a lower willingness to pay a bribe to expedite clearance, or a large firm with a higher ability to pay for a faster service. A lengthy process of discovering both commitment to an illicit transaction and the reservation costs of a shipper increases both the risk and the cost of setting bribes" (Sequeira and Djankov 2014, p. 289). A corruption deal based on tariff evasion has the additional benefit of "lowering the risk of detection of bribe payments since neither side implicated in the bribery deal will have an incentive to deviate from it, resulting in a more credible commitment (Schelling 1956)." (Sequeira and Djankov 2014, p. 289).

The fact that customs officials have significant bureaucratic latitude to extract different types of bribes suggests, however, that a widespread tariff removal scheme carries a higher probability of corruption being displaced from "selling" tariff evasion into other forms of bribe extraction. Following Yang (2008a), the magnitude of displacement is, however, likely to be limited by the fact that alternative forms of bribe extraction have higher fixed and variable costs than those associated with bribes for tariff evasion.

Sequeira and Djankov (2014, p. 282) further discuss the role of other public agents involved in the clearance process. "Regular port operators have a narrower mandate to move or protect cargo on the docks, and they sometimes lack access to the shipment's documentation specifying its value or the details of the client firm," among others. Bribes can be paid to different types of port officials along different stages of the clearing process, such as agents in charge of "adjusting reefer temperatures for refrigerated cargo stationed at the port; port gate officials who determine the acceptance of late cargo arrivals; stevedores who auction off forklifts and equipment on the docks; and scanner agents who move cargo through nonintrusive scanning technology."

The other "type of player involved in the import process is the clearing agent. In this setting, by law, no firm is allowed to interact directly with customs or port operators. Firms have to instead resort to private clearing agents who specialize in clearing cargo through the port or border post, mostly through ad hoc, shipment-based contracts. Clearing agents submit all the required documentation, monitor the clearance process, and make all necessary payments to customs officials and port operators, including bribes. While their services are optional in the United States and in other European countries, they have been made a mandatory fixture of the clearing process in several countries throughout the developing world."[11]

All three players have opportunities to engage in corruption and increase or decrease trade costs for firms. The following sections document the extent of corruption associated with the import process in Mozambique, and examine how

[11] For more detailed information on the role of clearing agents see World Trade Organization, Documents Online, WTO Trade Policy Reviews, http://docsonline.wto.org/ (accessed August 2016).

the tariff liberalization scheme affected both the level and the type of corruption engaged in by customs officials, port operators, shippers, and clearing agents.

### A. *Corruption: Evidence from Trade Gaps*

The most commonly used measure of corruption in the trade literature is the trade gap between declared exports by sending countries and declared imports by receiving countries (Bhagwati 1964; Fisman and Wei 2004; Javorcik and Narciso 2008). In theory, importers have a stronger incentive to misreport values or quantities of imports, widening this trade gap (Bhagwati 1964).

Beyond measurement, a standard econometric challenge when measuring the impact of tariff changes on corruption is to establish a credible counterfactual that can capture time trends in overall corruption patterns or changes in the quality of tariff enforcement across time. The staggered phase out of tariffs associated with the SADC Trade Protocol in southern Africa created a plausible control category of products that did not experience a change in tariff rates during the period under analysis. This allows for a straightforward difference-in-differences approach that purges the empirical estimates of time trends in the use of various bribe-extraction methods, as well as general changes in enforcement that should affect imports of all products equally. These include changes in rules conditioning clearance procedures or in the salaries of border officials, among others. I estimate the impact of the tariff liberalization scheme on corruption patterns through the following specification:

$$\text{(4)} \quad log\,Trade\,Gap_{it} = \gamma_1 Tariff\,Change\,Category_i \times POST + \mu POST + \gamma_2 Tariff\,Change\,Category_i + \beta_2 Baseline\,Tariff_i + \epsilon_{it},$$

where the $Log\,Trade\,Gap_{it}$ is either the natural log of the gap in reported quantities, in reported values, or in the reported unit value of all products $i$ in year $t$, exported from South Africa into Mozambique. The difference-in-differences estimator interacts an indicator identifying products that changed tariff in 2008 with an indicator for the years following 2008 ($POST$). The rationale for a binary treatment effect is twofold: the removal of tariffs was an absorbing state since no product experienced a reinstatement of the tariff and all tariffs were reduced from above the median tariff rate to zero, but also because of a common practice in customs to single out goods with a positive tariff rate for additional scrutiny.

Table 5 reveals that higher tariffs are associated with higher gaps in reported quantities, which suggests that the primary means of tariff evasion occurs through the under-reporting of quantities. Products experiencing a decline in tariffs were associated with a reduction in the reported quantity gap: a 1 percent decrease in the tariff rate was associated with a 20 percent reduction in the trade gap in quantities. The trade gaps measured in terms of reported values or unit values were insensitive to the tariff change.

Table 5—Trade Gaps and Tariff Levels, 2006–2014

| | log trade gap | | | | | |
|---|---|---|---|---|---|---|
| | Quantity (1) | Value (2) | Unit value (3) | Quantity (4) | Value (5) | Unit value (6) |
| log tariff | 0.201 | 0.055 | −0.013 | | | |
| | (0.042) | (0.035) | (0.010) | | | |
| Treated products × POST | | | | −0.493 | −0.083 | 0.022 |
| | | | | (0.097) | (0.077) | (0.031) |
| Treated products | | | | 0.308 | −0.092 | 0.104 |
| | | | | (0.243) | (0.219) | (0.087) |
| POST | | | | 0.385 | 0.118 | 0.394 |
| | | | | (0.086) | (0.068) | (0.028) |
| log baseline tariff | | | | 0.245 | 0.271 | −0.051 |
| | | | | (0.114) | (0.098) | (0.043) |
| Observations | 21,884 | 21,884 | 21,861 | 21,884 | 21,884 | 21,861 |
| Mean of dependent variable | 0.273 | 0.213 | 2.176 | 0.273 | 0.213 | 2.178 |
| $R^2$ | 0.187 | 0.165 | 0.675 | 0.170 | 0.155 | 0.422 |

*Notes:* Trade gap corresponds to the difference between quantities, price, and unit values reported by exporters in South Africa and the equivalent figures reported by importers in Mozambique. The treated products indicator equals 1 if products experienced a change in tariff in 2008 and 0 otherwise. POST corresponds to the periods after the 2008 tariff change.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code

Bribery for tariff evasion is, however, only one form of corruption that can affect trade costs. A plausible hypothesis discussed in the previous section is that the tariff removal displaced corruption into other forms of bribe extraction, with potential implications for firm-level trade costs. And yet, the trade gap measure is not well-suited to uncover all possible displacement effects and their magnitudes. To examine the extent of overall corruption associated with imports and how it affected changes in trade costs, I turn to a novel dataset of directly observed bribe payments during the import process.

### B. *Corruption: Evidence from Primary Data on Bribe Payments*

To measure corruption associated with imports, I collected primary data on bribe payments through an audit study that tracked a random sample of over 1,000 shipments going through the port of Maputo in Mozambique and the border post between Mozambique and South Africa. For sampling purposes, I began by creating a list of all official clearing agents in the region under study. The majority (76 percent) were independent clearing agents working for several client firms, with 50 percent of them handling between 5 to 50 shipments per month. Fifteen clearing agents were then randomly selected to participate in the study, out of a universe of 117. Four of these were stationed at the border post while the remainder were working at the port of Maputo. Clearing agents provided the list of shipments they expected to handle, prior to their arrival at the border. They were then instructed to track every third shipment, providing detailed information on the date, time of arrival, and date of clearance; and on a wide range of cargo characteristics such as size, value, and product type. Clearing agents also noted the primary recipients of bribes, the bribe amounts requested, and the reason for a bribe payment, ranging from the need to jump a long queue of trucks to get into the port, to evading tariffs, or lacking important clearance documentation.

The questionnaire used in this audit exercise was co-designed with the clearing agents who participated in the study to ensure that it captured the most relevant features of the import process and, more importantly, that it accommodated any confidentiality concerns regarding how much information clearing agents were willing to report. One such sensitive dimension related to information on the characteristics of client firms. To satisfy the clearing agents' participation constraint, the questionnaire only collected information on the average size of the client firm.

Throughout the data collection exercise, emphasis was placed on capturing all formal and informal costs of importing goods through the port and border post, in order to minimize the possibility of clearing agents strategically misreporting data only on bribe payments. In this setting, there appeared to be limited stigma attached to the payment of bribes to border officials, since clearing agents saw the bribe as a necessary payment made at the request of their client firms. Acting as mere intermediaries, clearing agents felt limited moral responsibility for their actions (Sequeira 2012; Sequeira and Djankov 2014). To directly test for misreporting, clearing agents were randomly assigned to being shadowed by surveyors during the clearance process. Surveyors were tasked with documenting all payments made through the clearance process. In the end, self-administration of the audit survey appears, however, to have led to a more truthful elicitation of bribes (see Section IVE for a discussion of this monitoring experiment).

Table 6 presents descriptive statistics of corruption patterns before and after the tariff change took place. The audit study revealed that corruption was pervasive prior to the main 2008 tariff change, with bribe payments occurring for about 80 percent of all shipments tracked. Bribes were sizable in absolute terms (the mean bribe was US$128 per tonnage), which was equivalent to 149 percent of overall port costs and 14 percent of the cost of shipping a container between the Far East and Mozambique (shipping includes costs with overland transport, port fees, and ocean shipping). Consistent with a long-standing result in the literature, the Tullock Paradox, bribes were small relative to the rent captured by the firms avoiding the tariffs: the amount of bribe paid corresponded to approximately 7 percent of the tariff amount due.[12]

Table 6 further shows that bribes were unlikely to be buying speed in the clearance process even after the tariff change since there was no correlation between the payment of a bribe and clearance speed (Cudmore and Whalley 2005). The descriptive evidence suggests instead that bribes were paid primarily to customs officials to buy tariff evasion. This is consistent with the evidence from the trade gaps examined in the previous section.

[12] Note that the clearing agents did not report precisely what percentage of the tariff duty was paid by the firm, in spite of the bribe. Clearing agents provided instead a general rule of thumb, in which the value or the quantity of the good was underreported by 50 percent in exchange for the bribe. The 7 percent figure results from a back of the envelope calculation based on this figure.

Table 6—Summary Statistics: Bribe Payments

| | Pre-tariff change | Post-tariff change | |
|---|---|---|---|
| | 2007 | 2008 | 2011–2012 |
| Probability of paying a bribe (percent) | 80 | 26 | 16 |
| Avg bribe amount per ton (Metical 2007, CPI adjusted) | 2,164 (7,800) | 280 (963) | 494 (2,746) |
| Primary bribe recipient | Customs (97%) | Customs (84%) | Customs (72%) |
| Primary reason for bribe payment | Tariff evasion (61%) | Congestion (59%) | Congestion (38%) |
| Ratio of bribe amount to tariff duties saved [0–1]* | 0.07 (0.13) | 0.028 (0.09) | 0.008 (0.02) |
| Average clearing time for all shipments (days) | 2.6 (2.2) | 2.6 (1.3) | 2.6 (3.6) |
| Average clearing time with the payment of a bribe (days) | 2.6 (2.3) | 2.2 (1.0) | 2.4 (3.1) |
| Average clearing time without the payment of a bribe (days) | 1.9 (1.2) | 2.7 (1.4) | 2.6 (3.7) |
| Average clearing time with bribe payment for tariff evasion (days) | 2.7 (2.4) | 2.4 (1.0) | 2.4 (1.8) |

*Notes:* Average clearing times moved in tandem with increases in the overall volume of cargo handled at the port between 2007 and 2011. Total volumes increased by 13 percent in 2008 and 18 percent in 2011. Note that in 2009, the port of Maputo was still functioning at 30 percent of capacity so it was capable of handling the observed increase in volumes without substantially increasing congestion.
*Conditional on the bribe being paid for tariff evasion.

*Source:* Audit study conducted by the author

Table 7 shows that most product and shipper characteristics, with the exception of whether the product was an agricultural good, are associated with a significant decline in the probability of paying a bribe and in the amount of bribe paid. These characteristics are directly controlled for in Section IIIB's regression analysis of the impact of the tariff change on corruption patterns.

*Tariff Liberalization and Changes in Corruption.*—To identify a causal relationship between changes in tariff rates and changes in corruption, I fit a difference-in-differences model to pooled cross sections of shipments audited between 2007 and 2013. In the main specification, the dependent variable is denoted by $y_{it}$ for shipment $i$ in period $t$, which corresponds to a binary variable equaling 1 if a bribe was paid and 0 otherwise. To formally identify the determinants of the amount of bribe paid, conditional on paying a bribe, the dependent variable $y_{it}$ becomes the natural log of the amount of bribe paid, for each shipment $i$. In both cases, the difference-in-differences estimator interacts a binary variable that equals 1 if the product shipped experienced a tariff change in 2008 and 0 otherwise; with the variable *POST* taking the value 1 after the 2008 change in tariffs, and 0 before then.

$$(5)\quad y_{it} = \gamma_1 \, Tariff\,Change\,Category_i \times POST + \mu POST + \gamma_2 \, Tariff\,Change\,Category_i + \beta_2 \, Baseline\,Tariff_i + \Gamma_i + p_i + \omega_t + \delta_i + \epsilon_{it}.$$

TABLE 7—BRIBES BEFORE AND AFTER THE TARIFF CHANGE: BY SHIPPER AND PRODUCT CHARACTERISTICS

| | Pre-tariff change | Post-tariff change | Difference p-value |
|---|---|---|---|
| *Panel A. Probability of paying a bribe (percent)* | | | |
| Large firm | 96 | 16 | 0.000 |
| Medium to small firm | 67 | 18 | 0.000 |
| Agricultural product | 13 | 12 | 0.739 |
| Differentiated product | 77 | 18 | 0.000 |
| Pre-inspected shipment | 68 | 10 | 0.000 |
| *Panel B. Amount of bribe paid per ton (Mtn, CPI adjusted)* | | | |
| Large firm | 3,373 | 150 | 0.004 |
| | (1,419) | (75) | |
| Medium to small firm | 3,882 | 503 | 0.000 |
| | (1,711) | (85) | |
| Agricultural product | 1,404 | 615 | 0.144 |
| | (922) | (143) | |
| Differentiated product | 2,062 | 537 | 0.000 |
| | (623) | (90) | |
| Pre-inspected shipment | 2,597 | 661 | 0.000 |
| | 1,136 | 130 | |

*Notes:* Panel B reports standard errors in parenthesis. The *t*-tests for equality of means reported in panel B assume unequal variances. Large firms are defined as having more than 100 employees. Differentiated products correspond to products that lack a reference international price (as defined in Rauch 1999). The pre-inspected shipment dummy variable denotes whether a shipment was inspected at origin.

*Source:* Audit study conducted by the author

The coefficient of interest is $\gamma_1$, which captures the difference in the probability of paying a bribe for products that changed tariff level, before and after the tariff change took place, relative to products that did not experience any change in tariffs throughout the period under analysis. The main specification includes a vector of product, shipment, clearing agent, and firm-level characteristics $\Gamma_i$. These controls include a dummy variable signaling if the shipper is a large firm (defined as having more than 100 employees); dummy variables categorizing the product as perishable, as an agricultural good or as a shipment pre-inspected at origin. It also controls for the terminal in which the cargo was cleared. Industry, year, and clearing agent fixed effects are captured by $p_i$, $\omega_t$, and $\delta_i$, respectively.[13] Standard errors are clustered at the level of the product's four-digit HS classification to allow for within product category correlation across time.

A growing literature suggests that products lacking internationally set prices may be more prone to corrupt practices due to the difficulty in assessing their actual value. In these situations, honest customs officials find it more difficult to detect an invoice stating an incorrect price, thus creating an incentive for importers to under-report the value of the product, while corrupt customs officials have a plausible excuse for why they did not detect underinvoicing in the fist place. I follow the classification conventionally used in the literature to identify differentiated products as those

[13] Given limited degrees of freedom, three clearing agents with fewer than 50 shipments each are clustered into one category of clearing agent fixed effect. Removing the clearing agent fixed effects leaves the results unchanged as shown in online Appendix Table 2.

that lack an international reference price according to Rauch (1999).[14] Examples of differentiated goods are clothes and cars, while non-differentiated goods could be oil or wheat. Rauch's (conservative) classification is at the four-digit SITC level, which I match to the bribe data based on the concordance in Feenstra (1996).

I then adjust the treatment variable to directly exploit the magnitude of the variation in tariffs experienced by different products. In this specification, the dependent variable captures the percentage point reduction in the tariff level experienced by each product.

Table 8 presents the results on the determinants of the probability of paying a bribe. Products that changed tariff level in 2008 are associated with a sizable decline (30 percent) in the probability of paying a bribe. When exploiting the magnitude of the tariff reduction, I find that a 10 percent decline in the tariff rate is associated with a 22 percent decline in the probability of paying a bribe. These changes are significantly different from zero, even with the most stringent specification that includes product, industry, and clearing agent fixed effects. The results are also robust to the inclusion of interactions between the post-treatment indicator ($POST$) and the covariates of interest, as shown in columns 2 and 4. I find no robust evidence in the data that shipping an agricultural, perishable, or a differentiated product had an impact on the probability of paying a bribe, before or after the tariff change.[15]

Table 9 shows that the tariff removal also led to a significant decline in the amount of bribes paid, conditional on the payment of a bribe. A 1 percent decline in the tariff rate is associated with a 20 percent decline in the amount of bribe paid.[16] To test the robustness of the results, I approach the data with a hurdle model estimated in levels, given the count nature of the variable capturing the amount of bribes paid. This two-stage estimation procedure fits a logit model to first distinguish between zero and positive counts, and then a zero-truncated negative binomial model is fitted to the positive counts, in levels. A negative binomial model is favored over a truncated Poisson distribution given over-dispersion in the bribe data. This estimation procedure accounts for the high occurrence of zeros in the dependent variable.[17] The hurdle model estimates in columns 5 through 8 confirm the results obtained with the ordinary least squares model, though lack of convergence prevents the inclusion of the full set of controls in the model.

I also examine the impact of the change in tariffs on bribes measured as a share of the shipment value and as a share of the shipment tonnage. Tables 10 and 11 show these results, replacing the dependent variable in equation (5) with an indicator of bribes as a share of the shipment value and as a share of the shipment size. In both

[14] Several studies have examined the relationship between differentiated goods and tariff evasion, only to find mixed results. Fisman and Wei (2004) failed to find a significant relationship between differentiated goods and tariff evasion whereas Javorcik and Narciso (2008) and Mishra, Subramanian, and Topalova (2008) find that the positive relationship between tariff evasion and tariff levels is stronger for differentiated goods.

[15] Results are also robust to the inclusion of several temperature controls interacted with the perishability of the good. Results are available upon request.

[16] All estimates are also robust to the inclusion of an interaction term between the level of the baseline tariff and both the value and the volume of the shipment. This accounts for the possibility that the "size of the pie" from which bribes can be extracted would affect the probability of paying a bribe and the bribe level paid (results not shown but available upon request).

[17] Note that the zeros observed in the variable "amount of bribe paid" are not sampling zeros, but structural zeros in the sense that they are only determined by shipments that do not pay a bribe. For those paying a bribe, this variable cannot be zero.

TABLE 8—DIFFERENCE-IN-DIFFERENCES: DETERMINANTS OF THE PROBABILITY OF PAYING A BRIBE

| | Probability of paying a bribe [0–1] linear probability model | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Tariff change category × POST | −0.429 | −0.296 | | |
| | (0.131) | (0.120) | | |
| Tariff change category | 0.448 | 0.357 | | |
| | (0.111) | (0.099) | | |
| Tariff reduction × POST | | | −0.025 | −0.021 |
| | | | (0.008) | (0.007) |
| Tariff reduction | | | 0.024 | 0.022 |
| | | | (0.005) | (0.009) |
| POST | −0.089 | −0.555 | −0.111 | −0.686 |
| | (0.106) | (0.203) | (0.116) | (0.241) |
| Differentiated product | 0.065 | 0.018 | 0.032 | −0.076 |
| | (0.078) | (0.102) | (0.071) | (0.109) |
| Agricultural product | 0.026 | −0.221 | 0.046 | 0.041 |
| | (0.030) | (0.096) | (0.029) | (0.030) |
| Pre-shipment inspection | −0.010 | 0.061 | 0.003 | 0.087 |
| | (0.010) | (0.061) | (0.020) | (0.07) |
| Perishable product | −0.047 | 0.260 | −0.052 | 0.137 |
| | (0.067) | (0.109) | (0.064) | (0.124) |
| Large firm | 0.058 | 0.161 | 0.066 | 0.172 |
| | (0.047) | (0.055) | (0.051) | (0.066) |
| log shipment value per ton | 0.014 | −0.035 | 0.017 | −0.034 |
| | (0.008) | (0.011) | (0.008) | (0.013) |
| *Controls* | | | | |
| Clearing agent fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Product four-digit HS code | Yes | Yes | Yes | Yes |
| Terminal | Yes | Yes | Yes | Yes |
| Day of the week arrival | Yes | Yes | Yes | Yes |
| Product from South Africa | Yes | Yes | Yes | Yes |
| Baseline tariff | Yes | Yes | Yes | Yes |
| Covariates × POST | No | Yes | No | Yes |
| Observations | 1,084 | 1,084 | 1,084 | 1,084 |
| $F$-statistic | 218.28 | 3,308.08 | 313.90 | 604.80 |
| $R^2$ | 0.36 | 0.39 | 0.35 | 0.37 |

*Notes:* The dependent variable equals 1 if a bribe was paid and 0 otherwise. The tariff change category indicator equals 1 if the product experienced a tariff change in 2008 and 0 otherwise. The tariff reduction variable corresponds to the percentage point reduction in tariffs experienced by each product in 2008. Robust standard errors clustered at the level of the four-digit HS code.

*Sources:* Audit study conducted by the author and Mozambican customs tariff code

cases, the difference-in-differences estimates are negative and significant suggesting that the tariff removal was associated with a decline in both the absolute and the relative size of bribes. An important distinction relative to the results from previous specifications is that large firms are no longer associated with larger bribes when taking into account the size and value of their shipments.

Overall, the data from the audit study on actual bribe payments suggest that bribes were frequent but small relative to the reduction in tariff costs they could buy for firms prior to the tariff change. This can potentially explain the trade elasticities identified in Section II: corruption enabled firms to significantly reduce their

Table 9—Difference-in-Differences: Determinants of the Amount of Bribe Paid

| | log bribe amount paid | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ordinary least squares | | | | Hurdle model | | | |
| | | | | | logit | Negative binomial | logit | Negative binomial |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Tariff change category × POST | −3.748 | −2.928 | | | −30.735 | −0.079 | | |
| | (1.075) | (0.944) | | | (1.995) | (0.459) | | |
| Tariff change category | 3.632 | 3.156 | | | 30.704 | −0.916 | | |
| | (0.953) | (0.803) | | | (1.898) | (0.436) | | |
| Tariff reduction × POST | | | −0.225 | −0.191 | | | −2.996 | −0.089 |
| | | | (0.058) | (0.064) | | | (0.174) | (0.031) |
| Tariff reduction | | | 0.200 | 0.191 | | | 2.969 | −0.042 |
| | | | (0.042) | (0.0478) | | | (0.171) | (0.0260) |
| POST | −0.678 | −3.449 | −0.864 | −4.652 | −0.392 | −0.633 | −0.371 | −0.426 |
| | (0.867) | (1.818) | (0.944) | (2.152) | (0.639) | (0.179) | (0.634) | (0.200) |
| Differentiated product | 0.545 | −0.121 | 0.303 | −0.925 | −0.0450 | 0.188 | −0.104 | 0.304 |
| | (0.648) | (0.849) | (0.603) | (0.876) | (0.660) | (0.423) | (0.643) | (0.427) |
| Agricultural product | 0.161 | −1.968 | 0.343 | 0.337 | 0.356 | 0.583 | 0.327 | 0.229 |
| | (0.285) | (0.931) | (0.265) | (0.243) | (0.365) | (0.563) | (0.355) | (0.494) |
| Pre-shipment inspection | −0.227 | 0.376 | −0.137 | 0.641 | −0.122 | −0.550 | −0.102 | −0.595 |
| | (0.208) | (0.628) | (0.197) | (0.712) | (0.215) | (0.182) | (0.207) | (0.189) |
| Perishable product | −0.084 | 3.400 | −0.119 | 2.299 | −0.551 | 0.311 | −0.711 | 0.768 |
| | (0.616) | (0.845) | (0.586) | (0.949) | (1.147) | (0.787) | (1.167) | (0.748) |
| Large firm | 0.600 | 1.593 | 0.662 | 1.708 | 1.137 | 0.270 | 1.198 | 0.277 |
| | (0.389) | (0.486) | (0.431) | (0.585) | (0.610) | (0.391) | (0.618) | (0.393) |
| log shipment value per ton | 0.130 | −0.221 | 0.152 | −0.217 | 0.160 | −0.037 | 0.158 | −0.035 |
| | (0.074) | (0.079) | (0.073) | (0.095) | (0.088) | (0.079) | (0.088) | (0.077) |
| *Controls* | | | | | | | | |
| Clearing agent fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Product four-digit HS code | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Terminal | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Day of the week arrival | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Product from South Africa | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Baseline tariff | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Covariates × POST | No | Yes | No | Yes | No | No | No | No |
| Observations | 1,084 | 1,084 | 1,084 | 1,084 | 1,084 | 1,084 | 1,084 | 1,084 |
| Mean of dependent variable | 1.486 | 1.486 | 1.486 | 1.486 | 1.486 | 1.486 | 1.486 | 1.486 |
| $F$-statistic | 265.38 | 3,937.63 | 422.36 | 188.25 | | | | |
| $R^2$ | 0.35 | 0.38 | 0.35 | 0.37 | | | | |
| log pseudo-likelihood | | | | | −2,243.93 | | −2,243.58 | |

*Notes:* Columns 1 through 4 denote estimates for an ordinary least squares model, with the dependent variable representing the logarithmic form of the amount of bribe paid, conditional on paying a bribe. Columns 5 through 8 fit a hurdle model with a truncated negative binomial, in levels, to ensure convergence. The negative binomial is preferred over a truncated Poisson model due to over-dispersion in the bribe amount variable. Tariff change category equals 1 if the product experienced a tariff change in 2008 and 0 otherwise. Tariff reduction corresponds to the magnitude of the tariff reduction experienced by each product in 2008. Robust standard errors clustered at the level of the four-digit HS code.

*Sources:* Audit study conducted by the author and Mozambican customs tariff code

tariff bills, at a relatively low cost. The removal of both tariffs and bribe payments combined might not have significantly changed trade costs for firms, and consequently, their import decisions.

In online Appendix Section IA, I reestimate trade elasticities replacing the nominal tariff rate with the implicit tariff rate determined by actual tariff evasion levels (based on the audit study), before and after the reduction in tariffs took place. This

TABLE 10—DIFFERENCE-IN-DIFFERENCES: BRIBES AS A SHARE OF SHIPMENT VALUE

| | log bribe amount paid as a share of shipment value OLS | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Tariff change category × POST | −0.010 | −0.010 | | |
| | (0.003) | (0.004) | | |
| Tariff change category | 0.010 | 0.010 | | |
| | (0.003) | (0.004) | | |
| Tariff reduction × POST | | | −0.001 | −0.001 |
| | | | (0.0580) | (0.0642) |
| Tariff reduction | | | 0.001 | 0.001 |
| | | | (0.000) | (0.000) |
| POST | −0.002 | −0.001 | −0.002 | −0.003 |
| | (0.001) | (0.011) | (0.001) | (0.011) |
| Differentiated product | 0.010 | 0.007 | 0.010 | 0.005 |
| | (0.005) | (0.007) | (0.004) | (0.006) |
| Agricultural product | −0.001 | −0.004 | −0.000 | −0.000 |
| | (0.001) | (0.004) | (0.001) | (0.001) |
| Pre-shipment inspection | −0.000 | 0.002 | 0.000 | 0.002 |
| | (0.001) | (0.005) | (0.001) | (0.005) |
| Perishable product | 0.001 | 0.004 | 0.001 | 0.002 |
| | (0.002) | (0.004) | (0.002) | (0.004) |
| Large firm | −0.003 | −0.004 | −0.003 | −0.003 |
| | (0.002) | (0.004) | (0.002) | (0.004) |
| log shipment tonnage | −0.000 | −0.001 | −0.000 | −0.002 |
| | (0.000) | (0.001) | (0.000) | (0.001) |
| *Controls* | | | | |
| Clearing agent fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Product four-digit HS code | Yes | Yes | Yes | Yes |
| Terminal | Yes | Yes | Yes | Yes |
| Day of the week arrival | Yes | Yes | Yes | Yes |
| Product from South Africa | Yes | Yes | Yes | Yes |
| Baseline tariff | Yes | Yes | Yes | Yes |
| Covariates × POST | No | Yes | No | Yes |
| Observations | 1,084 | 1,084 | 1,084 | 1,084 |
| Mean of dependent variable | 0.001 | 0.001 | 0.001 | 0.001 |
| $F$-statistic | 5.93 | 3.61 | 9.77 | 6.80 |
| $R^2$ | 0.435 | 0.461 | 0.431 | 0.452 |

*Notes:* Columns 1 through 4 denote estimates from an ordinary least squares model, with the dependent variable representing the logarithmic form $[\log(x+1)]$ of the amount of bribe paid as a share of the value of the shipment, conditional on paying a bribe. Tariff change category equals 1 if the product experienced a tariff change in 2008 and 0 otherwise. Tariff reduction corresponds to the magnitude of the tariff reduction experienced by each product in 2008. Robust standard errors clustered at the level of the four-digit HS code.

*Sources:* Audit study conducted by the author and Mozambican customs tariff code

exercise leads to higher estimates of trade elasticities, as shown in Table 1 (ranging from a 24 percent to a five-fold increase, depending on the specifications). These adjusted estimates are closer to the average trade elasticities estimated in the literature based on time-series variation in tariffs. These results further suggest that tariff evasion is a potential explanation for the observed smaller elasticities computed in Section IIB.

Table 11—Difference-in-Differences: Bribe Amounts Paid as a Share of Shipment Tonnage

| | log bribe amount paid as a share of shipment tonnage OLS | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Tariff change category × POST | −1.914 | −1.597 | | |
| | (0.504) | (0.462) | | |
| Tariff change category | 1.875 | 1.680 | | |
| | (0.465) | (0.427) | | |
| Tariff reduction × POST | | | −0.089 | −0.084 |
| | | | (0.026) | (0.027) |
| Tariff reduction | | | 0.084 | 0.087 |
| | | | (0.022) | (0.023) |
| POST | −0.274 | −3.003 | −0.420 | −3.713 |
| | (0.318) | (1.237) | (0.393) | (1.527) |
| Differentiated product | 0.182 | −0.079 | 0.085 | −0.375 |
| | (0.258) | (0.439) | (0.234) | (0.420) |
| Agricultural product | 0.117 | −0.701 | 0.198 | 0.129 |
| | (0.128) | (0.441) | (0.112) | (0.102) |
| Pre-shipment inspection | −0.104 | 0.299 | −0.056 | 0.491 |
| | (0.082) | (0.424) | (0.077) | (0.471) |
| Perishable product | 0.410 | 2.110 | 0.389 | 1.607 |
| | (0.324) | (0.381) | (0.307) | (0.513) |
| Large firm | −0.202 | −0.253 | −0.162 | −0.155 |
| | (0.241) | (0.470) | (0.264) | (0.500) |
| log shipment value | −0.001 | −0.173 | 0.001 | −0.189 |
| | (0.031) | (0.072) | (0.032) | (0.083) |
| *Controls* | | | | |
| Clearing agent fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Product four-digit HS code | Yes | Yes | Yes | Yes |
| Terminal | Yes | Yes | Yes | Yes |
| Day of the week arrival | Yes | Yes | Yes | Yes |
| Product from South Africa | Yes | Yes | Yes | Yes |
| Baseline tariff | Yes | Yes | Yes | Yes |
| Covariates × POST | No | Yes | No | Yes |
| Observations | 1,084 | 1,084 | 1,084 | 1,084 |
| Mean of dependent variable | 0.451 | 0.451 | 0.451 | 0.451 |
| $F$-statistic | 23.66 | 36.26 | 21.38 | 18.58 |
| $R^2$ | 0.249 | 0.279 | 0.228 | 0.262 |

*Notes:* Columns 1 through 4 denote estimates for an ordinary least squares model, with the dependent variable representing the logarithmic form of the amount of bribe paid as a share of the value of the shipment, conditional on paying a bribe. Tariff change category equals 1 if the product experienced a tariff change in 2008 and 0 otherwise. Tariff reduction corresponds to the magnitude of the tariff reduction experienced by each product in 2008. Robust standard errors clustered at the level of the four-digit HS code.

*Source:* Audit study conducted by the author and Mozambican customs tariff code

## IV. Robustness Checks

### A. *Nontariff Barriers*

A potential concern is that both the trade elasticities and the corruption analyses may be driven by other determinants of trade costs such as nontariff barriers. To check this possibility, in Table 12, I reestimate trade elasticities through equation (1)

TABLE 12—TARIFF LIBERALIZATION AND UNIT VALUE OF IMPORTS, 2006–2014: EXCLUDING AGRICULTURAL PRODUCTS

| | log share unit value | | | |
|---|---|---|---|---|
| | Fixed effects (1) | First differences (2) | Long differences (3) | Instrumental variable (4) |
| | | | | *A. 2 SLS Estimate* |
| log tariff rate | −0.060 | | | −0.101 |
| | (0.036) | | | (0.046) |
| Δ log tariff rate | | −0.013 | −0.061 | |
| | | (0.023) | (0.021) | |
| | | | | *B. First stage dep. var. log tariff rate* |
| Lagged log tariff rate (one period) | | | | 0.861 |
| | | | | (0.0626) |
| Lagged log tariff rate (two periods) | | | | −0.076 |
| | | | | (0.020) |
| Baseline tariff rate 2006 | | | | −0.057 |
| | | | | (0.003) |
| Kleibergen-Paap Wald $F$-statistic | | | | 136.211 |
| Observations | 13,292 | 10,178 | 8,483 | 9,434 |
| Mean of dependent variable | 0.948 | 0.911 | 0.924 | 0.958 |

*Notes:* log share import volumes corresponds to the unit value of South African imports (in kgs) as a share of the total quantity of imports from the rest of the world into Mozambique, in logarithmic form. Robust standard errors clustered at the level of the product's six-digit harmonization code.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code

on a restricted sample that excludes agricultural products (corresponding to HS codes 010111 to 530599), which tend to be particularly affected by nontariff barriers. As shown in column 4, the estimated trade elasticity coefficient is larger than before, but still close to 0.1. Note that in the corruption analysis, the main specifications control for whether the shipment includes an agricultural product and for additional nontariff barriers such as whether the shipment was subjected to pre-shipment inspection at origin.

Another important nontariff barrier to trade can be excessively high transport costs or lack of transport infrastructure altogether. To assess this possibility, I examine an indicator of the state of logistics and transport in different economies worldwide, constructed by the World Bank. This Logistics Performance Index measures perceptions on a country's logistics, based on the efficiency of customs clearance, the quality of trade, and transport-related infrastructure. These can include the ease of arranging competitively priced shipments, the ability to track and trace consignments, and the frequency with which shipments reach the consignee within the scheduled time. The index ranges from 1 to 5 with a higher score representing better performance. South Africa, where most of the trade corridor of interest in the analysis is located, kept its score stable between 2007 and 2014 at 3.46. The index for Mozambique stayed close to the subcontinent's average at 2.29. These figures are also not significantly different from those of other middle-income or developing countries such as India (3.1), Brazil (2.8), China (3.3), and in general, of developing countries in Latin America (2.5). Moreover, in the case of Mozambique, this figure masks significant heterogeneity in the quality of transport infrastructure across the country. The relevant transport corridor linking South Africa to Mozambique has received significant investments in the last 15 years that included a new port in Maputo (the capital), a new railroad, a new highway, and a new border post. It is currently being used at 30–40 percent of capacity and the Mozambican portion of the corridor is only 60 miles long (or 288 nautical miles in the case of cabotage shipment between the connecting ports in Mozambique and South Africa). Overall, inadequate transport infrastructure is unlikely to fully explain the estimated low elasticities given the relatively high quality of transport infrastructure in the trade corridor of interest for this study.

## B. *The Parallel Trend Assumption*

The validity of the difference-in-differences estimates in Sections IIIA and IIIB hinges on the key identifying assumption that in the absence of the tariff change, trends in the outcomes of interest would have been similar between products that changed tariffs and products that remained in the same tariff category. To directly test for the parallel trend hypothesis, I examine trends in the trade gaps of treatment and control products prior to the tariff change, in 2006 and 2007. While the trade gap can only capture corruption related to tariff evasion and smuggling, prior to the tariff change in 2008, tariff evasion appeared to be the most common form of corruption in the particular setting under study (see Section IIIB and Table 6). I reestimate equation (4), but now interacting the treatment indicator with a dummy indicating the year 2007. Table 13 presents the results of this placebo test and for comparison, reproduces the results for the actual tariff liberalization occurring in 2008. All the coefficients are insignificant and close to zero in the placebo specification. While these results are limited to the two years prior to the tariff change due to the unavailability of data for previous periods, they lend support to the parallel trend assumption: in the absence of the tariff change, evasion rates would have remained similar across treatment and control products.

## C. *Sampling Bias*

The firm survey conducted in 2006 and 2010 targeted 190 firms located in the trade corridor connecting Mozambique to South Africa. Attrition rates in the second wave of the survey were approximately 15 percent. The assumption underlying the analysis of the firm data is that firms are missing from the panel at random. Standard tests for equality of means and equality of the distributions of important firm-level characteristics for firms that stayed in the panel and those that exited, cannot be rejected at conventional levels of significance (see Table 14). These variables include the size of the firm, its age, ownership structure, and sales levels at baseline. Data on some of the covariates of interest are also missing in the firm survey, further reducing the sample size to 117 firms. Table 14 also shows that firms that remained in the panel with full information on covariates of interest are not statistically different from firms with missing data on covariates.

TABLE 13—THE PARALLEL TREND HYPOTHESIS: AGGREGATE TRADE FLOW DATA

| | Quantity trade gap | Value trade gap | Unit value trade gap |
|---|---|---|---|
| *Panel A. Trade gaps with placebo 2007 tariff liberalization* | | | |
| Tariff change category × POST 2007 | −0.038 | −0.006 | −0.073 |
| | (0.134) | (0.111) | (0.053) |
| Tariff change category | 0.031 | −0.159 | 0.702 |
| | (0.227) | (0.181) | (0.142) |
| POST 2007 | 0.079 | 0.088 | 0.094 |
| | (0.118) | (0.098) | (0.045) |
| log baseline tariff | 0.204 | 0.121 | −0.088 |
| | (0.084) | (0.067) | (0.058) |
| Observations | 4,655 | 5,423 | 4,640 |
| $R^2$ | 0.002 | 0.012 | 0.039 |
| *Panel B. Trade gaps with actual 2008 tariff liberalization* | | | |
| Treated products × POST 2008 | −0.493 | −0.083 | 0.022 |
| | (0.097) | (0.077) | (0.031) |
| Treated products | 0.308 | −0.092 | 0.104 |
| | (0.243) | (0.219) | (0.087) |
| log baseline tariff | 0.245 | 0.271 | −0.051 |
| | (0.114) | (0.098) | (0.043) |
| POST | 0.385 | 0.118 | 0.394 |
| | (0.086) | (0.068) | (0.028) |
| Observations | 21,884 | 21,884 | 21,861 |
| $R^2$ | 0.170 | 0.155 | 0.422 |

*Notes:* Tariff change category equals 1 if the product changed tariff category in 2008 and 0 otherwise. Log baseline tariff rate represents the product's tariff rate in 2006, in logarithmic form. Standard errors clustered at the four-digit HS code.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code

TABLE 14—FIRM CHARACTERISTICS: SELECTION

| | Attrition panel | | | Attrition covariates | | |
|---|---|---|---|---|---|---|
| | *t*-test *p*-value | Kolmogorov-Smirnov *p*-value | $\chi^2$ *p*-value | *t*-test *p*-value | Kolmogorov-Smirnov *p*-value | $\chi^2$ *p*-value |
| Firm age | 0.86 | 0.34 | | 0.90 | 0.26 | |
| Sales in 2006 | 0.12 | 0.37 | | 0.40 | 0.77 | |
| Number of workers in 2006 | 0.51 | 0.36 | | 0.18 | 0.92 | |
| Percentage of imported inputs | 0.73 | 0.85 | | 0.24 | 0.45 | |
| Percentage female ownership | 0.55 | 0.99 | | 0.01 | 0.13 | |
| Firm exports in 2006 | | | 0.29 | | | 0.33 |
| Ethnicity of firm manager | | | 0.31 | | | 0.15 |

*Notes:* *p*-values for *t*-tests of equality of means of continuous variables firm age, sales in 2006, number of workers in 2006, and percentage of imported inputs (assuming unequal variances). Exact Kolmogorov-Smirnov *p*-values for a non-parametric test of the equality of distributions of continuous variables and *p*-values for a $\chi^2$ test for equality of categorical variables.

*Sources:* Enterprise Surveys conducted by the author in 2006 and 2010

## D. *Misreporting Aggregate Trade Flows*

In theory, Mozambican importers have an incentive to under-report quantities or values, or to misclassify products into different tariff groupings during periods of

Table 15—Tariff Changes and Misreporting of Trade Flows

| | log volume (in kgs) | | log value | |
|---|---|---|---|---|
| | Mozambique (1) | South Africa (2) | Mozambique (3) | South Africa (4) |
| Tariff change category × POST | 0.456 | −0.048 | 0.132 | 0.039 |
| | (0.092) | (0.092) | (0.075) | (0.079) |
| Tariff change category | −0.775 | −0.390 | 0.714 | 0.619 |
| | (0.395) | (0.429) | (0.395) | (0.388) |
| POST | 0.136 | 0.526 | 0.463 | 0.594 |
| | (0.081) | (0.081) | (0.066) | (0.069) |
| *Controls* | | | | |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Product four-digit HS code fixed effects | Yes | Yes | Yes | Yes |
| Observations | 21,909 | 21,909 | 21,909 | 21,909 |
| Mean of dependent variable | 8.619 | 8.896 | 10.500 | 10.718 |
| $R^2$ | 0.01 | 0.01 | 0.01 | 0.02 |

*Notes:* Tariff change category equals 1 if the product experienced a tariff change in 2008 and 0 otherwise. POST indicator equals 1 for years 2008–2014 and 0 for years 2006–2007.

*Sources:* United Nations COMTRADE database and Mozambican customs tariff code

high tariffs, while reporting by South African exporters should be insensitive to the tariff grouping the good falls under (Bhagwati 1964). By construction, the trade gap measure used in Section IIIA captures not only differential incentives in reporting but also differences in transport costs and exchange rates, among others (for example, exporters report values f.o.b. (freight on board), while importers report imports including c.i.f. (cost, insurance, and freight)). If the observed trade gap is indeed driven primarily by strategic misreporting on the Mozambican side, then the tariff reduction should, in principle, eliminate this incentive and lead to more accurate reporting of imports of these products. To test for this possibility and confirm that the trade gap is driven by misreporting and corruption occurring on the side of the importer, I fit equation (4) to the aggregate trade flow data, replacing as the dependent variable the volume and value of import flows, as reported by Mozambican importers or South African exporters. Table 15 confirms that Mozambican importers reported higher volumes of imports for products that experienced a tariff reduction, but the tariff change elicited no differential change in reported volumes or values by South African exporters across treatment and control products. This result also confirms that prior to the tariff change, there was significant misreporting of quantities by Mozambican importers to evade tariffs. One of the benefits of the tariff liberalization scheme was therefore to create incentives for more accurate reporting of trade flows by importers. This is particularly important given that exporters have less of an incentive to track exports carefully due to the absence of export duties.

### E. *Measurement Bias*

To cross-check the accuracy and reliability of the bribe data collected, I implemented an experiment in which clearing agents were randomly assigned to sequences

Table 16—Monitoring Experiment

| | Bribe paid | | | | log bribe amount paid | | | |
|---|---|---|---|---|---|---|---|---|
| | Linear probability model | | | | OLS | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Monitored shipment | −0.100 | −0.101 | −0.200 | −0.190 | −0.951 | −0.895 | −1.647 | −1.418 |
| | (0.035) | (0.025) | (0.057) | (0.080) | (0.295) | (0.179) | (0.476) | (0.639) |
| Monitored shipment | | | 0.044 | 0.037 | | | 0.308 | 0.214 |
| × log tariff level | | | (0.017) | (0.027) | | | (0.138) | (0.216) |
| *Controls* | | | | | | | | |
| Industry fixed effects | No | Yes | No | Yes | No | Yes | No | Yes |
| Clearing agent | No | Yes | No | Yes | No | Yes | No | Yes |
| Product four-digit HS code | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Terminal | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month arrival | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Differentiated product | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Agricultural product | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Perishable | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pre-inspected shipment | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Large client firm | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Day of the week arrival | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| log value per ton | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| log tariff level | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bulk (non-containerized) shipments | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 919 | 919 | 919 | 919 | 919 | 919 | 919 | 919 |
| *F*-test | 5.31 | 15.49 | 24.68 | 24.04 | 6.71 | 16.82 | 18.02 | 30.76 |
| $R^2$ | 0.05 | 0.09 | 0.05 | 0.09 | 0.04 | 0.08 | 0.04 | 0.08 |

*Notes:* In columns 1 through 4 the dependent variable equals 1 if a bribe was paid and 0 otherwise, while in columns 5 through 8 the dependent variable corresponds to the amount of bribe paid in logarithmic form $[\ln(x+1)]$. Columns 1 through 4 fit linear probability models while columns 5 through 8 fit standard ordinary least squares. Robust standard errors are clustered at the four-digit HS code for each product.

*Sources:* Audit study conducted by the author

of monitored and unmonitored data collection. As described in Sequeira and Djankov (2014, p. 286), "the monitoring was conducted by locally-hired observers who shadowed clearing agents and verified the accuracy of the data reported. The observers had experience in the shipping industry and were familiar with all clearance procedures. To minimize any suspicion, they were also similar in age and appearance to any clerk who normally assists clearing agents in their interactions with port officials." Note that the clearing agents knew from the outset that they would be monitored at some point, making it "less likely that they would try to strategically misreport information on bribe payments while they were not being monitored."

Table 16 displays the results from the experiment. When monitored, clearing agents reported fewer instances of bribe payments and lower bribe amounts paid (an 11 to 17 percent decline in the probability of paying a bribe and a 60 percent decline in the amount of bribe paid). These results are robust to controlling for important cargo characteristics such as its size and value, for the characteristics of the client firm and the clearing agent, and for the timing of the shipments, among others.

As reported in Sequeira and Djankov (2014, p. 286) the observers participating in the monitoring exercise reported that "their presence had changed the nature of the interactions between the clearing agent and the public official, inhibiting certain illicit transactions." Interestingly, this Hawthorne effect appears to have been less pronounced "in cases in which corruption may have been more "justified" such as

Table 17—Summary Statistics: Shipment Characteristics

| Shipment characteristics | Difference Pre-post tariff change ($p$-values) | | |
|---|---|---|---|
| *Panel A* | All products | Treatment products | Control products |
| Average shipment value per ton | 0.28 | 0.97 | 0.27 |
| Percentage bulk cargo | 0.83 | 0.93 | 0.69 |
| Perishable product | 0.47 | 0.01 | 0.04 |
| Percentage of differentiated goods | 0.71 | 0.003 | 0.16 |
| *Panel B* | High-High | High-Low | Low-Low |
| Average shipment value per ton | 0.19 | 0.58 | 0.36 |
| Percentage bulk cargo | 0.01 | 0.20 | 0.53 |
| Perishable product | 0.001 | 0.000 | 0.56 |
| Percentage of differentiated goods | 0.03 | 0.01 | 0.06 |

*Notes:* The high-high grouping represents products that remained in the high tariff category; the high-low grouping represents products that went from high to low tariffs and the low-low grouping represents products that remained in a low tariff category throughout the period under analysis. Bulk represents non-containerized cargo. For the continuous variable average shipment value per ton, $t$-test for equality of means, accounting for unequal variances. For all other binary variables, the $p$-value corresponds to a $\chi^2$ test.

*Source:* Audit study conducted by the author

when the bribe was being paid for tariff evasion. In these cases, since both parties were benefiting from the illicit transaction, public officials may have felt less shame" (or less fear) in requesting a bribe in the presence of the observer, as suggested by the positive and marginally significant coefficients of the interaction between tariff level and whether a shipment was monitored (see columns 3, 4, 7, and 8).

As discussed in Sequeira and Djankov (2014, p. 286) these results lend support to an extensive literature in psychology arguing that "self-administered questionnaires increase the willingness of respondents to report sensitive behavior in a variety of settings" (Barnett 1998; Bradburn and Sudman 1979; Waterton and Duffy 1984; Groves 1989; Weinrott and Saylor 1991). The analysis in this paper therefore always controls for whether a shipment was monitored.

The main corruption results in Section IIIB also depend on the assumption that the error terms are uncorrelated with the measurement of bribes. This assumption would be violated if, among other reasons, the measure of bribes in the period 2007–2012 came from very different samples of products audited each year. The pattern of bribe payments observed could then be driven not by the tariff reduction but by changes in the composition of shipments in the sample. Table 17 shows the $p$-values for a test of equality of means, assuming unequal variances, for important product and shipment-level characteristics for each period. For the most part and for key variables such as the value of the shipments per ton, the $p$-values suggest that the audited shipments are indeed comparable across time.

## F. *Displacement Effects*

As described in Section III, bribe payments for duty avoidance are just a subset of the bribery deals available to border officials and firms during the import process. As officials attempt to protect bribe rents and private agents seek alternative methods to reduce the cost of clearing goods through borders, changes in tariff schedules can affect not only the levels of tariff evasion but also the broader set of corrupt interactions both parties engage in.[18] If displacement effects are large, they could significantly change the interpretation of the main results on the impact of the tariff liberalization scheme on corruption and, consequently, on trade costs. If corruption were displaced from cost-reducing tariff evasion to other forms of cost-increasing extortionary bribes, then these displacement effects could be an alternative explanation to the observed low estimated trade elasticities.

To examine the potential displacement of corruption caused by the tariff change, I track bribe payments along the entire chain of complementary stages in the clearance of imported goods. Prior to the tariff change, the most frequently cited reason for a bribe payment to customs was tariff evasion. Following the 2008 tariff change, the most common type of bribe extraction involved selling "speed" in the clearance queue, overlooking irregularities with the clearance documentation (real or fictitious), or allowing the cargo to skip normal clearing procedures such as the scanning process. While overall port volumes increased during the period under study (by 13 percent in 2008 and 18 percent in 2011), clearing times remained fairly stable, in part given significant excess infrastructural capacity in the trade corridor. There is also no statistically significant difference in clearing times between products that paid and did not pay bribes, before and after the tariff change, as shown in Table 6.

To examine potential displacement effects in the type of corruption associated with imports, I test whether products experiencing a tariff reduction also experienced any change in the type of bribes paid. The audit study captured whether a bribe payment was of the collusive type (i.e., if the rent generated from the illicit transaction was shared between the public official and the firm), or coercive in nature (i.e., if the rent was mostly captured by the public official) (Sequeira and Djankov 2014). I replace the dependent variable in equation (5) with a binary variable representing the probability of paying a coercive bribe, conditional on the payment of a bribe. This analysis is restricted to the sample of products that reported paying a bribe. The results are reported in Table 18, columns 1 through 4: a 1 percent percentage point increase in the tariff reduction is associated with a 3 percent increase in the probability of paying a coercive bribe, conditional on a bribe being paid.

I then extend the analysis to the entire sample through an ordered probit model, replacing the dependent variable with an indicator that takes the value $-1$ if a collusive bribe was paid, 0 if no bribe was paid and 1 if a coercive bribe was paid. Columns 5 and 6 in Table 18 confirm that products that changed tariff level in 2008 were more likely to pay coercive bribes following the tariff change.

While design constraints prevent me from conclusively identifying the reason behind this stickiness of bribe payments, a possible explanation is that shippers of former high tariff products had already signaled a high willingness to pay bribes (or a higher reference point of what was an "acceptable" bribe payment to clear a shipment) and would therefore be more likely to pay bribes for other reasons,

[18] While the potential for policy reform to trigger the displacement of corruption lies at the core of an extensive literature on law enforcement (Reppetto 1976; Chaiken, Lawless, and Stevenson 1974; McPheters, Mann, and Schlagenhauf 1984; Ayres and Levitt 1998; Levitt 1998; Di Tella and Schargrodsky 2004), displacement effects of corruption in the context of trade policy and trade costs have remained largely unexplored with the exception of Yang (2008a, b).

Table 18—Shift from Collusive to Coercive Corruption

| | Probability of paying a coercive bribe Linear probability model | | | | Shift collusive to coercive Ordered probit | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tariff change category × POST | 0.442 | 0.318 | | | 0.834 | |
| | (0.163) | (0.149) | | | (0.475) | |
| Tariff change category | 0.083 | 0.097 | | | 0.094 | |
| | (0.137) | (0.104) | | | (0.471) | |
| Tariff reduction × POST | | | 0.029 | 0.020 | | 0.018 |
| | | | (0.010) | (0.012) | | (0.030) |
| Tariff reduction | | | 0.014 | 0.007 | | 0.041 |
| | | | (0.007) | (0.006) | | (0.029) |
| POST | 0.295 | 0.174 | 0.231 | 0.127 | 0.864 | 1.140 |
| | (0.089) | (0.461) | (0.111) | (0.422) | (1.801) | (1.706) |
| Differentiated product | 0.040 | 0.041 | −0.021 | 0.031 | 0.350 | 0.114 |
| | (0.110) | (0.124) | (0.139) | (0.12) | (0.579) | (0.554) |
| Perishable product | −0.194 | 0.177 | −0.236 | 0.091 | 0.239 | 0.046 |
| | (0.145) | (0.192) | (0.160) | (0.187) | (0.778) | (0.776) |
| Firm size | −0.066 | −0.105 | −0.059 | −0.096 | −0.986 | −0.871 |
| | (0.064) | (0.076) | (0.058) | (0.079) | (0.382) | (0.385) |
| log shipment value per ton | 0.025 | −0.017 | 0.0167 | −0.019 | 0.0350743 | 0.018 |
| | (0.019) | (0.030) | (0.015) | (0.029) | (0.116) | (0.110) |
| *Controls* | | | | | | |
| Day of the week arrival | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Clearing agent | Yes | Yes | Yes | Yes | Yes | Yes |
| Pre-shipment inspection | Yes | Yes | Yes | Yes | Yes | Yes |
| Log baseline tariff | Yes | Yes | Yes | Yes | Yes | Yes |
| Covariates × post | No | Yes | No | Yes | Yes | Yes |
| Observations | 228 | 220 | 228 | 220 | 1,084 | 1,084 |
| $F$-statistic | 30.69 | 27.98 | 18.54 | 15.88 | | |
| Wald statistic | | | | | 1,156 | 1,102.08 |
| log pseudo-likelihood | | | | | −591.316 | −598.758 |
| $R^2$ | 0.32 | 0.32 | 0.29 | 0.29 | | |

*Notes:* Columns 1 through 4 represent a linear probability model, where the dependent variable equals 1 if a coercive bribe was paid and 0 if a collusive bribe was paid instead. Columns 5 and 6 represent an ordered probit in which the dependent variable equals −1 if a collusive bribe was paid, 0 if no bribe was paid and 1 if a coercive bribe was paid. All columns represent the standard difference-in-differences specification. In columns 1, 2, and 5 the treatment variable equals 1 if the product falls under a tariff category that experienced a tariff reduction in 2008 and 0 otherwise; in columns 3, 4, and 8 the treatment variable captures the percentage point tariff reduction experienced by each product. Robust standard errors are correlated at the level of the four-digit HS code.

*Source:* Audit study conducted by the author

relative to shippers who were less accustomed to paying bribes altogether. Note that a straightforward revealed preference argument suggests that this shift is suboptimal for customs officials. First, the option of extracting bribes through coercive methods was present even before the tariff change, and yet it was overlooked in favor of taking bribes for tariff evasion for high tariff goods. Second, customs officials continued to extract bribes from products that remained in high tariff categories, primarily by selling tariff evasion. Finally, despite customs officials' attempts to protect their bribe rents by resorting to alternative forms of bribe extraction, the total amount of bribes received by customs after the tariff change (in 2008, 2011, and 2012) represented only 46 percent of their previous intake in 2007. This confirms that the tariff liberalization program, and consequently the reduced possibility of selling tariff evasion, was associated with a significant decline in customs officials' overall bribe revenue.

Taken together, these results suggest that displacement effects did not lead to a substantial increase in firm-level trade costs. Overall, they dampened the total decline in corruption by less than 10 percent.[19] Further note that these results are broadly consistent with the prediction in Yang (2008b): displacement effects from tariff evasion were small since alternative methods of bribe extraction had both higher fixed and variable costs.

### G. *Changes in Other Moments of the Distribution of Bribe Payments*

A growing literature argues that it is not only the level of trade costs but the uncertainty around them that is detrimental to business performance (Hallward-Driemeier, Khun-Jush, and Pritchett 2012; Sequeira and Djankov 2014; Handley and Limao 2015). I therefore test whether the change in tariffs affected trade costs by changing other moments of the bribe distribution, namely the variance of bribe payments.

Panel A in Table 19 shows, descriptively, that while bribe dispersion decreased for products experiencing a tariff reduction, it remained constant for products that continued to pay a bribe for tariff evasion. This suggests that the tariff change had a limited impact on patterns of bribe payments for tariff evasion of high tariff products. Bribe dispersion also decreased for products paying bribes to customs for reasons other than tariff evasion, which is likely to be driven by the fact that following the tariff change, this category includes the smaller, coercive bribes paid by treatment products.

I then replace the dependent variable in equation (5) with the standard deviation of bribe payments, calculated at the four-digit level of the HS classification, for all shipments sampled in the audit study. These findings are confirmed in the regression results presented in panel B, since products experiencing a tariff reduction were associated with smaller and more predictable bribes. These results suggest that it is unlikely that the small trade elasticities were driven by an increase in the uncertainty associated with corruption-induced trade costs after the tariff change occurred.

## V. Conclusion

This paper exploits a tariff liberalization scheme implemented in southern Africa to estimate trade elasticities. This scheme induced a quasi-experimental variation in tariffs regulating trade between South Africa and Mozambique, with the most sizable reduction in tariffs occurring in 2007–2008. The main elasticity estimates are close to the lower range of elasticities estimated in the literature (0.1). I confirm these small elasticities at the micro-level, by directly observing how incumbent firms located in the main trade corridor under analysis do not appear to significantly adjust their import behavior in response to the sizable tariff change.

I then examine the role of corruption in driving the estimated low elasticities, by combining secondary data on trade gaps with primary data on bribe payments at borders. The data show that corruption was rampant prior to the tariff change, which might have significantly reduced effective tariff costs for firms. Bribes were,

[19] For a more detailed and comprehensive discussion of all displacement effects evident in the data, see online Appendix Section IC.

Table 19—Tariff Liberalization and Bribe Dispersion

| *Panel A. Test of equality of means* | Before tariff change | After tariff change | Difference | $p$-value |
|---|---|---|---|---|
| Standard deviation of bribes per ton | 2,021 | 1,692 | 329 | 0.17 |
| (all products) | (236) | (50) | | |
| Standard deviation of bribes per ton | 2,633 | 903 | −1,531 | 0.00 |
| (treatment products) | (448) | (140) | | |
| Standard deviation of bribes per ton | 1,652 | 1,059 | 593 | 0.35 |
| (bribes paid to customs for tariff evasion) | (446) | (449) | | |
| Standard deviation of bribes per ton | 2,448 | 1,316 | −1,133 | 0.06 |
| (bribes paid to customs by treatment products) | (450) | (392) | | |

| | SD of bribe amount paid per ton, OLS | |
|---|---|---|
| *Panel B. Dependent variable* | (1) | (2) |
| Tariff change category × post | −1,976 | −3,742 |
| | (1,599) | (1,835) |
| Tariff change category | 1,999 | 3,567 |
| | (1,479) | (1,754) |
| Post | 320 | −5,893 |
| | (315) | (4,739) |
| *Controls* | | |
| Clearing agent fixed effects | Yes | Yes |
| Industry fixed effects | Yes | Yes |
| Terminal | Yes | Yes |
| Day of the week arrival | Yes | Yes |
| Product from South Africa | Yes | Yes |
| log baseline tariff | Yes | Yes |
| Covariates × post | Yes | Yes |
| Observations | 1,072 | 1,072 |
| Mean of dependent variable | 2.622 | 2.622 |
| $R^2$ | 0.49 | 0.53 |

*Notes:* Standard deviation of bribes per ton calculated at the level of the four-digit HS code. Differences (panel A) and robust standard errors (panel B) significant at 1 percent, 5 percent, and 10 percent.

*Source:* Audit study conducted by the author

however, small relative to the rent accrued from evading tariffs. The liberalization process could therefore have translated into a small reduction in actual trade costs, as the tariff removal combined with the reduction in bribes were too small to significantly affect firms' import decisions.

These findings suggest that trade elasticities associated with tariff liberalization schemes may be smaller than expected in contexts of pervasive corruption, which can then lead to inaccurate estimates of the gains associated with reductions in tariffs. The removal of tariffs can, however, still effectively eliminate layers of corrupt transfers between firms and border officials and lead to more accurate reporting of trade flows by importers. This is particularly important given that exporters have less of an incentive to track exports as carefully as importers due to the lack of export duties.

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