Corruption and Agricultural Trade

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Abstract

Using a gravity model framework this paper examines the effect of corruption on bilateral agricultural trade. This is the first cross-country study in the trade literature to examine the relationship between corruption and agricultural trade. The article uses five-year panel data from 2006 to 2010 and corrects for sample-selection bias. It also uses an instrumental variable approach for addressing endogeneity concerns. The study provides evidence that corruption can be trade-taxing when the protection level is low, but with the degree of protection higher than a threshold level, it becomes trade-enhancing. The results are robust for different measures of corruption.

JEL classification codes: F10; F13; F14
Keywords: Corruption; Agricultural Exports; Gravity Model

1 Introduction

Corruption is an enduring phenomenon that is ingrained in a wide variety of socio-economic, cultural, and political factors. It is commonly defined as the abuse of public office for private gain[1]. Corruption can be present in various forms such as bribery, extortion, evasion, cronyism, nepotism, graft, embezzlement, etc. It is considered as one of the major obstacles in achieving the goals of public policies for both the developing countries and developed nations. It has adverse impacts on a nation's economic growth (Shleifer and Vishny, 1993), government expenditure, or per capita GDP (Mauro, 1995, 1998). By raising the transaction cost and uncertainty, corruption also hinders long-run foreign and domestic investment in an economy (Wei, 2000). Corruption gives rise to inequality and also elevates poverty (Gupta, et al., 2002). Despite these negative impressions, many economists argue that corruption can be beneficial for the economy. Some economists (Leff, 1964; Huntington 1968; mentioned by Mauro, 1995) have suggested that corruption raises economic growth. They argue that by removing government-imposed rigidities that hinder growth, corruption enhances the efficiency of the otherwise complicated system (Leff, 1964; Meon and Weill, 2008).

Though in most of the cases detecting corruption is very difficult, there are a few international organizations that publish corruption indices based on the perception of the people. According to the corruption indices published by the Worldwide Governance Indicators and Transparency International (The Control of Corruption Index (henceforth CCI) and Corruption Perception Index (henceforth CPI) respectively), not a single country in the world is entirely free from corruption. For example, in 2010, Denmark had both the highest score in CPI, 9.30 out of the maximum possible 10 (least corrupt) and the highest score in CCI, 2.41 out of the maximum possible 2.5 (least corrupt). While, in the same year, Somalia had the lowest scores, a CPI of 1.10 (the lowest possible score is 0), and a CCI of -1.74 (-2.5

[1] Visit: http://www1.worldbank.org/publicsector/anticorrupt/corruptn/cor02.htm

is the lowest possible score). Table 1 lists the five least and the most corrupt countries in descending order of corruption as measured by the CCI. Some of the least corrupt countries of the world are also some of the highest exporters of agricultural commodities. For instance, Denmark, New Zealand, Sweden, Singapore, and Finland are amongst the five least corrupt countries in the world according to the 2010 Control of Corruption Index.

Table 1: Least and Most Corrupt Countries in the World, 2010

Rank	Country	Country Code	Trade Value (million US $)	Control of Corruption Index	Corruption Perception Index
Least corrupt countries according to 2010 CCI					
1.	Denmark	DNK	16006.05	2.41	9.30
2.	New Zealand	NZL	15297.78	2.40	9.30
3.	Sweden	SWE	6186.42	2.32	9.20
4.	Singapore	SGP	4002.45	2.21	9.30
5.	Finland	FIN	1488.61	2.18	9.20
Most corrupt countries according to 2010 CCI					
5.	Turkmenistan	TKM	-	-1.45	1.60
4.	Equatorial Guinea	GNQ	-	-1.49	1.90
3.	Afghanistan	AFG	130.94	-1.62	1.40
2.	Myanmar	MMR	1420.60	-1.68	1.40
1.	Somalia	SOM	-	-1.74	1.10

The CCI takes values in the range of -2.5 to 2.5, and CPI takes values in the range of 0 to 10. A higher value of both the indices implies lower corruption. The data for total agricultural exports comes from United Nation's COMTRADE database. Trade value is measured in current US dollars.

While there is a plethora of empirical literature analyzing the causes and the consequences of corruption, cross-national empirical research studying the effect of corruption on international trade is rare. The literature is even more scarce if we consider the relationship between corruption and agricultural trade. The impact of corruption on agricultural trade can be potentially large. Also, the presence of protectionist trade policies can give rise to the incidence of corruption. Rigid trade policies provide bureaucrats with the opportunity to extract bribes. It also increases the incentive for foreign traders to offer bribes to customs officials in order to evade tariffs. This paper contributes to the trade literature by examining the relationship between corruption and agricultural exports across borders. It also suggests measures to facilitate trade in the presence of corruption as well as in case of rigid trade policies. Using an augmented gravity model, this paper investigates the role of corruption on bilateral agricultural exports for a broad set of countries, spanning five years from 2006 to 2010.

2 Corruption in International Trade

It is widely recognized that the institutional quality plays an important role in implementing policy measures in an economy. Efficient government institutions foster economic growth (Mauro, 1995). Institutional quality also plays a major role in determining the volume of trade across borders (Anderson and Marcouiller, 2000). Weak institutions give incentives for corrupt officials to exploit their discretionary power to extract or create rents (Aidt, 2003). The level of corruption represents the quality of institutions in an economy. In international trade, corruption prevails mostly in the form of bureaucratic corruption or government corruption where customs officers demand or accept bribes and in return sell government properties.

Two types of bribes plague the customs administrations around the world. Customs officials in authority to give customs clearance purposefully delays the process to attract more bribes. In the corruption literature, this process is known as extraction (Dutt and Traca, 2009). Sometimes in countries with protectionist trade policies and cumbersome rules and regulations, traders offer bribes to customs officials to reduce the tariff or other regulatory barriers to trade. This situation in which customs officials accept bribes for doing something that they are not entitled to do is known as evasion (Dutt and Traca, 2009).

Bribery in international trade acts as a hidden tax and results in an unreported trade. Corruption at the border reduces trade by increasing the transaction cost and also the price of the traded commodity. As mentioned by John and Bogmans (2011), "In low-income countries in which a large share of government revenue is collected through customs, corrupt customs officials reduce trade and deprive the government of revenue." According to the African Development Bank, "Every year $1 trillion is paid in bribes while an estimated $2.6 trillion are stolen annually through corruption, a sum equivalent to more than 5% of the global GDP."[2]

Trade literature suggests that the effect of corruption on international trade is mixed. Economists suggest that a protectionist trade policy leads to increased levels of bureaucratic corruption. In countries with complex tariff structure, bribes are seen as a way out from cumbersome rules and regulations. In countries with protectionist trade policy, bribes referred to as *"speed money"*, enable individuals to avoid bureaucratic delays and help improve efficiency (Bardhan, 1997). Also, irrespective of the level of red tape in a country, if the bribe acts as a *"piece rate"*, the customs officials who are allowed to levy bribes would work harder thereby increasing the efficiency of the system (Leff, 1964; Huntington, 1968). Some economists argue that offering speed money to the officials helps establishing a custom in the economy where the officials intentionally delay the license until the bribe is paid. The corrupt customs officials intentionally introduce new rules and regulations to extract more bribes (Krueger, 1993). Therefore, although practices like paying speed money might induce government workers to work hard and help individuals avoid delays at the border, the custom of paying bribes adversely affects the economy as a whole.

In his paper, Dutt (2009) found evidence that countries with protectionist trade policies face a higher level of corruption. His finding supports the notion that trade liberalization can lead to better governance and thereby reduced levels of corruption. Jong and Bogmans

[2]Visit: http://www.afdb.org/en/

(2011) investigate the effect of corruption on international trade for both the importing and exporting country. They found that corruption has an overall negative impact on trade, but bribe-paying to customs enhances imports.

Lambsdorff (1998) found that the degree of corruption of the importing country significantly affects the export performance of a country. For some countries, his result shows a positive relationship between corruption and export performance, but for a few other nations the corruption and export performance moves in the opposite direction. Lambsdorff (1999) reinforces his earlier findings and shows that some countries have a significantly lower market share in countries which are corrupt. He concludes that these differences arise due to a different willingness of exporters to offer bribes.

Since customs procedures can considerably increase the transit time between origin and destination, the extraction and evasion at the borders can play a major role in facilitating or hindering international trade. A study by Martincus et al. (2011) finds that a 10% increase in the median time spent in customs results in a 1.8% decline in the growth rate of exports. The effects are particularly acute for exports of time-sensitive products. Therefore, it is expected that corruption at the border will have a negative impact on the volume of international trade. On the other hand, if the trade policies are cumbersome and if the quality of customs is low, corruption can facilitate international trade.

Though few economists have investigated the impact of corruption on trade related to service sectors or manufactured goods, there are scant empirical studies that address how corruption might influence the volume of agricultural trade across the borders. Agricultural commodities are usually perishable in nature, although the degree of perishability varies. Along with increasing transaction costs, delays in the trade have an impact on the market price of agricultural commodities. Longer waits in customs to get clearance will influence the price of the traded goods and, thereby, can influence the volume of exports. The exporter of a commodity that is highly perishable in nature will have a greater propensity to pay a bribe. Also to avoid the delays at the border that result in higher inventory holding costs, the exporters will be willing to pay the bribe. This propensity to pay or accept bribes increases with the level of corruption prevailing in the exporting or the importing country.

Therefore, it can be argued that the level of corruption prevailing in a country can significantly influence the volume of trade across the border. So it is important to study the impact of corruption on agricultural trade between nations. This paper tries to fill this void in the trade literature by studying the impact of corruption on bilateral agricultural exports. Specifically, this paper examines the following hypothesis:

Hypothesis 1: The level of corruption prevailing in a country will have a significant impact on the volume of agricultural trade.

This paper uses an augmented gravity model and combines different estimation techniques to empirically investigate the impact of corruption on bilateral agricultural trade. Using different measures of corruption, this paper attempts to measure the extent to which corruptions affect the trade performance of a country. In this paper the CCI, is used as the main explanatory variable. For sensitivity analysis, the CPI is used as a proxy for corruption. To analyze the data, multiple regressions are used, and results are tested for robustness. To reduce the omitted variable bias, a broad range of theoretically plausible determinants of agricultural trade are also included in the model. To deal with the endogeneity issue, the instrumental variable approach is used in this paper. Furthermore, Hekman's two-step model is used to reduce the sample-selection bias present in the data.

3 Empirical Strategy

To study the relationship between the level of corruption prevailing in a country and the volume of agricultural exports, the augmented gravity model is used in this paper. The gravity model of international trade pioneered by Tinbergen (1962) is expressed as:

$$Y_{ei} = G\frac{(M_e M_i)}{D_{ei}} \tag{1}$$

A standard gravity model assumes that the volume of trade between two countries is positively related to the size of the economies and negatively related to the trade costs between them. Here, Y_{ij} measures the trade flow between country e and i, M_e and M_i represents the size of country e and i respectively, D is the geographical distance between the countries, that captures trade costs. G is the gravitational constant. The market size of the economy is usually measured by the GDP of the country.

Additional dummy variables, including island economy, landlocked economy, common language, a common border, colonial heritage, income level or geographical region are included in the model to capture trade factors. The population is also included as a measure of country size. In this paper, the level of corruption in a country is used as a proxy for the quality institutions. Along with the main variable of interest, this paper controls for other variables that can influence the volume of trade. Since bilateral trade involves two countries, the quality of institutions prevailing in both the countries can affect the outcome of the exchange. Therefore, a variable representing the level of corruption prevailing in the partner country is included in the model. The model also controls for variables such as bilateral import tariff and the exchange rate that have the potential to influence the volume of agricultural trade. In this paper, a weighted average of bilateral applied tariff rates, weighted by the values of bilateral agricultural trade, is used as a measure of a country's tariff structure. This study includes two interaction term between tariff structure and the corruption index for exporting and importing countries respectively in the model. Since a complex tariff structure gives customs officials' incentive to demand bribes and also gives incentive to the foreign exporters to offer bribes, it is necessary to include the interaction terms in the model.

In this paper the log-linearized augmented gravity equation takes the following form:

$$\begin{aligned}\log(Export)_{eit} = \alpha &+ \beta_1 Corruption_{et} + \beta_2 Corruption_{it} + \gamma_1 \log(GDP)_{et} + \gamma_2 \log(GDP)_{it} \\ &+ \gamma_3 \log(Population)_{et} + \gamma_4 \log(Population)_{it} + \gamma_5 \log(Distance)_{ei} \\ &+ \gamma_6 Landlocked_e + \gamma_7 Language_{ei} + \gamma_8 Colony_{ei} + \gamma_9 Border_{ei} + \gamma_{10} Island_e \\ &+ \gamma_{11} Income_e + \gamma_{12} Region_e + \gamma_{13} \log(ExchangeRate)_{et} + \gamma_{14} \log(Tariff)_{iet} \\ &+ \gamma_{15} \log(Tariff)_{iet} \times Corruption_{et} + \gamma_{16} \log(Tariff)_{iet} \times Corruption_{it} \\ &+ \delta_{ei} + \epsilon_{eit} \end{aligned} \tag{2}$$

Here, e and i represents the exporting and importing countries, respectively, and t denotes time. $Export_{eit}$ denotes volume of agricultural export from country e to country i at time period t. $Corruption_{et}$ and $Corruption_{it}$ denote level of corruption in country e and i, respectively, at period t. GDP_{et} and GDP_{it} are the real GDP of country e and i, respectively, at time period t. $Population_{et}$ and $Population_{it}$ denote population of country e and i, respectively, at time period t. $Distance_{ei}$ gives the distance between the capital cities of country e and i. *Land* is a binary dummy variable that takes a value of unity if country e is landlocked. $Language_{ei}$ is a binary dummy variable which is unity if country e and country i have a common language and zero otherwise. $Colony_{ei}$ is a binary dummy which is unity if e and i had the same colonizer. $Border_{ei}$ is a binary dummy variable which is unity if e and i share a common border. $Island_e$ is a binary dummy taking a value of unity if country e is an island economy. $Income_e$ represents the set of dummies representing the income group to which country e belongs. $Region_e$ represents the set of dummies representing the geographical region to which country e belongs. $Tariff_{iet}$ is a weighted average tariff applied by country i on country e's exports at period t. $ExchangeRate_{et}$ represents the real exchange rate of country e quoted in the US dollar. δ_{ei} is a set of time fixed effects. ϵ_{eit} is the error term that is assumed to be normally distributed with mean zero.

The model is estimated using five-year panel data from 2006 to 2010. It is expected that corruption will have a negative impact on the volume of international trade. In that case, the coefficient of the corruption parameter is expected to take a positive sign (a higher value of the corruption index implies the country is less corrupt). Therefore, the positive coefficient of the corruption index should capture the trade-taxing extortion effect. On the other hand, if the trade policies are cumbersome and if the quality of customs is low, corruption can facilitate international trade. As a result, the coefficient of the corruption index is expected to take a negative sign. Also, a negative coefficient on the (corruption $\times$ tariff) interaction term captures the trade-enhancing evasion effect. This negative coefficient implies that corruption can be trade enhancing when the level of tariffs rises above a certain threshold level (Dutt and Traca, 2009).

As mentioned earlier, GDP is used as a proxy for the size of the economy. The larger the economy, the higher will be the volume of agricultural trade between country pairs. Therefore, the coefficient of $log(GDP)$ is expected to be positive. The coefficient for the log value of distance, which is used as a proxy for trade cost is expected to be negative as higher distance increases the trade cost, thereby reducing the volume of trade between the countries. It is also assumed that the volume of trade will be higher between the countries sharing similar cultural or colonial heritage. The same goes for the country pairs belonging to the same income group or the same geographical region. Again, the higher the population of the countries, the higher will be the demand for the commodities. As a result, the coefficient of $log(Population)$ of the importing country is expected to have a positive sign. The more the demand at home, the lower will be the volume of exports. Therefore, with increasing population at home, the volume of export will be lower. As a result, the coefficient of $log(Population)$ of the exporting country is expected to take a negative sign. As complex tariff barriers discourage trade, the coefficient of the tariff parameter is therefore expected to take a negative sign. The coefficient of the exchange rate is also expected to take a negative sign. A higher value of this variable implies that the value of the exporting country's currency appreciates in terms of the US dollar. With an appreciation of the domestic currency, the price of its exports increases. Therefore, a higher value of a country's exchange rate will negatively influence its exports.

In this paper, the log-linearized augmented gravity model is initially estimated using the Ordinary Least Square (OLS) method. Next, sample-selection bias arising from missing trade values is then corrected using Heckman's two-step model. To alleviate potential endogeneity present in the model, instrumental variable regression is then used.

3.1 Sample-selection Bias

In trade data, sample-selection bias is common due to the presence of missing trade values. Zero trade flows may result from a country's decision not to trade with another economy. As the log of zero is undefined, the missing trade value creates a problem when the log-linearized augmented gravity model is estimated using OLS. Zero trade flows will be automatically dropped from the log-linearized equation, giving rise to sample-selection bias.

To alleviate sample-selection bias, this paper follows Helpman et al., (2006), who use Heckman's two-step procedure to reduce this bias (Heckman, 1979). In Heckman's two-step model, Probit estimation is conducted in the first-stage to determine the probability of a country pair engaging in trade. In the second stage of the estimation, the expected values of the trade flow from the first stage, conditional on that country pairs are trading, are estimated using OLS. In this two-step model, to identify the parameters in both equations, an identification variable is required. The variable should hold the property that it influences a country's propensity to engage in trade but should not have any effect on its volume of trade. Previous literature suggests that variables like common religion, common language, etc. satisfy this condition (Helpman et al., 2006). In this paper "Common Language" is used as an identification variable.

3.2 Endogeneity

The cross-country correlation suggests a possible causal relationship between the volume of trade and the level of corruption prevailing in a country. The level of corruption in a country and the volume of trade might be determined simultaneously. For example, a higher degree of corruption can lower the volume of trade, or larger volume of trade might reduce the level of corruption prevailing in a country. This creates a circular causal chain between corruption and the volume of agricultural trade, giving rise to endogeneity.

In the augmented gravity model, the level of corruption can also be endogenous to the volume of agricultural trade because of the possibility of omitted variable bias, especially arising due to the presence of unobserved country-specific fixed factors. These unobserved country-specific factors pose the biggest challenge in the empirical corruption literature, owing to the invariability of corruption indices over time. This invariability of corruption indices makes it infeasible to carry out a panel study in corruption. In the presence of endogeneity, OLS estimation gives a biased result as the orthogonality assumption is violated.

To deal with the issue of endogeneity, this paper uses Instrumental Variable (IV) regression. An index of Ethnolinguistic fractionalization (ELF) is used as an instrument. The choice of instrument is guided by theoretical and economical findings by various economists. Development economists suggest that ethnic diversity or ethnolinguistic fractionalization leads to political instability and poor economic performance (Feraon, 2002). It lowers a country's economic growth rate or level of the public goods provision (Alesina et al., 1997).

A higher degree of ethnic diversity also results in an increased level of corruption in an economy. Ethnically diverse societies are more likely to engage in non-collusive bribery, which is more harmful than the collusive bribery present in a homogenous society (Shleifer and Vishny, 1993). According to Mauro (1995), "Ethnic conflict may lead to political instability and, in extreme cases, to civil war. The presence of many different ethnolinguistic groups is also significantly associated with worse corruption, as bureaucrats may favor members of their same group."

Ethnolinguistic fractionalization (ELF) index measures "the probability that two randomly selected persons from a given country will not belong to the same ethnolinguistic group" (Mauro, 1995). The higher the value of ELF index, the more fragmented the country will be. For this variable to work as an instrument, it should be true that ELF directly influences the level of corruption in a country but has no direct impact on the volume of agricultural exports. This paper uses the ELF index for 1961 constructed by Roeder (2001) as an instrument for corruption. Roeder (2001) provides ethnic diversity data for 150 countries. This ELF index is constructed mainly based on Atlas Narodov Mira, published by Soviet ethnographers in 1964 together with other Soviet ethnographic studies from the 1980s (Roeder 2001). The ELF index given by the following equation is constructed using the Taylor and Hudson (1972) formula. A fractionalization index, is defined as,

$$ELF = 1 - \sum_{i=1}^{n} \Pi_i^2 \qquad (3)$$

Where, Π_i is the proportion of people belonging to the ethnic group i . The lower the value of Π_i, the higher will be the value of ELF, and the more fragmented the country will be. According to the corruption literature, higher ethnolinguistic fractionalization will lead to a higher level of corruption.

4 Data

To undertake the empirical investigation, this paper uses cross-country data and constructs a panel dataset. The bilateral trade flow data for the dependent variable is collected from the Commodity and Trade Database (COMTRADE) of the United Nations Statistics Division. Agricultural goods are defined as commodities in Category 0 at the one-digit level of the Standard International Trade Classification (SITC Revision 1, Category 0). All data are expressed in current US dollar. Table 2 summarizes the relevant variables used in this paper.

Table 2: Corruption & Agricultural Exports: Summary Statistics

Variable	Mean	Std. Dev.	Obs.
$\log(\text{Export})_{ei}$	13.98	3.138	61595
CorruptionCCI$_{_e}$	0.307	1.062	62817
CorruptionCCI$_{_i}$	0.139	1.062	61847
CorruptionCPI$_{_e}$	4.864	2.313	60825
CorruptionCPI$_{_i}$	4.461	2.285	58222
$\log(\text{GDP})_e$	25.55	2.072	61752
$\log(\text{GDP})_i$	24.82	2.345	60667
$\log(\text{Distance})_{ei}$	3.691	0.392	56777
$\log(\text{Population})_e$	16.62	1.747	62292
$\log(\text{Population})_i$	16.07	1.964	61890
$\log(\text{Real Exchange Rate})_e$	4.589	0.076	39172
$\log(\text{Tariff})_{ie}$	2.097	1.294	29365
Ethnolinguistic Fractionalization Index$_{_e}$	0.417	0.273	53146
Ethnolinguistic Fractionalization Index$_{_i}$	0.436	0.267	57256

Summary statistics are presented together for the years 2006 to 2010.

This paper uses the CCI as the primary measure of corruption. The CCI comes from the worldwide governance indicators (WGI). They purpose of CCI as described by Kaufmann et al. (2010) is, it “Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as ‘capture’ of the state by elites and private interests.” The CCI takes a value in the range of -2.5 (most corrupt) to 2.5 (least corrupt). To conduct the sensitivity analysis, the paper includes the CPI constructed by Transparency International as a measure of corruption. According to Transparency International, “corruption is the abuse of entrusted power for private gain. It hurts everyone who depends on the integrity of people in a position of authority.” Transparency International collects data from a number of different surveys that report the perceived level of corruption in the public sector in different countries. The CPI index ranges from 0 to 10 where, zero implies a country is highly corrupt, and ten implies a country is almost clean.

The tariff data were derived from the Trade Analysis and Information System (TRAINS) database. The data for real exchange rate, GDP, and population comes from the World Bank. Variables capturing the variation in trade costs between country pairs such as distance, common language, common border, colonial pasts, and other gravity model variables comes from the CEPII. The data for ethnolinguistic fractionalization index, which is used as an instrument for corruption is provided by Roeder (2001).

5 Results

In this section, the full regression results quantifying the effect of corruption on agricultural exports are presented. Here, CCI is used as a proxy for the level of corruption. Before estimating equation 3.2, all countries are pooled and the top and bottom 1% of log value of agricultural exports in each of the pools are trimmed. The first column in each table includes standard gravity model variables along with the level of corruption as the main explanatory variable. It also includes region and income dummies. Next, the model controls for a number of variables to minimize the omitted variable bias. Column 2, controls for the effect of variables such as population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption in the exporting and importing countries respectively. Finally, the last column presents results of regressions which control for all the variables in the same specification along with time specific fixed effects. In terms of panel data, this fixed effect estimation accounts for all sources of unobserved heterogeneity that are constant for a given year across all countries. To deal with this issue of heteroscedasticity, robust clustered standard errors are used. Standard errors are clustered by distance, which is unique to each country pair but is identical for both trading partners.

5.1 OLS Estimates

Initially, the gravity model is estimated using the Ordinary Least Square (OLS) method. The consistency of OLS requires the error term to be uncorrelated with the explanatory variables. Therefore, Pooled Ordinary Least Square (POLS) is consistent in the Random Effect (RE) model but is inconsistent in the Fixed Effect (FE) model. In this paper, due to the presence of time-invariant factors, the RE model is more appropriate than the FE model. Thus, the estimates from the POLS model are assumed to be consistent in this study.

The results from POLS model are presented in table 3. The coefficient of corruption in the exporting country is highly significant in each column with the expected positive sign. This result suggests that the level of corruption in the exporting country has a significant and negative impact on the volume of exports (i.e., the more corrupt a country is, the lower will be the volume of agricultural exports). For example, in column 4, the coefficient of corruption in the exporting country suggests that an increase in the corruption ranking by one (becoming less corrupt) will increase the volume of agricultural exports by almost 84%. However, the corruption level in the importing country does not significantly affect the volume of agricultural exports. This can be true because the exporters will have a higher propensity to pay a bribe as they have to sell their product. Irrespective of the level of corruption in their own country or the partner country, exporters will always be willing to pay a bribe. Therefore, they will be willing to trade even with a country that is highly corrupt. On the other hand, the importing country has the option to choose a trading partner that is less corrupt. As mentioned earlier, the positive coefficient of the corruption index captures the trade-taxing extortion effect. Moreover, the positive coefficient of the interaction term between tariff structure and the level of corruption does not show any evidence of a trade-enhancing evasion effect.

Table 3: Corruption (CCI) & Agricultural Exports: Pooled OLS

Dependent variable: log(Export)$_{ei}$	(1)	(2)	(3)	(4)
CorruptionCCI$_{_e}$	0.902***	0.759***	0.843***	0.841***
	(0.050)	(0.075)	(0.092)	(0.093)
CorruptionCCI$_{_i}$	0.113***	0.055	-0.055	-0.057
	(0.034)	(0.054)	(0.069)	(0.069)
log(GDP)$_e$	0.146**	-0.018	-0.023	-0.018
	(0.055)	(0.089)	(0.089)	(0.093)
log(GDP)$_i$	0.610***	0.670***	0.667***	0.668***
	(0.023)	(0.034)	(0.034)	(0.034)
log(Distance)$_{ei}$	-2.772***	-2.822***	-2.808***	-2.809***
	(0.074)	(0.112)	(0.112)	(0.112)
Island Economy$_{_e}$	-0.151*	-0.395***	-0.399***	-0.399***
	(0.068)	(0.098)	(0.098)	(0.098)
Landlocked Economy$_{_e}$	-1.097***	-0.700***	-0.699***	-0.700***
	(0.084)	(0.130)	(0.130)	(0.130)
Common Colony$_{_ei}$	1.267***	0.355	0.360	0.359
	(0.190)	(0.406)	(0.407)	(0.408)
Common Language$_{_ei}$	0.699***	1.014***	1.016***	1.016***
	(0.077)	(0.102)	(0.102)	(0.102)
Common Border$_{_ei}$	1.127***	0.911***	0.890***	0.890***
	(0.149)	(0.235)	(0.235)	(0.235)
log(Population)$_e$	0.597***	0.668***	0.673***	0.668***
	(0.059)	(0.099)	(0.099)	(0.104)
log(Population)$_i$	0.073**	0.019	0.029	0.028
	(0.026)	(0.038)	(0.038)	(0.038)
log(Tariff)$_{ie}$		-0.118***	-0.118***	-0.118***
		(0.027)	(0.034)	(0.034)
log(Real Exchange Rate)$_e$		1.992***	1.990***	1.999***
		(0.357)	(0.356)	(0.360)
log(Tariff)$_{ie}$ × CorruptionCCI$_{_e}$			-0.039	-0.039
			(0.022)	(0.022)
log(Tariff)$_{ie}$ × CorruptionCCI$_{_i}$			0.069**	0.069**
			(0.025)	(0.025)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	41171	14373	14373	14373
Adjusted R^2	0.43	0.416	0.417	0.417

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The first column includes standard gravity model variables, region and income dummies along with CCI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption. The last column controls for time specific fixed effects. Constant not reported.

5.2 Heckman Model Estimates

Results of the first-step Heckman procedure are presented in table 4. The result shows the identification variable, the probability that two randomly drawn people from a country pair speak the same language, to be an important determining factor for the country pairs to engage in trade. Econometrically, this provides the necessary exclusion restriction for identification of the second stage trade flow equation. Therefore the variable "Common Language" is used as an exclusion variable in the construction of the Inverse Mills Ratio for the second stage Heckman procedure.

Table 4: Corruption & Agricultural Exports: Heckman's Two Step Model.
First-step Estimates; Identification Variable: Common Language

	Island Economy	Landlocked Economy	Common Border	Common Colony	Constant
Coefficient	0.228***	0.0002	1.032***	1.279***	-1.331***
Standard Error	0.019	0.025	0.035	0.055	-0.009

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 shows the second-stage results from Heckman's Two-step model. After correcting for the selection bias arising due to missing trade values, the coefficient for the level of corruption in the exporting country takes the expected positive sign. The positive coefficient for the corruption index captures the trade-taxing extortion effect and suggests that the level of corruption in the exporting country will reduce the volume of exports. The negative coefficient of the interaction term between tariff structure and the level of corruption suggests that trade enhancing evasion effect can be present in the model, but the result is not highly significant. However, the estimate for corruption in the importing country still remains insignificant but takes a positive sign after controlling for other variables. The standard gravity model variables also take the expected sign, and the results are statistically significant in most of the cases.

Table 5: Corruption (CCI) & Agricultural Exports: Heckman's Two-step Model. Second-step Estimates

Dependent variable: $\log(\text{Export})_{ei}$	(1)	(2)	(3)	(4)
CorruptionCCI_e	0.987***	1.198***	1.463***	1.463***
	(0.182)	(0.231)	(0.248)	(0.252)
CorruptionCCI_i	-0.176	-0.008	0.099	0.104
	(0.111)	(0.144)	(0.191)	(0.194)
$\log(\text{GDP})_e$	0.278	0.123	0.092	0.086
	(0.154)	(0.230)	(0.232)	(0.244)
$\log(\text{GDP})_i$	0.717***	0.716***	0.717***	0.716***
	(0.069)	(0.102)	(0.101)	(0.103)
$\log(\text{Distance})_{ei}$	-2.836***	-3.040***	-2.974***	-2.974***
	(0.230)	(0.375)	(0.383)	(0.384)
$\log(\text{Population})_e$	0.493**	0.414	0.451	0.458
	(0.182)	(0.267)	(0.269)	(0.282)
$\log(\text{Population})_i$	-0.083	-0.033	-0.025	-0.023
	(0.078)	(0.106)	(0.105)	(0.106)
$\log(\text{Real Exchange Rate})_e$		1.347	1.365	1.321
		(0.715)	(0.712)	(0.730)
$\log(\text{Tariff})_{ie}$		0.067	0.140	0.142
		(0.074)	(0.089)	(0.089)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCCI}\_e$			-0.122*	-0.123*
			(0.050)	(0.050)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCCI}\_i$			-0.048	-0.049
			(0.077)	(0.074)
Inverse Mills Ratio	-1.556***	-1.253**	-1.247**	-1.249**
	(0.248)	(0.469)	(0.470)	(0.470)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	4636	1944	1944	1944
Adjusted R^2	0.450	0.450	0.452	0.452

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The first column includes standard gravity model variables, region and income dummies along with CCI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption. The last column controls for time specific fixed effects. Constant not reported.

5.3 IV Estimates

Table 6 reports the results of the GMM analysis using ethnolinguistic fractionalization (ELF) index as an instrument for corruption. The coefficient for corruption in the exporting country appears with the expected positive sign across different specifications and is statistically significant. After controlling for causality and omitted variable bias, the coefficient for corruption in the importing country becomes significant and takes the expected positive sign. The positive coefficient of the corruption index captures the trade-taxing extortion effect and suggests that the higher level of corruption prevailing in the exporting country will reduce the volume of exports. Also, the negative and significant coefficient for the interaction term between tariff structure and the level of corruption, suggests corruption can be trade enhancing in the presence of complex tariff structures.

Here the coefficients from the instrumental variable regression are somewhat larger than the OLS estimates suggesting that OLS estimates were downwards biased due to the problem of endogeneity. Furthermore, the F-statistic presented at the bottom of the Table 6 suggests that the instrument is strong in each column (i.e., the more fragmented a country is in terms of ethnicity, the more severe will be the level of corruption).

5.4 Sensitivity Analysis

Table 7 to 9 presents the results with an alternative measure of corruption, CPI, published by Transparency International. CPI takes values between 1 to 10 where a higher value implies a lower level of corruption and vice-versa. The point estimates obtained using the CPI as a measure of corruption are very similar to the estimates from the regressions using CCI. This significant and comparable estimates using CPI strengthens the confidence in the estimated coefficients from the previous sections.

Table 6: Corruption (CCI) & Agricultural Exports: IV Analysis (GMM)

Dependent variable: $\log(\text{Export})_{ei}$	(1)	(2)	(3)	(4)
$\text{CorruptionCCI}_{\_e}$	3.378**	2.720***	4.360***	4.498***
	(1.202)	(0.710)	(1.196)	(1.192)
$\text{CorruptionCCI}_{\_i}$	9.664	2.688**	2.946**	2.515**
	(7.346)	(1.039)	(1.008)	(0.911)
$\log(\text{GDP})_e$	-0.846	-1.203**	-1.357**	-1.543**
	(0.473)	(0.432)	(0.477)	(0.512)
$\log(\text{GDP})_i$	-4.382	-0.421	0.067	0.158
	(3.846)	(0.441)	(0.221)	(0.204)
$\log(\text{Distance})_{ei}$	-4.293***	-3.796***	-3.750***	-3.722***
	(0.974)	(0.269)	(0.247)	(0.232)
Common $\text{Colony}_{\_ei}$	-1.878	1.022*	0.843*	0.786*
	(2.489)	(0.419)	(0.380)	(0.369)
Island $\text{Economy}_{\_e}$	-0.224	-0.147	-0.154	-0.113
	(0.151)	(0.114)	(0.111)	(0.117)
Landlocked $\text{Economy}_{\_e}$	-2.101**	-1.181***	-1.060***	-1.061***
	(0.665)	(0.190)	(0.166)	(0.161)
Common $\text{Language}_{\_ei}$	0.688***	0.776***	0.736***	0.739***
	(0.119)	(0.108)	((0.105)	(0.101)
Common $\text{Border}_{\_ei}$	0.241	0.158	0.043	0.0224
	(0.554)	(0.226)	(0.245)	(0.243)
$\log(\text{Population})_e$	1.890**	2.143***	2.370***	2.574***
	(0.595)	(0.530)	(0.591)	(0.628)
$\log(\text{Population})_i$	5.599	1.243*	0.753**	0.646**
	(4.254)	(0.492)	(0.257)	(0.235)
$\log(\text{Real Exchange Rate})_e$		2.110***	2.090***	1.595***
		(0.373)	(0.385)	(0.431)
$\log(\text{Tariff})_{ie}$		0.115	0.721**	0.642**
		(0.100)	(0.270)	(0.243)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCCI}_{\_e}$			-0.595**	-0.596***
			(0.184)	(0.177)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCCI}_{\_i}$			-0.680**	-0.570**
			(0.247)	(0.221)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	32378	11962	11962	11962
Wald F Statistics	1.005	9.338	14.48	16.49

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Instrumented variables: $\text{CorruptionCCI}_{\_e}$, $\text{CorruptionCCI}_{\_i}$. The first column includes standard gravity model variables, region and income dummies along with CCI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption. The last column controls for time specific fixed effects. Constant not reported.

Table 7: Corruption (CPI) & Agricultural Exports: Pooled OLS.

Dependent variable: log(Export)$_{ei}$	(1)	(2)	(3)	(4)
CorruptionCPI$_{_e}$	0.288***	0.284***	0.321***	0.320***
	(0.022)	(0.033)	(0.041)	(0.041)
CorruptionCPI$_{_i}$	0.073***	0.066**	0.006	0.005
	(0.016)	(0.025)	(0.032)	(0.032)
log(GDP)$_e$	0.243***	-0.046	-0.051	-0.044
	(0.059)	(0.096)	(0.095)	(0.099)
log(GDP)$_i$	0.602***	0.642***	0.635***	0.636***
	(0.024)	(0.035)	(0.035)	(0.035)
log(Distance)$_{ei}$	-2.662***	-2.782***	-2.762***	-2.764***
	(0.079)	(0.117)	(0.118)	(0.118)
Island Economy$_{_e}$	-0.138	-0.419***	-0.422***	-0.422***
	(0.071)	(0.101)	(0.101)	(0.101)
Landlocked Economy$_{_e}$	-1.062***	-0.730***	-0.730***	-0.732***
	(0.088)	(0.135)	(0.135)	(0.135)
Common Colony$_{_ei}$	1.248***	0.394	0.405	0.402
	(0.189)	(0.419)	(0.419)	(0.420)
Common Language$_{_ei}$	0.674***	1.006***	1.010***	1.010***
	(0.081)	(0.107)	(0.107)	(0.107)
Common Border$_{_ei}$	1.229***	0.903***	0.882***	0.882***
	(0.155)	(0.245)	(0.245)	(0.245)
log(Population)$_e$	0.465***	0.677***	0.681***	0.674***
	(0.063)	(0.105)	(0.105)	(0.108)
log(Population)$_i$	0.073**	0.045	0.057	0.056
	(0.027)	(0.039)	(0.039)	(0.039)
log(Tariff)$_{ie}$		-0.118***	-0.215*	-0.215*
		(0.028)	(0.097)	(0.097)
log(Real Exchange Rate)$_e$		2.027***	2.024***	2.037***
		(0.369)	(0.368)	(0.372)
log(Tariff)$_{ie}$ × CorruptionCPI$_{_e}$			-0.018	-0.018
			(0.011)	(0.011)
log(Tariff)$_{ie}$ × CorruptionCPI$_{_i}$			0.040***	0.040***
			(0.012)	(0.012)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	37892	13469	13469	13469
Adjusted R^2	0.424	0.411	0.413	0.413

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The first column includes standard gravity model variables, region and income dummies along with CPI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption. The last column controls for time specific fixed effects. Constant not reported.

Table 8: Corruption (CPI) & Agricultural Exports: Heckman's Two-step Model. Second-step Estimates

Dependent variable: $\log(\text{Export})_{ei}$	(1)	(2)	(3)	(4)
CorruptionCPI__e	0.270**	0.403***	0.502***	0.502***
	(0.083)	(0.110)	(0.124)	(0.126)
CorruptionCPI__i	-0.059	0.029	0.067	0.066
	(0.051)	(0.063)	(0.091)	(0.091)
$\log(\text{GDP})_e$	0.337*	0.125	0.103	0.119
	(0.161)	(0.247)	(0.250)	(0.262)
$\log(\text{GDP})_i$	0.717***	0.706***	0.705***	0.708***
	(0.071)	(0.104)	(0.103)	(0.105)
$\log(\text{Distance})_{ei}$	-2.845***	-2.862***	-2.820***	-2.830***
	(0.249)	(0.416)	(0.421)	(0.424)
$\log(\text{Population})_e$	0.435*	0.398	0.423	0.406
	(0.188)	(0.282)	(0.284)	(0.296)
$\log(\text{Population})_e$	0.099	0.046	0.033	0.034
	(0.083)	(0.113)	(0.112)	(0.113)
$\log(\text{Real Exchange Rate})_e$		1.640*	1.662*	1.637*
		(0.762)	(0.761)	(0.780)
$\log(\text{Tariff})_{ie}$		0.088	0.420	0.422
		(0.080)	(0.293)	(0.294)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCPI\_}_e$			-0.048	-0.049
			(0.027)	(0.027)
$\log(\text{Tariff})_{ie} \times \text{CorruptionCPI\_}_i$			-0.017	-0.017
			(0.036)	(0.036)
Inverse Mills Ratio	-1.660	-1.458	-1.445	-1.435
	(0.254)	(0.485)	(0.486)	(0.487)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	4223	1787	1787	1787
Adjusted R^2	0.445	0.432	0.434	0.433

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The first column includes standard gravity model variables, region and income dummies along with CPI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption. The last column controls for time specific fixed effects. Constant not reported.

Table 9: Corruption (CPI) & Agricultural Exports: IV Analysis (GMM)

Dependent variable: log(Export)$_{ei}$	(1)	(2)	(3)	(4)
CorruptionCPI$_{_e}$	1.185***	1.347***	2.144***	2.309***
	(0.152)	(0.307)	(0.548)	(0.582)
CorruptionCPI$_{_i}$	0.745*	0.954**	1.143**	1.199**
	(0.322)	(0.313)	(0.353)	(0.382)
log(GDP)$_e$	-0.723***	-1.468***	-1.627**	-1.797***
	(0.178)	(0.425)	(0.509)	(0.542)
log(GDP)$_i$	-0.152	-0.151	0.0701	0.134
	(90.36)	(0.287)	(0.194)	(0.184)
log(Distance)$_{ei}$	-3.188***	-3.671***	-3.765***	-3.751***
	(0.126)	(0.202)	(0.239)	(0.232)
Common Colony$_{_ei}$	0.871***	0.753*	0.662	0.619
	(0.241)	(0.354)	(0.391)	(0.392)
Island Economy$_{_e}$	0.057	0.027	0.021	0.061
	(0.049)	(0.137)	(0.149)	(0.155)
Landlocked Economy$_{_e}$	-1.420***	-1.179***	-1.037***	-1.051***
	(0.102)	(0.164)	(0.152)	(0.152)
Common Language$_{_ei}$	0.586***	0.800***	0.705***	0.703***
	(0.052)	(0.095)	(0.109)	(0.108)
Common Border$_{_ei}$	0.924***	0.361	0.063	0.038
	(0.105)	(0.189)	(0.249)	(0.250)
log(Population)$_e$	1.604***	2.375***	2.596***	2.778***
	(0.201)	(0.499)	(0.604)	(0.639)
log(Population)$_e$	0.900*	0.928**	0.752***	0.677**
	(0.396)	(0.313)	(0.221)	(0.209)
log(Real Exchange Rate)$_e$		1.171**	1.121*	0.632
		(0.451)	(0.519)	(0.608)
log(Tariff)$_{ie}$		0.0711	3.464***	3.283***
		(0.076)	(1.005)	(0.946)
log(Tariff)$_{ie}$ × CorruptionCPI$_{_e}$			-0.340***	-0.342***
			(0.095)	(0.095)
log(Tariff)$_{ie}$ × CorruptionCPI$_{_i}$			-0.292**	-0.260**
			(0.099)	(0.092)
Region Dummy	Yes	Yes	Yes	Yes
Income Dummy	Yes	Yes	Yes	Yes
Year Fixed Effect	No	No	No	Yes
Observations	30093	11390	11390	11390
Wald F Statistics	19.39	20.76	17.87	18.75

Heteroscedasticity robust standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Instrumented variables: CorruptionCPI$_{_e}$, CorruptionCPI$_{_i}$. The first column includes standard gravity model variables, region and income dummies along with CPI as the main explanatory variable. Column 2, controls for the effect of population, real exchange rate, and tariff structure. Column 3 includes the interaction terms between tariff structure and the level of corruption in the exporting and importing countries respectively. Finally, the last column controls for time specific fixed effects. Constant not reported.

6 Conclusion

This paper investigated the effect of corruption on bilateral agricultural exports. The augmented gravity model was used to identify the relationship between corruption and agricultural trade. In this study, the sample-selection bias present in the trade data was corrected using Heckman's two-step method. The study found a trade-taxing extortion effect of corruption prevailing in the exporting country that suggests that the higher level of corruption is associated with reduced agricultural exports. However, the trade-taxing extortion effect was insignificant for the corruption in the importing country. After correcting for endogeneity, the study found that the level of corruption in both the exporting and importing country will have a significant and negative impact on the volume of agricultural exports. Also, the negative and significant coefficient for the interaction term between the tariff structure and the level of corruption suggest that corruption can be trade enhancing in the presence of complex tariff structures. Therefore, according to the findings of this paper, corruption can be trade-taxing when the protection level is low, but with the degree of protection higher than a threshold level, it becomes trade-enhancing. The results were robust for different measures of corruption.

For trade and institutional reforms, these results have quite important policy implications. The presence of protectionist trade policies provides bureaucrats with the opportunity to extract bribes. It also increases the incentive for foreign firms to evade tariffs by offering bribes to the customs officials. In such situations, the most effective policy to stimulate trade is to liberalize international trade. Otherwise, the attempts to reduce corruption might have an adverse effect on international trade. Trade liberalization has the potential to alleviate corruption by removing opportunities for rent-seeking activities. Moreover, the government can adopt trade facilitation reforms to reduce the volume and impact of red tape and to enhance the transparency of the system. By applying modern techniques and technologies, trade facilitation measures help lessen the probability of direct interaction between the traders and the customs officials, thereby deterring corrupt activities. Unlike tariff elimination that results in the loss of tariff revenues, embracing trade facilitation measures are rewarding for all the trading partners. Similarly, an improvement of the governance structure, an increase in the quality of human capital, or increased freedom of the press, among other actions that have the potential to dissuade corruption can be trade-enhancing.

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