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Corruption in Paraguay: Investigating Tariff Evasion

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Abstract: Customs duties compose a significant source of fiscal revenue for Paraguay. This thesis empirically investigates the relationship between tariff evasion and the tariff rate in Paraguay by employing panel data covering the years 1991 to 2010. Mirror statistics on reported exports by the United States and reported imports by Paraguay constitute the proxy for evasion. The main findings include that a one-percentage point increase in the tariff rate on average is associated with an increase in evasion of 1.7 percent. Specifically, evasion is carried out through underreporting of total values, underreporting of quantities and by deliberate misclassification of a higher taxed product as a lower taxed similar product. Finally, the results suggest that the situation with tariff evasion in Paraguay is at least as severe today as in the early 90s.

Keywords: Tariff evasion, Corruption, Paraguay, International Economics, Mercosur

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Introduction

Import tariffs often make up an important part of total tax revenue in low- and middle–income countries with shares ranging between 18 to 22 percent, which stands in stark contrast to the same share for high-income countries, around 2.5 percent (Jean and Mitaritonna, 2010). Therefore it is problematic that the collected rate (the ratio of de facto collected tariffs and import value) in low- and middle-income countries frequently only amount to 50 percent.[1] Thus, evasion of custom duties is a serious fiscal matter for many countries. Furthermore, as Javorcik and Narciso (2008) points out, there are other downsides to trade tax evasion apart from loss of revenue for the state. It may adversely give corrupt and well-connected firms an advantage over honest and tax paying companies as well as it might paint the country in a bad light, suggesting that potential foreign investments could be lost.

This paper aims to investigate trade tax evasion and its responsiveness to the tariff rate in Paraguay by using data on tariff rates in Paraguay and bilateral trade flows between the United States (U.S.) and Paraguay. Following the approach in Fisman and Wei (2004), the gap between reported exports by the partner country (the U.S.) and reported imports by the source country (Paraguay), also mirror statistics, will be used as a proxy for evasion in an econometric specification described in detail below. Data coverage spans from the foundation of Mercosur, a Regional Trade Agreement (RTA) established in 1991, to 2010. During this time the tariff rate in Paraguay has been adjusted both upwards and downwards, but on average there has been a decline from the higher levels in 1991 to subsequently lower levels. The method proposed by Fisman and Wei also make it possible to distinguish between tax evasion through under-invoicing in values and quantities and to determine if products are being deliberately classified as similar goods with lower tariffs. Panel data allows for the inclusion of controls for unobserved effects and thus more precise estimates compared to cross-sectional studies such as Fisman and Wei (2004). Furthermore, this paper is also an attempt to shed light on the development of

[1] Brenton et al (2007) find average collected rates ranging from 70 percent to below 50 percent in a sample of African countries. See Pritchett and Sethi (1994) for a more nuanced description of tariff revenue and collected rates.

evasion in Paraguay over the years studied and will infer some economic implications of such corruptive behavior.

According to the Corruption Perception Index (CPI) compiled by Transparency International, Paraguay gets a score of 2.2 in 2010, indicating widespread corruption and making the country likely to be engaging in customs fraud. Paraguay also lends itself to this type of study since taxes on international trade compose a significant part of total tax revenue, 12.1 percent in 2008 (IMF, 2010). Thus, examining Paraguay's possible problem with tariff evasion and its prevalence is of importance. To my knowledge this is the first paper to explicitly do so.

The thesis is structured as follows: section I provides a brief background on the political developments in Paraguay and tariff related consequences of the foundation of Mercosur. Section II describes the related theoretical and empirical literature of tax and tariff evasion. In section III a theoretical framework is presented and section IV presents the compilation of the dataset and discuss potential weaknesses. The econometric model is then outlined in section V and followed by descriptive statistics in section VI. Section VII present results from, and analysis of, the regressions and section VIII concludes.

I. Background: Political developments and the foundation of Mercosur

Since the mid 19th century, there has been ongoing political rivalry between conservatives and liberals in Paraguay. The Colorado party, which represents the conservative side, was in power during the late 19th century, but was overthrown and replaced by the liberals in the beginning of the 20th century through the revolution of 1904. Up until the end of World War II, political instability and shifts in political power characterized the country. In 1947, a civil war broke out between liberals and left-wing groups on the one side and conservatives on the other. In 1954, Alfredo Stroessner took power by way of a coup de main and was elected president (as the only running candidate) for the Colorado party. The rule of the Colorado Party last no less than 61 years, and ends when former

bishop Fernando Lugo is elected president in 2008 representing the newly formed Patriotic Alliance for Change, an alliance including center and left wing parties.

During the rule of the Colorado party, with de facto power held by dictator Stroessner until 1988, Paraguay was plagued with murders, torture, and imprisonment of political dissidents carried out by the armed forces. Stroessner was finally removed from office through a coup, and was replaced by commander in chief Andrés Rodríguez in 1989. As promised, Rodríguez stepped down from power in 1993 to leave room for a civil candidate.

Since the 1990s, Paraguay, although no longer ruled with a rod of iron by a dictator, has suffered from political instability, severe corruption, failed attempts of military coups, and political murders (notably the assassination of vice president Luis Maria Argaña in 1999). After the dictatorship the country undertook some economic reforms such as the abolition of the fixed exchange rate, privatization of state owned companies, and trade liberalization. Paraguay's average tariff line on imports in 1986 was 20 percent, a decade later it amounted to about 9 percent (Olarreaga and Soloaga, 1998).

An integration process with the neighboring countries Argentina, Brazil and Uruguay was initiated in 1991 through the agreement on a common market and customs union named Mercosur (Mercado Común del Sur). Common external tariffs (CET) were negotiated and approved on all products in 1994, but were only implemented on 75 percent of all tariff lines in 1995 (Olarreaga and Soloaga, 1998). Other barriers to trade, such as quantity restrictions (QRs) and administrative policies, were removed between 1993 and 1995 (IMF, 1998). The RTA also set as a goal to eliminate internal tariffs (tariffs on goods traded between member countries) by the year 2000. The average of the CET was set to 11.15 percent, which implied a slight adjustment upwards of Paraguayan tariff lines in 1995. Furthermore, Paraguay was allowed deviations from the CET, and these totaled 23 percent of tariffs in 1996 (Olarreaga and Soloaga, 1998). A full implementation of the agreed upon border taxes was to take place in 2006, but has been postponed and Paraguay is still allowed to deviate from the CET in

about 23 percent of the tariffs (WTO, 2011). Moreover, Paraguay has used the trade policy space provided by a large discrepancy between bound and applied tariff rates to alter its tariff rates significantly during the years studied in this paper.[2] [3] Apart from nationally allowed deviations, the Mercosur member countries have also jointly agreed to alter the CET on many other goods, for instance in 2009 on diary, textiles, and bags, to name a few (USTR, 2011).

II. Literature review

The responsiveness of tax evasion to the tax level has attracted vast academic attention during the past decades. However, the theoretical literature provides no clear-cut answer on the effect of taxes on evasion. In their seminal work, Allingham and Sandmo (1972) modeled a decision problem of a taxpayer: whether to declare the full amount of income or just part of it. They show how the sign of the evasion elasticity depends on the assumptions regarding the agents risk willingness and the level of punishment associated with evasion. Since then, the Allingham-Sandmo model (A-S model) has gone through many suggested extensions and improvements by other authors, but in a review of the literature on tax evasion Slemrod and Yitzhaki (2000) establish that the predicted outcomes of previous literature crucially rely on the modeling assumptions.

Tax evasion is difficult to observe, and this has made also empirical estimations difficult. However, in an early contribution, Bhagwati (1964) suggested an area where tax evasion was clearly observable and measurable, namely in customs records. Bhagwati shows how import statistics in Turkey customs largely fall short of reported exports to Turkey as recorded by a number of its trade partners. This fact the author attributes to deliberate under-invoicing of the price or quantity of a product as a means for an importer to reduce her tax burden.

[2] The bound rate is the rate a WTO member country has committed not to exceed, whereas the applied rate is what is actually levied on imports in terms of tariffs. The wedge between the two is often referred to as the tariff overhang. (World Bank, 2009),
[3] The tariff overhang amounted to 21 percent in 2009 (World Bank, 2009).

Following Bhagwati, Fisman and Wei (2004) took the research one step further in their work on reported trade flows between China and Hong Kong. In an econometric setting the authors used Chinese tax rates to explain the variation in evasion (proxied by the discrepancy between reported exports by Hong Kong and reported imports by China) for a set of specific products. They provide evidence that a one-percentage point increase in the tax rate induces a three-percentage point increase in evasion. Moreover, evidence is also found in favor of a hypothesis proposed by Bhagwati (1964), namely that evasion not only takes place through underreporting, but also by mislabeling a higher tax product as lower taxed one.

A few studies have since then been conducted employing a similar method as the one in Fisman and Wei's paper. Levin and Widell (2007) compare trade tax evasion in Kenya and Tanzania and find evasion to be greater in Tanzania than in Kenya. Bouët and Roy (2008) find statistically significant results for evasion in Kenya, Mauritius, and Nigeria and conclude that trade reform possibly could lead to higher tax revenues. Van Dunem and Arndt (2009) report that a one-percentage point increase in tariffs correspond to an increase in evasion by 1.4 percent for Mozambique, about half the response compared to Fisman and Wei's results for China. Studying ten East European transition countries and their trade with Germany, Javorcik and Narciso (2008) provide evidence that evasion is easier and therefore more severe among differentiated products. Mishra et al (2008) in a similar manner find support for their hypothesis that higher enforcement in customs will reduce the responsiveness of evasion to tariffs in a study on India. Jean and Mitaritonna (2010) look for underlying institutional determinants of evasion when employing data on a larger set of countries. Findings include evasion to be more common among low-income countries, which are associated with weaker institutions, specifically a lower degree of rule of law.

III. Theoretical model

There are as mentioned in the previous section numerous theoretical models following the A-S model that deal with the decision problem faced by an agent on how much of her income to declare. Depending on the model, the agent takes into account different sets of costs of tax evasion, then decides on whether to declare all income or just a portion of it. Tax evasion models have also been translated into the similar setting of tariff evasion. Mishra et al (2008) construct one such model based on earlier models of the income declaration type, another more extensive model is offered in Jean and Mitaritonna (2010). In this thesis I will adopt the former model proposed in Mishra et al (2008). It should be noted that this section largely draws on their contribution since I make no additional assumptions or extensions to their set-up, but the model fits well as a motivation for what is later investigated in the econometric part of the paper.

The starting point in the model is an agent that is to decide whether to pay the full tariff charge or evade it by some fraction θ, where $0 < \theta < 1$. Furthermore, whether or not an agent is caught by customs depends on, to borrow a term from Jean and Mitaritonna (2010), the "ease of enforcement" by customs, and is denoted by ω. The cost function of evasion is then modeled as

$$C = C(\theta, \omega), \quad \text{where } \omega \in (0, \infty) \tag{1.1}$$

It is also assumed that evasion is associated with a positive cost, that is, $C = C(\theta, \omega) > 0$. The cost function above will further be given some characteristics. Firstly,

$$\frac{\partial C}{\partial \theta} > 0 \tag{1.2}$$

implying that the larger fraction of goods the agent doesn't pay tariffs for, the higher are the costs. Secondly

$$\frac{\partial C}{\partial \omega} > 0 \tag{1.3}$$

i.e. the easier it is for customs to detect evasion, the higher are the costs. Furthermore,

$$\frac{\partial^2 C}{\partial \theta^2} > 0 \tag{1.4}$$

in words this implies that every additional unit costs more to get passed customs the larger the initial fraction is. Also,

$$\frac{\partial^2 C}{\partial \theta \partial \omega} > 0 \tag{1.5}$$

which states that each additional unit costs more to get passed customs as detection becomes easier. Given the cost function, the representative firm wants to maximize its profits,

$$\Pi = M - (1 - \theta)MT - C(\theta, \omega) \tag{1.6}$$

where T represents tariffs and M is the inelastically imported amount of goods. The company then chooses the θ that maximizes its profits. The first order condition (FOC) of equation (1.6) with respect to (w.r.t.) the fraction smuggled is

$$\frac{\partial \Pi}{\partial \theta} = MT - C_1(\theta, \omega) = 0 \tag{1.7}$$

This simply states that the company should smuggle additional goods until it is not worth it any longer in terms of the costs associated; specifically, until marginal cost and benefit equates. Given that firms are assumed to behave optimally, the model then turns to investigating the responsiveness of evasion to tariffs. Taking the derivative of equation (1.7) w.r.t. tariffs, and noticing that equation (1.7) implicitly defines evasion as a function of ease of enforcement and tariffs , $\theta = f(\omega, T)$, this yields

$$\frac{\partial \theta}{\partial T} = f_2(\omega, T) = \frac{M}{C_{11}(f(\omega, T), \omega)} \tag{1.8}$$

From equation (1.4) $\frac{\partial^2 C}{\partial \theta^2} > 0$, so we can conclude that $\frac{\partial \theta}{\partial T} > 0$. That is, the importing firm chooses a larger fraction to smuggle the higher the tariffs are, which is also the core assumption that will be taken to the data below. Furthermore, the theoretical framework can also make predictions on the responsiveness of evasion w.r.t. ease of enforcement. Again, taking the derivative of equation (1.7), but now instead w.r.t. ω, we have

$$\frac{\partial \theta}{\partial \omega} = f_1(\omega, T) = -\frac{C_{12}(f(\omega, T), \omega)}{C_{11}(f(\omega, T), \omega)} \tag{1.9}$$

Noting that $\frac{\partial^2 C}{\partial \theta \partial \omega} > 0$ from equation (1.5) and that $\frac{\partial^2 C}{\partial \theta^2} > 0$ from equation (1.4), this implies that $\frac{\partial \theta}{\partial \omega} < 0$. In words, the fraction smuggled is expected to decrease when detection is more likely. Lastly, Mishra et al looks at what happens to the responsiveness of evasion w.r.t. tariffs when ease of enforcement is altered. Taking the derivative of equation (1.8) w.r.t. ease of enforcement one finds that

$$\frac{\partial^2 \theta}{\partial \omega \partial T} = f_{21}(\omega, T) = -\frac{M}{(C_{11}(f(\omega, T), \omega))^2} \times \frac{\partial C_{11}(f(\omega, T), \omega)}{\partial \theta} \tag{1.10}$$

An assumption is needed here, namely that $\frac{\partial C_{11}(f(\omega,T),\omega)}{\partial \theta} > 0$. This implies that if customs workers have an easier time catching smugglers for some reason, smugglers will find that the marginal cost of smuggling, i.e. the cost of each additional good, is increasing faster the larger the fraction is. We know from (1.4) that $C_{11}(f(\omega, T), \omega) > 0$. Together, this leads to the prediction that $\frac{\partial^2 \theta}{\partial \omega \partial T} < 0$, meaning that raising the tariff has a lower effect on smuggling the easier it is to detect smuggling (the better custom enforcement is).

Mishra et al (2008) show that for reasonable choices of functional forms for the cost function, the predictions regarding the responsiveness of evasion to tariffs and ease of enforcement will hold. The model, and specifically the cost function, have an admittedly simple construction and could be extended to take into

account for instance the potential punishment for evasion.[4] However, its simplicity serves the purpose here in that it boils down to two testable predictions that will be investigated in the empirical section: the responsiveness of evasion to tariffs, and as an extension, the responsiveness of evasion to the ease of enforcement.

IV. Data

In order to carry out the econometric estimations below, data has been gathered on Paraguayan tariffs, and trade flows between the U.S. and Paraguay, covering the years 1991 to 2010. The U.S. is a reasonable choice of trade partner since the country throughout the sample period represents one of the largest sources of imports to Paraguay among the countries outside of Mercosur. In 2010, the U.S. accounted for 17.4 percent of total imports to Paraguay (EC, 2011). Furthermore, as a country outside the RTA, the U.S. is subject to Most Favored Nation (MFN) duties, which contain fewer exceptions compared to the internal Mercosur rates. Ideally, one would want to utilize data on all Paraguayan external trade partners to take into account possible incentives for a customs official to deliberately classify a product as imported from the U.S. when it in reality originates from some other third country, but the extent of such data handling lies outside the scope of this paper. However, because external countries are subject to MFN rates due to Paraguay being a member of the World Trade Organization (WTO), it is less likely that the choice of trade partner would be the source of any bias.

Tariff data has been extracted from the World Integrated Trade Solutions (WITS) database, managed by the UN and UNCTAD. Tariff data for Paraguay is available from 1991 to 2010.[5] The tariff data is measured at the 6-digit Harmonized System (HS) level according to the 1988/1992 classification and include applied

[4] A shorter elaboration on the possible effects of different kinds of punishment on the evasion elasticity will be given in section VII below.

[5] It should be noted that there is a gap in the data in 1992-1993. Following Javorcik and Narciso (2008) I will keep the tariff rate from 1991 constant over these years in the regression analysis. Excluding these years in the baseline regression leads to very similar estimates; results available in the appendix.

MFN ad valorem tariffs.[6] As mentioned in section I, the applied tariff rates in Paraguay have varied significantly over the years in the sample, partly due to a general trade liberalization process, and partly because of the vast number of allowed exceptions from the CET. Paraguay is still allowed to deviate from the CET on more than 2600 products until December 31, 2011 (USTR, 2011), which can be compared to the 2016 unique products this sample contains at the HS 6 digit level. Data on imports as recorded by the Paraguay authorities, and exports as recorded by the U.S., in value and in quantity, are sourced from the UN Comtrade database. Coverage spans continuously from 1991 to 2010 and is also reported at the 6-digit HS 1988/1992 level. Together the data constitute a panel, allowing for the inclusion of fixed effects, which are discussed in more detail in the following section.

Regarding the tariff data, WITS only provide very limited data on Ad Valorem Equivalents (AVEs).[7] However, non-ad valorem tariffs haven't appeared in Paraguayan tariff lines since the formation of Mercosur (WTO, 2005 and 2011). Furthermore, one could argue (as in Fisman and Wei (2004)) that a corrupt importer evading tariffs through underinvoicing also is likely not to pay the Value Added Tax (VAT) on that good. Some of the papers employing the same methodology as in Fisman and Wei (2004) have therefore constructed an aggregate measure of tariff plus VAT as the explanatory variable (e.g. Levin and Widell (2007)), while others have restricted their study to the tariff rate (e.g. Javorcik and Narciso (2008), Mishra et al (2008)). Although I lack detailed data on the product level for VAT rates, I will attempt to control for the possible distorted incentives this could imply for a fraudulent importer by dropping a couple of HS categories in the empirical section where the VAT is different from the otherwise flat 10 percent charge. Apart from VAT, excise duties are also in some instances charged on goods, and the same argument as above can be applied to these. Accordingly, I will exclude some further broad HS categories where such taxes have been levied.[8] Investigating if the results change when

[6] Ad Valorem is a simple percentage rate applied on the value of the imported good.
[7] AVEs are calculated when tariffs are not expressed in ad valorem terms. This is for instance the case for a specific tariff, which is a fixed amount applied on the imported good, or compound tariffs which are a mix of specific and ad valorem tariffs.
[8] The VAT rates and the excise tax are based on figures from IMF (2010).

restricting the sample in this way is also an attempt to overcome a potential omitted variable bias, which could be the case if the VAT or excise tax are also correlated with the tariff rate. For instance, this could be the case if a state tries to compensate for a loss in tax revenue due to trade liberalization by raising its VAT rate.[9] Further details of the regression analysis from these procedures are found in section VII.

An additional concern about the exogeneity of the tariff rate need also be addressed. Product characteristics are certainly likely to make evasion easier (harder) for some products, e.g. whether the good is homogenous or differentiated in nature. Hence, if the Mercosur countries in setting the CET (or Paraguay when using its allowed exceptions from the CET) recognized that evasion of tariffs is easier for some goods than others, they might have set certain tariff rates so as to minimize the loss in tariff revenue, that is, lower tariff rates for evasion-prone products, as pointed out by Fisman and Wei (2004) in the context of China. If so, the results of the responsiveness of evasion to the tariff could be underestimated. To try to overcome these concerns, the econometric model to be estimated will include product fixed effects at the HS 6-digit level to control for unobservable product characteristics that could affect evasion and also be correlated with the tariff rate (and that would otherwise be hidden in the error term). Also, it is reasonable to suspect that there are time-variant factors that play a part in explaining evasion, for instance the salary paid to customs workers; a raise in salary could lead to larger incentives for the customs worker to disclose evasion. For this reason, year fixed effects are also applied in the model. In sum, exploiting variation over time and the inclusion of fixed effects will work in favor of measuring unbiased, more precise estimates of the responsiveness of the trade gap to tariffs.

Regarding the trade gap, it is as mentioned to be considered a proxy for evasion. However, there are reasons apart from evasion why a discrepancy in reported trade flows might be observed. For one, reported export values are in most cases expressed in free on board (f.o.b.) terms while, reported imports include costs of

[9] A similar line of reasoning is applicable to QRs, as noted my Mishra et al (2008). However, as noted in section II above, QRs were abolished in connection with the founding of Mercosur. There could of course be exceptions to this rule, but unfortunately I have no data on the matter.

insurance and freight (c.i.f.). It is also commonly assumed that imports tend to be more closely monitored than exports because of import duties. Thus, assuming no evasion, recorded imports exceeding recorded exports in the data is a reasonable expectation. Other problems, brought up by for instance Yeats (1995), include that trade statistics might be reported in different currencies, making the exchange rate conversion to U.S. dollars (the reported currency in the UN Comtrade database) a possible problem. Furthermore, if there are long transit periods, trade could be recorded in different time periods. There is also the possibility of customs officials unintentionally misclassifying products in different ways. Lastly, the presence of export subsidies (e.g. the Export Enhanced Program in the U.S.) or taxes could be an incentive for an over- or under – statement of exports.

In light of the above, it is apparent that the trade gap is an imperfect measure of evasion, i.e. it is measured with error. However, as long as these errors are not correlated with the independent variable, the estimates will be consistent and unbiased. This means that for instance the f.o.b. – c.i.f. discrepancy, the possible problems of time lag, overstated exports, or currency conversion are not to be correlated with the Paraguayan tariff rate, which is a reasonable assumption. The measurement errors will however imply less precise estimates, often referred to as there being random "noise" in the data.

V. Econometric model

As mentioned in the previous section, the trade gap constitutes the proxy for evasion. The definition of evasion in values follows from that outlined in the study by Fisman and Wei (2004). It is defined as

$$Value\_Gap_{pt} = \log(X_{pt}) - \log(IM_{pt}) \qquad (2.1)$$

where X represents the value of exports of product p as recorded by the U.S. at year t and IM are the reported imports of the same product in the same time period by Paraguayan customs. Evasion in quantities is defined as in equation

(2.1), only imports and exports are measured in quantities; this will be referred to as the quantity gap in what follows.

The baseline model that will be used to investigate the relationship between the trade gap and tariffs takes the form

$$Value\_Gap_{pt} = \beta_0 + \beta_1 * T_{pt} + \alpha_t + \gamma_p + \varepsilon_{pt} \quad (2.2)$$

where α_t represents year fixed effects to control for possible changes in e.g. customs enforcement or technological improvements. Product fixed effects, γ_p, are included at the HS 6 digit product level to control for characteristics particular to a specific product that might affect evasion. Again, controlling for the fixed effects is intended to isolate the effect of the tariff rate on evasion, also referred to as the evasion elasticity below.[10] The estimates are thus not affected by variation across product groups, only within. T_{pt} is the tariff rate for product p in year t. The standard error component ε_{pt} is clustered at the 6 digit product level since the error terms might be correlated over time, i.e. serial correlation, due to some products being more likely to be evaded than others. The coefficient of interest in this specification is β_1 which indicate the responsiveness of evasion w.r.t tariffs. The prediction from the theoretical section is that $\beta_1 > 0$, in words; an increase in the tariff is predicted to induce an increase in evasion (a widening of the trade gap).

Extensions of the baseline model

Underinvoicing isn't the only way to evade tariffs. As mentioned above, evasion may also take the form of deliberate misclassification of a higher taxed product as a lower taxed one. In order to investigate whether this is present in the data, the additional regressor Avg_T_{pt} is added and the following variation to the basic set up specified in the previous sub-section will be estimated

$$Value\_Gap_{pt} = \beta_0 + \beta_1 * T_{pt} + \beta_2 * Avg\_T_{pt} + \alpha_t + \gamma_p + \varepsilon_{pt} \quad (2.3)$$

[10] To be precise, this is a semi-elasticity since the left hand side is in log form and the right hand side is in levels, as pointed out by Mishra et al (2008).

The added regressor Avg_T_{pt} was proposed in Fisman and Wei (2004) and refers to the average tariff on products within the same 4-digit HS level. The reasoning behind this specification is that the incentive for misclassification is greater the lower the average tariff is on goods similar to good p (the ones within the same 4 digit HS category). Hence, if mislabeling is present in the data, β_2 is expected to be negative. In other words, while keeping the tariff on product p constant, a lower value for Avg_T_{pt} will lead to more evasion.

Lastly it will be tested if the ease of enforcement correlates negatively with evasion. To measure ease of enforcement, I will adopt a proxy suggested by Mishra et al (2008), namely whether the good is to be considered homogenous or differentiated, following the classification by Rauch (1999).[11][12] Differentiated goods are expected to lend themselves more easily to underreporting since their prices are less commonly known in contrast to a typical homogenous good, such as metals, which are traded in stock markets and carry well known prices. To put this reasoning in the context of customs, a corrupt Paraguayan customs official in cahoots with some importer will more likely get away with underreporting a differentiated good. The ease of enforcement is thus expected to be greater for homogenous goods, leading to the following specification

$$Value\_Gap_{pt} = \beta_0 + \beta_1 * T_{pt} + \beta_2 * D_p * T_{pt} + \alpha_t + \gamma_p + \varepsilon_{pt} \qquad (2.4)$$

where D_p is a dummy variable taking on the value 1 if the good is classified as non-differentiated. The assumption is that the coefficient on the interaction term will be negative since the tariff rate is assumed to have a greater effect on evasion among differentiated products (where enforcement is more difficult). Year and product fixed effects are included as in earlier specifications.

[11] Rauch's classification is based on the Standard International Trade Classification (SITC). I use correlation tables from the UN Statistics Division to make them comparable to the HS 1988/1992 classification I employ.

[12] Rauch makes two classifications of goods, one that he labels conservative, and one liberal. I follow for instance Jean and Mitaritonna (2010) in employing the former, stricter definition of a homogenous good in the main specification. However, since the results, as noted below, are somewhat sensitive to which classification is used, the estimates from the liberal classification are included in the appendix for reference.

VI. Descriptive statistics

Before looking at the summary statistics over the variables used in the regression analysis, Table 1 below describes in what HS categories most import value and the largest trade gaps are found. Over the full sample, HS code 84 (see Table 1 for definitions) represent the largest category in terms of total imports; almost 7 billion USD. The largest discrepancy in reported trade flows, i.e. the trade gap, is found in the same HS category and amounts to about 5.5 Billion USD, a substantial sum of non-reported import value on the Paraguayan side. Second in magnitude, in both total imports and trade gap, is HS code 85, and these two categories are dominant in both the first and last year of the sample. Within HS category 84 one finds that the by far most imported goods are parts and accessories of computers (HS code 847330) and various types of assembled computers (HS code 847120); these two goods categories alone account for close to 2.5 and 1.4 Billion USD respectively, over the full sample. Lastly, the HS categories included in Table 1 partly reflect the general pattern of Paraguayan imports consisting to a large extent of manufactured goods.

After pairing up matching product codes for exports and imports at the HS 6 digit level the sample size amounted to 14862 observations. Not all products had corresponding tariff lines in the data, which led to further elimination of data and a final sample of 13457 observations to be used in the baseline regression, see Table 2 below. The data in quantities were of significantly worse quality with a final sample of 6992 observations.[13] A problem with the data in quantities was that units of measurement didn't always match up, e.g. kilos reported on the one side, number of units on the other. Those observations were therefore dropped. Due to the poorer quality in the quantity data, and therefore less reliable estimates, the analysis in the next section will for the most part be centered on evasion in values.

[13] Programming code used to arrive at the final sample, and extensions, is available upon request.

Table 1: Most imported goods and largest trade gaps (in 1000 USD)

Full sample		1991		2010	
HS code	Imports	HS code	Imports	HS code	Imports
84	6 974 336	84	84 656	85	541 907
85	3 759 076	85	55 280	84	521 373
95	963 388	24	54 197	95	235 980
90	604 459	88	13 218	27	64 964
24	427 401	90	11 110	33	59 887
HS code	Trade Gap	HS code	Trade Gap	HS code	Trade Gap
84	5 521 003	84	32 320	85	506 601
85	2 716 246	88	12 367	84	430 519
95	880 593	24	8 218	95	224 080
90	349 538	73	7 604	27	41 213
33	116 234	95	4 518	33	17 490

HS code	Description
24	Tobacco and manufactured substitutes
27	Mineral fuels, oils, waxes and bituminous substitutes
33	Oils and resinoids, perfumery, cosmetic or toilet preparations
73	Articles of iron or steel
84	Nuclear reactors, boilers, machinery and mechanical appliances, computers
85	Electrical machinery, sound and television recorders and telecommunication equipment
88	Aircraft, spacecraft; parts thereof
90	Optical, photographic, cinematographic, measuring, checking, precision and medical or surgical instruments; parts thereof
95	Toys, games and sports equipment; parts thereof

Note: The trade gap is measured as (US recorded exports to Paraguay) - (Paraguayan recorded imports from the US) in values. Data in the upper part of the table on imports are based on US recorded exports. Category descriptions are abridged in some case, see harmonizedsystem.com for exact definitions.

Missing data on the export side could be the result of human error in the U.S. customs. It could also be the result of a misclassification of indirect imports from a third country as direct imports from the U.S. on the Paraguayan side. Imports from the U.S. are subject to MFN tariffs, as mentioned above I therefore make the assumption that incentives to deliberately misclassify an indirect import from any other country as one directly imported from the U.S. are low. Thus, such misclassifications are most likely due to the inability of Paraguayan customs to

distinguish between indirect and direct imports in some cases.[14] Missing data on the import side could of course also be a result of human error, but could possibly also be an indication that these goods never went through customs but were completely smuggled.

Table 2: Summary statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Log(export value)	13457	10.80	1.87	7.83	19.30
Log(import value)	13457	10.26	2.14	0	17.79
Value Gap	13457	0.54	2.12	-6.72	13.66
Log(export quantity)	7783	7.62	2.91	0	21.68
Log(import quantity)	7783	7.26	3.06	0	22.08
Quantity Gap	6992	0.26	2.50	-11.65	16.12
Tariff	13437	11.80	7.81	0	72
Average tariff	13456	11.95	7.01	0	72

Note: Dependent variable measured as log(exports from the US to Paraguay) - log(imports from the US to Paraguay). Summary statistics are for the matched data, that is, when observations were present on both sides.

Table 3 provides a first indication of how the gap value is related to tariffs and thus also the appropriateness of using the trade gap as the proxy for evasion. Here, the sample has been split along the median tariff with the above section presenting figures for the value gap below the median and the lower part displaying gaps above the median tariff. The higher mean of the value gap above the median tariff provides some informal evidence of evasion being more widespread at higher tariff levels (Column 2). A similar relationship is visible for evasion in quantities (Column 4).

[14] If this is the case, noted by Fisman and Wei (2004), what is actually observed is Imports*, which contains both direct imports and misclassified indirect imports. Assuming the misclassifications stems from human error, they makes up some proportional part q of direct imports. Thus, what is denoted as IM in the baseline regression above is strictly speaking IM*=IM +qIM.

Table 3: Mean Gaps over/under median tariff

Below median tariff			
Value Gap		Quantity Gap	
Observations	Mean	Observations	Mean
6683	0.28	3463	0.06
Above median tariff			
Value Gap		Quantity Gap	
Observations	Mean	Observations	Mean
6774	0.80	3529	0.46

Note: The median tariff in the full sample is 11.5%

Furthermore, a glance at Table 4 provides some informal evidence supporting the assumption that differentiated goods are associated with more difficult customs enforcement. The trade gap is clearly higher among the differentiated products, although the mean tariff is slightly lower among the homogenous goods. The empirical results will thus have to shed more light on whether the difference in trade gaps are driven by the tariff rate or not. Note that a little less than a thousand observations are lost compared to Table 1, this because the classification of goods by Rauch (1999) doesn't cover all HS 6 digit products.

Table 4: Trade gaps and tariffs for differentiated and homogenous goods, in values

	Mean Gap	Mean Tariff	Observations
Differentiated	0.55	0.12	11499
Homogenous	0.26	0.10	1182

Note: Figures presented are based on Rauch's (1999) conservative classification of goods.

VII. Results

Below, the results from the specifications in section V, and a couple of extensions, are presented. Firstly, the analysis will be centered on the effect of the tariff rate on evasion. The next issue to be investigated is whether there exists statistical evidence for deliberate misclassification of a product as a similar one associated with a lower tariff. Following this the focus will shift to determining what effect

the ease of enforcement has on evasion, which is done by examining if evasion is more prevalent among differentiated products than homogenous products.

Table 5a: Effect of tariffs on evasion

	(1)	(2)	(3)	(4)
	Dependent variable Value Gap			
Tariff	3.07***	3.70***	1.14**	1.72***
	(0.42)	(0.45)	(0.47)	(0.53)
Observations	13437	13437	13437	13437
Adjusted R-squared	0.0129	0.0293	0.3821	0.3946
	Dependent variable Quantity Gap			
Tariff	2.22***	2.72***	2.56**	2.65**
	(0.59)	(0.61)	(1.11)	(1.24)
Observations	6986	6986	6986	6986
Adjusted R-squared	0.0044	0.0118	0.3897	0.3937
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at the HS 6 digit product level in parenthesis. All regressions include a constant. Dependent variable measured as log(exports from the US to Paraguay) - log(imports from the US to Paraguay). Value Gap refers to evasion in values and Quantity Gap to evasion in quantities. ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Table 5a reports the estimated results for equation (2.2). The coefficient on the tariff term is positive and statistically significant in all specifications. This holds also for evasion measured in quantities. The estimates in column 1 reports the results for the baseline regression, not controlling for product or year fixed effects, and are included for comparative purposes. In column 2, year fixed effects are added with the intention of eliminating unobserved time-variant factors, other than tariffs, that might affect evasion, such as general improvements in customs due to, for example, increased funding from the government. Including the year fixed effects increases the magnitude on the tariff coefficient some, from about 3.1 to 3.7, but not much explanatory power is added according to the R-squared measures.

In column 3, product fixed effects are included which reduce the impact of tariffs on evasion in values quite substantially, from about 3.1 (column 1) to 1.1. Including these fixed effects serves the purpose of controlling for unobserved product characteristics that are of importance to evasion. In other words, the product fixed effects absorbs the unique effect of each product on evasion. The dampened coefficient on the tariff term, when unobserved product characteristics are controlled for, indicates that there is some correlation between tariffs and these characteristics that affects evasion.

In column 4, both year and product fixed effects are included. Since controlling for the fixed effects clearly affects the estimates, this will, similarly to Mishra et al (2008), be deemed the soundest specification to draw conclusions from. That is, on average, a one-percentage point increase in tariffs roughly causes a 1.7 percent increase in evasion of custom duties. This confirms the prediction of equation (1.8) in the theoretical model and also the indications of Table 3 above. Contrasting this result to other studies of tariff evasion is somewhat delicate in the sense that the empirical specifications and sample techniques used differ across the different studies. Mishra et al (2008) employ as mentioned both product and year fixed effects to panel data covering multiple years of trade flows to India, a specification close enough to be compared to this study. They estimate an elasticity of evasion of approximately 0.1, thus 17 times smaller than the one found here for Paraguay. This could be perceived as a big discrepancy, but is clearly reflecting the notorious problem of corruption in Paraguay.[15] The study on China by Fisman and Wei (2004) finds an estimate of about 3, although employing a cross-sectional method, and not controlling for product fixed effects.

As mentioned in section IV, I will also run the core model regressions while dropping a few HS 2-digit categories where VAT rates are reduced or exempt and excise duties are charged. These are HS chapters 1-24 (agricultural products, exempt from VAT), HS 30 (pharmaceutical goods, reduced VAT of 5 percent). Regarding excise duties, I exclude HS 33 (make-up and perfumes), HS 71 (pearls, stones and precious metals), HS 91 (clocks and watches) and HS 93 (weapons and ammunition). Excise tax is also charged on HS code 22 (alcohol and fuel) and

[15] On the recent history of corruption in Paraguay, see for instance Franks et al (2005).

HS 24 (tobacco), but these are already considered among the agricultural products. The results from these regressions are closely related to the ones in Table 5a and are presented below in Table 5b.[16] [17]

Table 5b: Effect of tariffs on evasion, HS adjusted for VAT and excise tax

	(1)	(2)	(3)	(4)
	Dependent variable Value Gap			
Tariff	2.87***	3.46***	1.15**	1.71***
	(0.47)	(0.50)	(0.56)	(0.62)
Observations	11686	11686	11686	11686
Adjusted R-squared	0.0105	0.0259	0.3738	0.3861
	Dependent variable Quantity Gap			
Tariff	2.34***	3.01***	2.36*	2.41*
	(0.65)	(0.67)	(1.41)	(1.61)
Observations	5911	5911	5911	5911
Adjusted R-squared	0.0048	0.0158	0.3769	0.3825
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. All regressions include a constant. ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Lastly, the R-squared values in column 1 of Tables 5a and 5b are indications of a rather poor fit of the model, in other words, the variation in the tariff rate explains only a small portion of the variation in the trade gap. The increase in R-squared in columns 3 and 4 stems from the inclusion of product fixed effects, it is not due to an increase in the explanatory power of the tariff rate. Therefore it is important to point out that the aim here isn't to try to explain the total size of the gap in the trade statistics, but to investigate how the gap correlates with the

[16] Also note that Fisman and Wei, who construct their tax variable by adding up tariff plus VAT for each product, find their results being close to identical when they, in a robustness check, estimate the evasion elasticity using solely the tariff rate as an explanatory variable (Fisman and Wei, 2004, pp. 7). This further indicates that the method of using only the tariff rate as the independent variable is a reliable one.

[17] As a further sensitivity check briefly mentioned above, I re-run the core model regressions excluding the years 1992-1993. During these years, the tariff rate in the main specification in Table 5 is manually kept constant until a new tariff line appears in the data (for a maximum of two years) as in Javorcik and Narciso (2008). The magnitudes and standard errors slightly increase; on a whole the estimates are however similar to those in Table 5. Results in the appendix.

tariff rate. Nonetheless, the trade data clearly suffers from noise for various reasons previously brought up in section IV. In order to partly overcome the problem with noise, I follow Fisman and Wei (2004) by aggregating the data.

Table 6: Effect of tariffs on evasion, aggregated trade gap data

	Dependent variable	
	Value Gap	Quantity Gap
Tariff	3.07***	2.22***
	(.62)	(.64)
Observations	475	384
R-squared	0.1802	0.0532

Note: Regressions include a constant, robust standard errors in parenthesis. Dependent variable measured as Mean[log(X_{pt}) - log(IM_{pt})] per unique tax rate.

Table 6 provides results from running the baseline regression when the dependent variable is measured as the mean of the trade gap per tariff rate. There are 475 unique tariff rates in the sample, producing 475 observations in values and somewhat fewer in quantities. The regressions are then weighted by the number of observations per tariff rate. The goodness-of-fit of the model, indicated by R-squared, increase from about .01 to .18 when the dependent variable is measured in values, and from .005 to .05 when quantities are considered. At two decimal points, the coefficients on the tariff rate are identical to those in Table 5. This operation appears to successfully reduce noise in the data, indicating a tolerable fit of the model, although clearly better in values compared to quantities.

Intentional misclassification of goods

Another issue to investigate was whether there is statistical evidence supporting the claim that importers intentionally mislabel a higher taxed product as a lower taxed one. This is estimated by adding the regressor "average tax on similar products" to the baseline model and the expectation is that $\beta_2 < 0$. Thus, while keeping the tariff rate on a specific product constant, lowering the average tariff

on a similar product ("similar" when found within the same 4 digit HS category) will increase the incentives to misclassify the product. The results from equation (2.3) are presented below in Table 7.

It's evident from Table 7 that deliberate mislabeling indeed is present in the data, although not symmetrically across the board. The sign on the average tax variable has the expected negative sign in all specifications and is statistically significant at the 5 percent level in the fixed effects model of column 4. The large standard errors, compared to the results from the core model in Table 5, indicate that there might some multicollinearity between the independent variables. The variables tariff and average tariff on similar goods are correlated at 0.89. This partly explains the lower statistical significance of the coefficient on the average tariff variable in the first two columns. The results also emphasize that mislabeling and under-invoicing both are common practice.

Table 7. Deliberate mislabeling of products

	(1)	(2)	(3)	(4)
		Dependent variable Value Gap		
Tariff	4.64***	4.77***	3.41***	3.46***
	(0.98)	(0.98)	(0.93)	(0.93)
Average tariff on similar goods	-1.95*	-1.36	-3.10***	-2.64**
	(1.08)	(1.26)	(1.10)	(1.14)
Observations	13437	13437	13437	13437
Adjusted R-squared	0.0137	0.0296	0.3831	0.3952
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. All regressions include a constant. ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level. Average tariff is the average tariff rate within each 4-digit HS category.

These estimates fit well with related work, see for reference Gatti (1999) who finds that measures of corruption are positively correlated with a heterogeneous tariff structure. Hence, in light of the results, a policy implication is a further homogenization of the tariff lines in order to reduce incentives for deliberate

mislabeling. A slight narrowing of the tariff structure has been implemented over the sample period, as visible in Table 8 where the standard deviation and the mean of the tariff rate in the first and last year of the sample are displayed.

Table 8. Tariff rates and standard deviation, 1991 and 2010.

Year	Mean Tariff	Std. Dev.
1991	16.5%	9.6%
2010	10.7%	6.6%
Difference	5.9%	3%

Note: Calculations are based on the trade flows between Paraguay and the US used in this study, figures naturally differ slightly when other countries are considered.

Ease of enforcement

The second prediction from the theoretical model above was that evasion is decreasing in the ease of enforcement. Ease of enforcement, in other words how easy it is for a customs worker to unmask evasion, is proxied by whether the good is classified as being of homogenous nature or of differentiated nature according to the specification in Rauch (1999). Homogenous products are broadly defined as goods traded on organized exchanges and whose prices therefore are more likely to be common knowledge. The results from equation (2.4) are presented in Table 9.

The assumption was that the interaction term between tariffs and the dummy (taking on the value 1 if the good is classified as non-differentiated) was to have a negative coefficient. Again, this is because the underreporting of a differentiated good is assumed to be easier for a corrupt customs official to get away with since prices aren't well known. This, in turn, is assumed to lead to difficulties in revealing underinvoicing for the authorities. The sign on the interaction term has the expected negative sign in all columns. However,

significance is lost and the effect decreases considerably as product fixed effects are introduced (columns 3 and 4 of Table 9).[18]

Table 9. Ease of enforcement: homogenous and differentiated goods

	(1)	(2)	(3)	(4)
	Dependent variable Value Gap			
Tariff	3.37***	4.05***	0.98*	1.55***
	(0.44)	(0.47)	(0.51)	(0.57)
Tariff*non-differentiated dummy	-2.37***	-2.53***	-0.75	-1.65
	(0.67)	(0.68)	(1.84)	(1.90)
Observations	12661	12661	12661	12661
Adjusted R-squared	0.0162	0.0328	0.3806	0.3926
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. All regressions include a constant. Estimates based on the conservative classification of goods by Rauch (1999). ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Although the results are vague as to whether the tariff rate has a greater effect on differentiated goods, this does not necessarily imply that the theoretical framework presented earlier makes a faulty prediction regarding the effect of ease of enforcement on the evasion elasticity (Mishra et al (2008) indeed find econometric results using this proxy, verifying the predictions from their theoretical model). More plausible is that the proxy used isn't the best one in this case. There could be other unobserved product characteristics that are more important in making evasion simpler for certain goods in Paraguay, for instance the bulkiness of a good, which could be an explanation for the lost significance in columns 3 and 4.[19]

As a comparison to the results found in Javorcik and Narciso (2008), who base their conclusion regarding magnitudes on a specification including time fixed

[18] When re-running the model, but with a liberal, less strict classification on what goods are to be considered homogenous, also compiled by Rauch (1999), results are even weaker and the coefficient takes on the perverse sign in one of the specifications. See Appendix for results.
[19] Unfortunately, I have been unsuccessful in gathering data on other such characteristics of goods at a detailed enough level.

effects, the significant results in column 2 imply that a one-percentage point increase in the tariff rate leads to an effect on evasion that is about 2.5 percentage points larger for differentiated products compared to homogenous ones. Javorcik and Narciso (2008) find a 0.6 percent increase in evasion for homogenous products and a 2.1 percent increase in evasion for differentiated products in their sample of ten post-Soviet States. Note, however, that their results are also robust when they control for unobserved product characteristics, although with magnitudes shrunk.

Functional form

When interpreting the estimates in the baseline specification above (Table 5) it is assumed that the relationship between tariffs and evasion is linear. This might however not be the case. For instance, as pointed out by Fisman and Wei (2004), if the punishment for evasion is constant there could be low tariff levels when evasion is not profitable, i.e. the cost of getting caught exceeds the potential profits to be made from evading customs duties. This in turn would be cause for the elasticity of evasion to be non-linear in relation to the tariff rate. In the following I adopt a specification that will allow for the marginal effect of the tariff rate on evasion to differ across quartiles of the tariff rate. Added to the baseline model are interaction terms between the tariff rate and a dummy taking on the value 1 if the tariff rate lies within the specified quartile. The equation to be estimated looks as follows

$$Ev\_value_{pt} = \beta_0 + \beta_1(T_{pt} * Q_1) + \beta_2(T_{pt} * Q_2) + \beta_3(T_{pt} * Q_3) + \beta_3(T_{pt} * Q_4) + \alpha_t + \gamma_p + \varepsilon_{pt}$$

where Q_n is the tariff quartile dummy and n=1,…,4. The results are presented in Table 10. The point estimates suggest that evasion is the most severe above the median tariff rate associated with the third quartile dummy, and then the estimate is reduced for the goods attached to the highest tariff rates. There is also an indication that evasion is widespread even at the lowest level of tariffs, although the estimate is not significantly different from zero in the first quartile. If the punishment for evasion were constant, as suggested above, one would have

expected to see lower, perhaps even negative, estimates in Q1, which is not the case here. Perhaps a more suitable interpretation is that the punishment is somehow related to the amount evaded, but the data is ambiguous on a clear shape of the relationship between evasion and the tariff rate.

Table 10: Test for non-linear relationship between tariffs and the evasion elasticity. Dependent variable is Value Gap.

Q1*Tariff	3.35
	(3.03)
Q2*Tariff	0.76
	(1.04)
Q3*Tariff	2.83***
	(0.73)
Q4*Tariff	1.51***
	(0.54)
Observations	13437
Adjusted R-squared	0.3955

Note: Specification includes HS 6 digit product fixed effects and year fixed effects. Standard errors clustered at HS 6 product level in parenthesis and all regressions include a constant. ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Complete smuggling of goods

Considering how the informal trade sector is well known to be large in Paraguay, I will in this sub-section adopt a transformation of the dependent variable proposed in Mishra et al (2008). In their study, the so called "extreme smuggling assumption" assumes that when trade flow data is missing on the import side, but are reported on the export side, the corresponding good is smuggled, i.e. never enters customs. In constructing this variation of the dependent variable, trade flows on the import side previously coded as missing are now instead coded as zero. The extreme smuggling variable takes the form $\log(1 + X_{pt}) - \log(1 + IM_{pt})$ and the baseline regression is re-estimated using this dependent variable. The motivation for the variable is simply that products for which tariffs

are high are intuitively more likely to be smuggled into Paraguay compared to ones with low tariffs. The expectation is as before a positive sign attached to the coefficient on the tariff term, but also a larger estimated effect. Results are presented in Table 11 below.

Table 11: Effect of tariffs on evasion, extreme smuggling assumption

	(1)	(2)	(3)	(4)
	Dependent variable "Extreme Smuggling" Value Gap			
Tariff	3.65***	3.64***	1.90***	1.00
	(0.49)	(0.52)	(0.58)	(0.65)
Observations	13821	13821	13821	13821
Adjusted R-squared	0.0120	0.0296	0.3672	0.3830
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. Dependent variable measured as log(1+exports from the US to Paraguay) - log(1+imports from the US to Paraguay). ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

This transformation increases the sample size about 3 percent. The estimates are similar to those in Table 5, but measured with slightly larger errors and the specification loses its significance in column 4. Hence, not much new information can be extracted from this specification. In fact, when regressing the tariff rate on a dummy equal to 1 when there are reported exports, but no corresponding imports, as the dependent variable, no significant results are found, confirming that the tariff rate is not robustly higher for the assumed completely smuggled goods; results are included in the appendix. This is unlike what Mishra et al (2008) found in their study. Lastly it should be pointed out that this method doesn't account for the smuggling of a good altogether, i.e. when there is no data on either the export or the import side, which is of course the case for trade in illegal goods, e.g. narcotics.

Economic implications and discussion

The results obtained from the baseline regression allows for some suggestive economic conclusions to be drawn. The point-estimate from the baseline regression in Table 5a indicate that a one-percentage point increase in tariffs on

average leads to a more than one percent increase in evasion. To be more specific, using the point estimate of 1.72 from column 4 of Table 5a, (which is the most general specification and the one I will rely on to draw conclusions from in this section) and the mean tariff of 11.8 percent (Table 1), the core equation (2.2) predicts a trade gap of 1.54.[20] In words, this translates into a quite alarming effect: on average, a product recorded to be worth 1 USD in Paraguayan customs should have been recorded at 1.54 USD if no evasion was present. That is, the product is recorded at about a 35 percent lesser value than its true value, which in turn is a severe amount of lost fiscal revenue for Paraguay. This can be contrasted to Van Dunem and Arndt (2009) who in a similar manner find a predicted trade gap of 1.35 in their study on Mozambique, thus less severe compared to these results.

Using the same point estimates it is also possible to infer how altering the tariff rate affects tariff revenue. The value on which tariffs can be collected in Paraguayan customs, derived from equation (2.2), is $e^{-(\beta_0+(\beta_1\times T))}$. Thus, collected tariffs amount to $Revenue = T\times e^{-(\beta_0+(\beta_1\times T))}$.[21] The peak revenue in this simple framework occurs at $\frac{\partial Revenue}{\partial T}: T = \frac{1}{\beta_1}$, which translates into a tariff slightly greater than 58 percent. Since the average tariff in the sample is about 12 percent, a decrease in the tariff rate would produce revenue losses for the state. However, this is a rather unrealistic scenario since the calculation doesn't take into account the implications of a change in the tariff rate on the amount of imports, that is, import demand is assumed inelastic above. A more realistic assumption is that demand responds negatively to increases in the price, i.e. the tariff rate. I lack data on specific estimates on price elasticity for Paraguay, but it would take an elasticity of about 3.8 to produce a peak in tariff revenue at the average, 12 percent, tariff rate and an elasticity of, say, 2 is associated with a revenue peak at a tariff rate close to 31 percent. The former elasticity, although plausible for some goods, is highly unrealistic on average and the latter still

[20] This is calculated by simply plugging in the numbers in equation (2.3), including the constant, as follows: $Log(X_{pt}) - Log(IM_{pt}) = 0.23 + 1.72(0.118) \rightarrow e^{0.43296} \approx 1.54$.
[21] Consider recorded exports of 1 USD. Now, a simplified version of equation (2.3) looks like: $Log(1) - Log(IM) = \beta_0 + \beta_1\times T \rightarrow Log(IM) = -(\beta_0 + \beta_1\times T) \rightarrow IM = e^{-(\beta_0+(\beta_1\times T))}$.

comparably high to common estimates.[22] The point here is to demonstrate that at the average tariff rate of about 12 percent, decreasing the tariff rate is likely associated with falling tariff revenue, contrary to for instance Fisman and Wei (2004) who find that at the average tax rate in China (tariff plus VAT in their study), reducing the tax rate is actually associated with an increase in revenue.

It is furthermore of interest to examine what the relation between the tariff rate and evasion has looked like over the years studied and if there have been any changes. An indication of the prevalence of evasion over the years studied is given in Table 12 that lists the coefficient on the tariff term for each separate year in the sample, thus providing yearly portrayals of the evasion situation. In order to control for unobserved product characteristics, which proved to have important effects on the estimates as is clear in for instance Table 5, product fixed effects at the HS 2 digit level are included. Note that controlling for unobserved product effects at the HS 6 digit level, as in the baseline set up, is not possible here since there is only one observation per year at this level. Thus, the results from these cross-section regressions are at a slightly less refined level and therefore should not be considered immediately comparable to results from the baseline regression since the controls for product characteristics are measured at broader categories and time fixed effects are not applicable in this setting.[23]

The coefficient on the tariff rate has the expected positive sign in all years, although loses its significance on three occasions. Interestingly, the responsiveness of evasion to the tariff rate is similar or even more severe towards the end of the sample compared to 20 years ago, although it should be noted that the estimate for 2010 is statistically insignificant and with a relatively low coefficient. Since the average tariff rate has declined over the sample (in 1991 it amounted to about 16.5 percent, compared to about 10 percent in the final years of the sample), incentives based on the tariff rate for under-invoicing were on average higher in 1991, further indicating that the situation with

[22] Consistent estimates on the price elasticity of import demand are difficult to come by, but Reinhart (1995) find estimates for Latin America around 0.4.

[23] To clarify, the regression run is hence: $Ev\_value_p = \beta_0 + \beta_1 \times T_p + \gamma_{HS2\,p} + \varepsilon_p$ separately for the years 1991-2010.

evasion has deteriorated. If the final conversion to the CET tariffs takes place as planned in 2011, Paraguay will have to adjust its average tariff upwards.

Table 12: Responsiveness of evasion to tariffs, yearly cross-sections in values

Year	Coefficient	T-statistic	Observations
1991	3.76	3.30	621
1992	1.06	1.08	532
1993	0.26	0.26	588
1994	2.35	1.59	866
1995	3.13	2.57	955
1996	3.43	2.28	748
1997	4.25	2.95	886
1998	3.25	1.87	787
1999	3.82	2.49	699
2000	4.28	2.44	596
2001	3.33	1.72	569
2002	4.27	1.49	450
2003	7.79	2.54	451
2004	6.86	3.08	424
2005	5.61	2.92	556
2006	3.25	1.98	567
2007	4.03	2.53	742
2008	5.25	3.01	737
2009	4.39	2.55	806
2010	0.87	0.53	857

Note: all regressions include a constant and product fixed effects at the HS 2 digit product level. Standard errors are clustered at the HS 6 digit product level.

Another part of Table 12 catching the eye is that the responsiveness of evasion to the tariff appears to have peaked around 2003 and has thereafter been on a declining trend, however, with a few bumps on the road. This is likely in part reflecting the efforts to fight corruption by Nicanor Duarte Fortes, elected president in 2003. Measures taken by Fortes in 2003 included dismissing tax officials and auditors who were suspected of corruption (Franks et al, 2005). The same authors link these steps to an upswing in tariff revenue in the following year. Furthermore, in 2006 the Millennium Challenge Corporation (MCC), a foreign aid agency based in the U.S., approved a grant of about USD 30 million,

partly intended to strengthen the customs office in Paraguay by increasing internal investigations, increase audits, and digitalize cargo manifests.[24] In sum, a notion that has gained wide support over the last decades, and has been formally shown to have an impact in an increasing body of literature, is that a set of well functioning institutions need to be in place in order for policy measures to have desired and stronger effects. Thus, in the context of this paper, simply lowering tariffs won't alone do the trick of reducing evasion. Indeed, Jean and Mitaritonna (2010) for instance find strong evidence in favor of introducing automated computer systems (so called Asycuda systems) in customs as a means to counter evasion, and more generally they find that institutions, specifically the rule of law, is highly relevant for the evasion elasticity. Paraguay introduced electronic clearance of all imports in 2010 when a so-called Single Window for Imports (VUI) was introduced (WTO, 2011). Although it is tempting to link this fact to the low estimate of evasion in 2010 in Table 12 above, I leave the effect of this and other evasion combating measures for future work to dwell upon.

VIII. Conclusions and final remarks

The overall object of this paper has been to investigate the prevalence of evasion of border taxes in Paraguay and its forms and implications. The results indicate that a one-percentage point increase in the tariff rate on average induce approximately a 1.7 percent increase in evasion of tariffs. This further suggests that at the average tariff rate, about 35 percent of the value of imports goes missing. This is 35 percent that is lost in potential tax revenue for a state largely dependent on revenue from trade taxes, and more value is lost at higher tariff rates. Moreover, the situation seems not to have markedly changed since the early 1990s when Paraguay entered into Mercosur, if anything the results point in the direction of deterioration.

Furthermore, significant results are not only found for corruptive behavior by underreporting of import values, but also for deliberate undercounting of the number, kilos, liters or other quantity related measures of goods. Fraudulent

[24] See www.mcc.gov for further information on the project.

misclassification of a good as a lower-tariffed one is also present in the data. Estimates on whether an increase in the tariff rate will lead to larger effects in the evasion of differentiated goods compared to homogenous goods are more ambiguous, although there are some indications favorable to that claim. These unclear results are, however, more likely resulting from a failure of the proxy for the enforcement quality to capture this, rather than evidence against the prediction from the theoretical framework (evasion is declining in the ease of enforcement) adopted from Mishra et al (2008).

Tackling the problem with tariff evasion is a challenge. In light of the results in this paper, a reduction in the dispersion of the tariff lines would lower evasion incentives, as would generally lowering the tariff rates, but the latter albeit at the direct short term cost of a decline in tariff revenue. Moreover, Paraguay is (partly) tied to the jointly agreed upon CET of Mercosur, whether adjustments downwards of the tariff lines lie on the agenda table is uncertain; focus since the formation has been on the reduction of internal tariffs. There are also other potential ways to deal with evasion of tariffs. This would include reducing the possibilities for corrupt behavior in customs by increasing monitoring, internal investigations, and possibly tougher punishment on tariff evasion; however, these procedures are not explicitly tested for in the paper.

Some informal evidence suggest that an increase in evasion came to a halt in 2003 and in the years thereafter saw a decline, which could possibly be linked to the election of Nicanor Duarte Fortes as president in 2003 who introduced harsher policies aimed at corruption. External help, such as from the MCC, could be an additional factor that has played a part in the fight against customs evasion. Transparency International's overall measure of corruption (the CPI) for Paraguay increased from 1.6 in 2003, to 2.6 and 2.4, respectively, in 2006 and 2007, likely mirroring these events.

An interesting extension to this study would be to investigate the prevalence and evolution of border tax evasion between Mercosur member countries in order to study the plausible effect the RTA and the reduction of internal tariffs has had. Another angle would be to look at what measures are taken to combat evasion

within Mercosur and evaluate the potential impact of different methods on evasion across the member countries to gather micro-evidence on what works, what doesn't, and why.

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Appendix 1

Table A1: Effect of tariffs on evasion, excluding the years 1992 and 1993 were the tariff rate is kept constant in Table 5.

	(1)	(2)	(3)	(4)
	Dependent variable Value Gap			
Tariff	3.82***	4.20***	2.01***	2.23***
	(0.48)	(0.50)	(0.57)	(0.62)
Observations	12317	12317	12317	12317
Adjusted R-squared	0.0171	0.0308	0.3961	0.4084
	Dependent variable Quantity Gap			
Tariff	2.65***	3.08***	3.34**	3.44**
	(0.64)	(0.66)	(1.25)	(1.38)
Observations	6734	6734	6734	6734
Adjusted R-squared	0.0057	0.0121	0.3985	0.4026
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. All regressions include a constant.
***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Appendix 1

Table A2. Ease of enforcement: homogenous and differentiated goods

	(1)	(2)	(3)	(4)
	Dependent variable Value Gap			
Tariff	3.40***	4.07***	0.93*	1.50***
	(0.44)	(0.47)	(0.51)	(0.57)
Tariff*non-differentiated dummy	-1.91***	-2.05***	0.15	-0.51
	(0.65)	(0.67)	(1.59)	(1.65)
Observations	12661	12661	12661	12661
Adjusted R-squared	0.0161	0.0327	0.3806	0.3925
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: Standard errors clustered at HS 6 product level in parenthesis. All regressions include a constant. Estimates based on the liberal classification of goods by Rauch (1999). ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.

Table A3: Checking for validity of the extreme smuggling assumption

	(1)	(2)	(3)	(4)
	Dependent variable No recorded import dummy			
Tariff	0.08***	0.01	0.10***	-0.07
	(0.02)	(0.02)	(0.03)	(0.04)
Observations	13821	13821	13821	13821
Adjusted R-squared	0.0013	0.0597	0.2264	0.2709
Year FE	No	Yes	No	Yes
Product FE	No	No	Yes	Yes

Note: The dependent variable is a dummy=1 when no imports are recorded for a HS 6 digit product even though there is a record of exports of the same product. All regressions include a constant and standard errors are clustered at the HS 6 digit product level. ***Significant at 1 percent level, **Significant at 5 percent level, *Significant at 10 percent level.