Institute for Economic Studies, Keio University

Keio-IES Discussion Paper Series

Machinery Production Networks and Tariff Evasion

Mateus Silva Chang, Chin-Ho Lin

8 August, 2017
DP2017-023
http://ies.keio.ac.jp/en/publications/8103/

Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp
8 August, 2017

Machinery Production Networks and Tariff Evasion
Mateus Silva Chang, Chin-Ho Lin
Keio-IES DP2017-023
8 August, 2017
JEL classification: F14; K42; H26
Keywords: Tariff evasion; Import tariff; Machinery Production Networks; East Asia

Abstract

In this paper we followed Fisman and Wei's (2004) approach to estimate the effects of import tariff rates on import tariff evasion. We focus on East Asian countries import of machinery products. Our main objective is to test if the trade realized inside production networks (intra-regional) is less prone to import tariff evasion than imports from countries outside it (inter-regional). In this study we considered the differences in tariff evasion between intra and inter-regional imports; parts and components and final products; and the heterogeneity between electric machinery and transport equipment. The data provide evidences that intra-regional imports are less prone to tariff evasion than inter-regional imports. Besides this, we identify differences in the channels employed to evade tariff. The results suggest that underreport of quantities was the main channel employed in intra-regional imports tariff evasion, while inter-regional import tariffs were evaded through unit price misreport.

Mateus Silva Chang
Graduate School of Economics, Keio University
2-15-45 Mita Minato-ku Tokyo, 108-8345, Japan
mateus.chang@keio.jp

Chin-Ho Lin
Graduate School of Economics, Keio University
2-15-45 Mita Minato-ku Tokyo, 108-8345, Japan
chinho0929@gmail.com

Acknowledgement:This work was supported by the MEXT-supported Program for the Strategic Research Foundation at Private Universities. I am also thankful to Professor Kimura for making this paper included in Keio-IES Discussion Paper Series.

Machinery Production Networks and Tariff Evasion[1]

Mateus Silva Chang[2]

Research Assistant, Graduate School of Economics

Keio University

Chin-Ho Lin

Research Assistant, Graduate School of Economics

Keio University

Abstract: In this paper we followed Fisman and Wei's (2004) approach to estimate the effects of import tariff rates on import tariff evasion. We focus on East Asian countries import of machinery products. Our main objective is to test if the trade realized inside production networks (intra-regional) is less prone to import tariff evasion than imports from countries outside it (inter-regional). In this study we considered the differences in tariff evasion between intra and inter-regional imports; parts and components and final products; and the heterogeneity between electric machinery and transport equipment. The data provide evidences that intra-regional imports are less prone to tariff evasion than inter-regional imports. Besides this, we identify differences in the channels employed to evade tariff. The results suggest that underreport of quantities was the main channel employed in intra-regional imports tariff evasion, while inter-regional import tariffs were evaded through unit price misreport.

JEL: F14, K42, H26

Key words: Tariff Evasion, Import Tariff, Machinery Production Networks, East Asia

1. Introduction

One important issue in the fields of international trade and development economics is corruption. According to Sequeira (2012), the corruption is still one of the most challenging barrier to the economic development and growth. On top of that, the World Bank (1996) reported that high taxes and corruption were the first and second most

[1] We deeply appreciate the valuable comments from Professor Fukunari Kimura, Kozo Kiyota, and Toshihiro Okubo from Keio University. We also appreciate the financial aid provided by Keio Economic Society. The analysis and results presented in this research are only the responsibility of the authors.

[2] Corresponding author: Graduate School of Economics, Keio University. 2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan. E-mail: mateus.chang@keio.jp

important obstacles for doing business. Though corruption manifest itself in many different ways, it is very difficult to study this topic given the nearly impossibility of observing it directly. Therefore, the initial researches related to corruption in the international trade focused on the specific case of tariff evasion, examining the link between import tariff levels and tariff evasion. From the point of view of the firm, the higher the import tariff and the lower the enforcement of the law, the higher will be the incentive for the firm to find alternative methods to reduce the cost of clearing goods through borders. On the other side, public officials that work on the customs will attempt to protect bribe rents if the risk of punishment is low. This situation leads to what Shleifer and Vishny (1993) called "corruption with theft", a case of corruption that involve import duty evasion in which briber and bribe collude to rob the public.

According to Jean and Mitaritonna (2010), there are many ways to evade customs duties, including the smuggling, bribery, and fallacious declarations. Independent of the chosen method the result is a decrease in the collected tariffs. The lack of transparency and enforcement of the law impose difficulties for the trade and can affect countries that depend heavily on such tariffs.[3]

Despite of the importance of the topic, corruption is a matter hard of been studied given the lack of available data. In the case of import tariff evasion, Bhagwati (1964, 1967) was the first one to use the discrepancies between matched import and export declarations at product level to reveal customs duty evasion. He studied the Turkish case, identifying the existence of under-invoicing of imports, in special for manufactured products. Pritchett and Sethi (1994) analyzed custom data from three developing

[3] According to Bausgaard and Keen`s data (2009) the share of trade tax revenue in total tax receipts in 2001-2006 amounted to an average of 2.5% in high-income countries, 18.1% in middle-income countries and 22% in low-income countries.

countries (Jamaica, Kenya, and Pakistan) and found that collected and official tariff rates were only weakly related, with variance of collected rate increasing strongly with the level of the official rate. More recently, Fisman and Wei (2004) developed the methodology of observing econometrical relations between import tariff rate level and the existence of gaps between the reported import and export values, what they referred to as missing imports or evasion gap, as an evidence of tax evasion. Using public available data of Hong Kong reported exports to China and Chinese reported imports from Hong Kong to quantify the effects of tax rate on tax evasion, they discovered that a one percentage point increase in the tax was associated with a 3% increase in tax evasion.

Mishra *et al.* (2008) analyzed the case of Indian imports and Javorcik and Narciso (2008) analyzed the imports of ten Eastern European countries from Germany, employing the same methodology as Fisman and Wei (2004). Both works contributed to the tariff evasion literature confirming the existence of a positive relation between import tariff rates and tariff evasion, and discovering that products classified as homogeneous goods, according to the Rauch classification (1999), were less vulnerable to tariff evasion than differentiated goods. According to the authors, homogeneous goods have prices that are widely known, been harder to be misreported, while differentiated goods have prices that are less known and usually determined in specific transactions, creating opportunities for unnoticed misreports. Other studies performed a similar exercise but for different countries and periods of time.[4]

In a recent research Javorcik and Narciso (2017) analyzed the unintended impact that the accession of a country to the World Trade Organization (WTO) had in its tariff

[4] For other studies on import tariff evasion verify: Levin and Widell (2014) that analyze the tariff evasion in Kenya and Tanzania; Bouët and Roy (2012) that study the case of Kenya, Mauritius and Nigeria; Epaphra (2015) that research the case of Tanzania; and Kume *et al*. (2011) that study the case of Brazil.

evasion. According to their study, countries accessing the WTO have to comply with the Customs Valuation Agreement (CVA) that estipulate that customs officers cannot exercise discretion with respect to assessing values of imported goods, been obliged to accept the prices from the invoices. Using data for 15 countries that joined the WTO between 1996 and 2008 the authors verify that this rule effectively closed down one channel of import tariff evasion (misreport of the unit value), increasing the evasion through undercounting of quantities and misclassification.

Concomitant to these discoveries the international trade increased exponentially since the beginning of the 1990s boosted by the second unbundling (Baldwin, 2011). The development of production networks resultant from the outsourcing and offshoring processes lead to an increase in the trade of parts and components, generating new opportunities for developing countries interested in engaging on it. The industry most predisposed to the production fragmentation is the machinery one, given the use of many parts and components to assemble a final product. Considering that all machinery parts and components and final products are classified as differentiated goods, been more exposed to tariff evasion, and that fragmentation of the production increases the number of times parts and components cross borders until the final good is assemble, this paper focus on the import tariff evasion of machinery products.

Given the characteristics of production networks the engagement on it presuppose efficiency, fine harmonization between all the production steps, and competitive costs, especially from the developing countries. Consequently, tariff evasion is a very sensitive topic for this type of production organization. In other words, troubles in the customs can undermine the efficiency of production networks, given the exposition of the producers to unexpected extra time and monetary costs in the clearance process, attributed to bribe negotiations, plus the creation of future uncertainties.

To the best of our knowledge, the only study to approach this topic is Lin (2017) that investigated the trade of machinery final products and parts and components inside the "Factory Asia".[5] The author analyzed the impact of import tariff on tariff evasion in the machinery intra-regional trade, concluding that an increase in one percentage point of import tariff lead to an increase of 0.66% in tariff evasion. The author also verified that final products are more prone to suffer from tariff evasion than parts and components.

In this paper we complement the existing literature investigating the East Asian imports of machinery from countries inside and outside the "Factory Asia" in order to attest if there are differences in tariff evasion patterns. The main objective of the paper is to verify if production network trade is less vulnerable to tariff evasion than trade with countries outside the production network. A secondary contribution of this paper is the analysis of heterogeneity of import tariff rate effects on import tariff evasion between different machinery sectors. We decompose the machinery trade focusing on the main machinery sectors: electric machinery and transport equipment.

The rest of this paper is organized as follows: section 2 reports the data sources and the construction of the employed database. Section 3 briefly exposes some summary statistics and trends of tariff rates and tariff evasion gap. Section 4 explains how we set the model, while section 5 presents the results, section 6 robustness check exercises, and section 7 the concluding remarks.

[5] According to Athukorala (2011) the East Asian region is the most outstanding example of machinery production network due to deeper and wider intra-regional trade of machinery parts and components.

2. Data

The database used in this study is constructed using data from two key sources. The first data source is the World Integrated Trade Solution (WITS), which provides different schemes of import tariffs based on UNCTAD's Trade Analysis and Information System (TRAINS) database. This source provides detailed tariff information, such as importer, product imported, tariff rate, exporter and year, at the Harmonized System (HS) 6-digit level. We use the available data on applied tariffs and complement our database with the value of the nearest year data (preference is given to previous year data) to replace the missing tariff data. Our analysis period covers different versions of HS classification such as HS1992, HS1996, HS2002, and HS2007. The code of products might slightly change depending on the specific version of HS classification. To address this problem, we use a conversion table to convert all variations to the HS1992 classification.

The second data source is the United Nations Commodity Trade Statistics Database (UN Comtrade) that provides trade data at the HS 6-digit product level. Following Lin (2017), we use the recorded imports of eleven East Asian countries[6]. We limit the group of exporters to 93 countries[7] that comprise around 99.5% of the East Asian countries import value in 2011. The import values recorded by the eleven East Asian countries and the export values recorded by the exporter countries are all classified

[6] East Asia in this paper is composed by the countries from ASEAN+3 (Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Singapore, the Philippines, Thailand and Vietnam plus China, Japan and South Korea), excluding Lao PDR from the sample due to data limitation. Although Hong Kong is also considered part of East Asia, its data is used only when the country appears as an exporter to other East Asian countries. The same applies to Singapore, given that the import tariff of these two countries are zero for all machinery products.

[7] The list containing the 93 countries divided by regions is available in the Appendix.

according to HS1992 classification. Following the literature, we match these data and drop the products that are reported just by one side, having missing values on the other side.

Given the availability of data, the analysis covers the period from 1996 to 2011. The machinery industry is comprised by all the goods categorized as general machinery sector (HS84), electric machinery sector (HS85), transport equipment sector (HS86-89), and precision machinery sector (HS90-92). These products are classified as parts and components and final products according to Kimura and Obashi (2010) classification.

3. Import tariff rates, trade gap, and machinery sector: a descriptive analysis

The distribution of East Asian countries imported machinery products import tariff rates are shown in Figure 1. The variation in the import tariff rates is low, with a concentration of products around zero tariff rate achieving almost 40%. Since zero tariff products account for more than one-third of all machinery products (approximately 34.7%), we examine if there is a significant difference on trade gap between zero import tariff and non-zero import tariff products. It is expected that the lower the tariff rate the smaller would be the incentive for importers and corrupt customs officers to evade import tariff, while for zero tariff products this incentive should be almost null.[8]

== Figure 1 ==

Table 1 shows the summary statistics for the evasion gap[9] of products with zero and non-zero import tariff levels. As expected, products whose tariff rates are zero have

---

[8] The existence of other types of tax, like the VAT, and non-tariff barriers can also be interpreted as minor incentives to customs evasion and positive trade gaps.

[9] Evasion gap is the name given by Fisman and Wei (2004) for the difference between the logarithm of the registered export value and the logarithm of the registered import value. In this paper we refer to evasion gap and trade gap as synonyms.

lower evasion gap than products whose tariff rates are larger than zero. In fact, the products with zero tariff have a negative mean, indicating none or very small levels of tariff evasion. Decomposing the machinery imports in final products and parts and components we identify a similar pattern: zero tariff products have a negative mean, while non-zero tariff products have a positive mean. In particular, the evasion gap mean of parts and components is smaller than the final products one in the zero tariff products category, indicating a smaller probability of tariff evasion. The same applies for parts and components evasion gap mean for non-zero tariff products. The results indicate that the magnitude of the evasion gap can have some relation with the type of products and the level of tariff rates.

== Table 1 ==

Next, we disaggregate the data and perform the same exercise for the two main machinery sectors: electric machinery and transport equipment. Since zero tariff products are less prone to tariff evasion, we focus just on non-zero tariff products. Table 2 contains the summary statistics for both machinery sectors. The first thing we observe is that electric machinery products seems to be less prone to tariff evasion than transport equipment, since the mean of the latter is higher than the former. Besides this, the final electric products seems to be more exposed to tariff evasion. On the other hand, the transport equipment descriptive analysis indicates the opposite, with parts and components been more prone to tariff evasion than final products.

== Table 2 ==

As our main objective is to verify the differences in trade inside and outside the “Factory Asia”, we disaggregate the data in intra and inter-regional imports. Our hypothesis is that the intra-regional mean evasion gap would be smaller than the inter-regional one, however the summary statistics in Table 3 reveals the opposite pattern with inter-regional evasion gap mean been smaller. Although the descriptive analysis result do not corroborate with the hypothesis that intra-regional trade is less prone to tariff evasion, one needs to analyze carefully this result. As already mentioned, our main interest is not identifying the trade gap per se, since these results also involve possible measurement errors, misclassification involving re-exports, and other discrepancies that are not necessarily related to tariff evasion. Consequently, we still need to perform some econometrical exercises in order to verify the existence or not of a statistical relation between the import tariff rate and the trade gap for different groups sorted according to the above mentioned characteristics.

== Table 3 ==

Given the results of the summary statistics, in the next section we present the methodology and model employed to perform econometrical exercises that test if the summary statistics results hold.

4. Empirical strategy

In this paper we focus on the relationship between import tariff rate and tariff evasion for the East Asian countries intra and inter-regional import of machinery products. Our objective is to examine whether the business environment created by the development of machinery production networks inside East Asia leads to lesser import tariff evasion than in imports from countries outside these production networks. In this exercise we consider the differences in tariff evasion between parts and components and final products. We also analyze the differences in tariff evasion between the two main machinery sectors: electric machinery and transport equipment.

In order to perform the mentioned exercises we define trade gap following Fisman and Wei (2004). Trade gap is defined as the log difference between the value of exports recorded by the exporting country and the value of imports recorded by the importing country. The gap is calculated at the 6-digit level HS product for each exporter-importer pair and year. According to Epaphra (2015) a discrepancy between the recorded values is to be expected, because the export values are expressed in FOB (free on board) terms, while imports are recorded in CIF (including the cost, insurance and freight). Intuitively, the values in CIF should be higher than the values in FOB. Besides this, countries tend to monitor imports more carefully than exports, consequently, in the absence of tariff evasion one would expect the difference to be negative. If the gap is positive, that suggests a possible presence of tariff evasion. The trade gap is defined as follows:

$$gap\_value_{ijkt} = \ln(Export_{value})_{ijkt}^{i,record} - \ln(Import_{value})_{ijkt}^{j,record} \tag{1}$$

where country *i* exports to country *j* the product *k* in year *t*. The notations *i,record* and *j,record* represent exports recorded by an exporting country and imports recorded by an importing country, respectively.

However, just the analysis of the trade gap per se does not constitute a conclusive evidence, given the existence of measurement errors and other factors mentioned before. A stronger evidence of corruption would be the existence of a systematic relationship between import tariff level and tariff evasion, reflecting not random, but intentional misreports. In accordance with the previous literature, we model this relationship and use fixed effects to control for country-year specific and product specific characteristics.[10] In

[10] Following the literature we also cluster the standard errors at the 6-digit product level to account for potential serial correlation of evasion for a particular product.

order to capture possible differences between the tariff evasion in imports inside and outside the production networks, an intra-regional dummy and an interaction term between the tariff and the intra-regional dummy was added. For the most detailed specification we also control for differences between parts and components and final products adding a parts and components dummy, an interaction between the tariff and the parts and components dummy, and an interaction between tariff, intraregional dummy and parts and components dummy. The baseline specification is as follows:

$$gap_{value_{ijkt}} = \ln(Export_{value})_{ijkt}^{i,record} - \ln(Import_{value})_{ijkt}^{j,record} = \beta_0 + \beta_1 Tariff_{jikt} + \beta_2 Tariff_{jikt} * intraregional_i + \beta_3 intraregional_i + \beta_4 Tariff_{jikt} * PC_k + \beta_5 PC_i + \beta_6 Tariff_{jikt} * intraregional_i * PC_k + \theta_{it} + \pi_{jt} + \mu_k + \varepsilon_{ijtk} \quad (2)$$

where $tariff_{jipt}$ refers to the tariff rate imposed by country j on imports of product k from country i at year t; $intra\text{-}regional_i$ is the intra-regional trade dummy that has the value of one if the exporter i is also an East Asian country; PC_k is the parts and components dummy that has the value of one if the traded product k is a part or component ; θ_{it} and π_{jt} are vectors of fixed effects for the exporting-year and the importing-year countries, respectively; and μ_k is a vector of HS 6-digit product fixed effects that controls for time-invariant factors on particular products.

If evasion induced by tariff rate is prevalent, we expect $\beta_1>0$, like in the previous literature. Our main interest is in β_2 that explains the evasion with respect to the tariff rates in the case of imports inside the East Asian production network. It is expected that $\beta_2<0$, indicating that product network imports are less prone to tariff evasion.

According to the literature, there are three different forms of evading import tariffs. The first way is through the misreport of the imported products unit value, while the second way is undercounting the physical quantities of imported products. These two forms of evading tariffs are accounted in the following specifications:

$$gap\_quantity_{ijkt} = \ln\left(Export_{quantity}\right)_{ijkt}^{i,record} - \ln\left(Import_{quantity}\right)_{ijkt}^{j,record} = \beta_0 + \beta_1 Tariff_{jikt} + \beta_2 Tariff_{jikt} * intraregional_i + \beta_3 intraregional_i + \beta_4 Tariff_{jikt} * PC_k + \beta_5 PC_i + \beta_6 Tariff_{jikt} * intraregional_i * PC_k + \theta_{it} + \pi_{jt} + \mu_k + \varepsilon_{ijtk} \quad (3)$$

$$gap\_unitprice_{ijkt} = \ln\left(\frac{Export_{value}}{Export_{quantity}}\right)_{ijkt}^{i,record} - \ln\left(\frac{Import_{value}}{Import_{quantity}}\right)_{ijkt}^{j,record} = \beta_0 + \beta_1 Tariff_{jikt} + \beta_2 Tariff_{jikt} * intraregional_i + \beta_3 intraregional_i + \beta_4 Tariff_{jikt} * PC_k + \beta_5 PC_i + \beta_6 Tariff_{jikt} * intraregional_i * PC_k + \theta_{it} + \pi_{jt} + \mu_k + \varepsilon_{ijtk} \quad (4)$$

The third channel is through mislabeling or misclassification of similar products. According to Fisman and Wei (2004), a misclassification between similar products happens when a higher-taxed product is reported as a lower-taxed variety. In order to investigate these cases the authors proposed that products can be consider similar if they are classified in the same category of the 4-digit HS code. They control for tariffs on similar products by including in the model the weighted average tariff of the products similar to k (w_avg($Tariff_{jikt}$)):

$$gap_{value_{ijkt}} = \beta_0 + \beta_1 Tariff_{jikt} + \beta_2 w_{avg(Tariff_{jikt})} + \theta_{it} + \pi_{jt} + \mu_k + \varepsilon_{ijtk} \quad (5)$$

In the presence of goods misclassification it is expected that $\beta_2<0$, meaning that when the own product tariff rate is held constant, the lower the weighted average tariff rate of the similar products the higher will be the incentive to misclassify product *k* as one of its similar.

5. Estimation results

5.1 Trade gap, quantity gap, unit price gap, and mislabeling

Our first exercise is to estimate the models presented in the previous section. As highlighted in section 3, almost 35% of the variety of imported machinery products have a zero import tariff. Once that products with zero import tariff are less prone to trade evasion, given the lack of incentives to incur in illegal actions, just non-zero tariff products will be considered in this investigation. The outcome for the estimations of trade value gap are reported in columns 1-4 in Table 4. The first thing we observe is if the estimated β_1 is positive and statistically significant for machinery products, what would be an evidence of tariff evasion. Column 1 reveals that a one percentage point increase in the tariff rate is associated with an increase in the trade gap of 0.6%. In the next column we test if mislabeling is one of the channels used to evade tariffs by adding the weighted average tariff on similar products variable.[11] Once again the tariff coefficient is positive and statistically significant, while the weighted average tariff on similar products coefficient is negative and statistically significant at the 10% level, providing a weak evidence that mislabeling could possibly be a secondary channel used to evade tariffs. In the next column we test for the difference in intra and inter-regional trade by adding a dummy variable that assumes the value of one when imports are from East Asian countries and an interaction of this dummy with the tariff variable. The interaction term reveals how the marginal effects of intra-regional imports differ from the marginal effects of inter-regional imports. To facilitate the analysis of the results in the lower part of the

[11] To calculate the weighted average tariff of similar products it is necessary data of at least one similar product. Consequently, the products without a similar product are dropped from the estimation, slightly decreasing the number of observations.

table we report the combined marginal effects. The tariff coefficient is still statistically significant and positive, indicating the presence of intentional tariff evasion in inter-regional imports. On the opposite side, the result from the sum of the tariff coefficient and the interaction of tariff and intra-regional trade coefficient is positive and smaller, indicating that machinery intra-regional imports are less prone to tariff evasion than inter-regional ones. According to the results in column 3 a one percentage point increase in the tariff rate is associated with an increase in the trade gap of 0.8% for inter-regional imports and 0.2% for intra-regional imports. However, the F statistic is not statistically different from zero in the intra-regional imports case, indicating the inexistence of intentional tariff evasion in intra-regional imports. Finally, in the fourth column a dummy for parts and components as well as the necessary interactions were added in order to identify the differences between parts and components and final products tariff evasion. The results reveal that a one percentage point increase in the tariff rate is associated with an increase in the trade gap of 1.0% in inter-regional imports of final products, 0.7% in inter-regional imports of parts and components, and 0.4% in intra-regional imports of parts and components. Once again the F statistic is not statistically different from zero in intra-regional imports of final products and parts and components. These initial results indicate that inter-regional trade of machinery suffers with tariff evasion, while the same does not apply to intra-regional trade.

== Table 4 ==

In columns 5-10 we analyze the quantity gap and unit price gap in order to identify the contribution of each channel to the tariff evasion. The majority of the tariff coefficients in columns 5-7 are statistically insignificant, indicating that quantity underreport is not the main channel used to evade tariffs. In column 6 we find evidences that underreport of quantities was employed to evade tariffs in intra-regional imports. In the next column the intra-regional imports are separated in parts and components and final products, with parts and components coefficient been positive and statistically significant at the 5% level, while final products one is also positive, but smaller and statistically significant at 10% level. Evidences were found that a one percentage point increase in parts and components import tariff leads to an increase of 0.8% in the quantity gap, while weak evidences indicate that a one percentage point increase in final products import tariff leads to an increase of 0.5% in the quantity gap. This result indicates that trade evasion through the misreport of traded quantities is constrained to the intra-regional trade of machinery and more specifically to parts and components.

Columns 8-10 report the coefficients for the same specifications considering the unit price gap. The tariff coefficients are all statistically significant and positive in all columns. The coefficient in column 8 indicate that a one percentage point increase in the tariff leads to an increase in the unit price gap of 0.3%. The interaction between intra-regional dummy and tariff in column 9 has a negative coefficient, indicating that intra-regional trade is less prone to tariff evasion than inter-regional trade. The coefficients in column 10 indicate that a one percentage point increase in the tariff leads to an increase in the unit price gap of 0.6% in inter-regional trade of final products, 0.8% in inter-regional trade of parts and components, and declines in intra-regional unit price gap of 0.5% in the final products and 0.3% in parts and components. In fact, the negative coefficients in columns 9 and 10 provide an unexpected and counter-intuitive result. There are two possible explanations for these results. Kellenberg and Levinson (2016) pointed out that tariff evasion is a product of the interaction of two offsetting forces, in other words, the higher the tariffs the more incentive will exist for the importer to evade the tariff and for the government to accurate report the imports and collect the tariffs. Consequently, it is possible that increases in tariff rate generate decreases in tariff evasion. Another cause is related to the fact that country-product level tariff data cannot account for the existence and use of export processing zone schemes. These schemes allow for the exemption of import tariffs in cases when machinery, equipment and parts and components are imported and used, inside specific geographical zones, in the production of goods that will supply the external market. Consequently, for these cases the nominal tariff is positive, but in reality the importer pays no import tariff, having no incentive to evade tariffs. This bias decrease the values of the coefficients. Therefore, instead of focusing on the absolute values of the coefficients we are more interested in the existence of statistically significant relationship between import tariff rate and evasion gap, an evidence of tariff evasion, and the relative values of the coefficients.

In this subsection the results revealed that, in general, intra-regional imports are less prone to tariff evasion than inter-regional imports. The engagement in production networks presuppose efficiency and low cost of production. Thus, the existence of bureaucracy and corruption in the customs can be a hindrance to the engagement in it. Consequently, the creation of the business environment necessary to participate in production networks, resultant from agreements and other tacit measures that complement the decrease in import tariffs, should favor the tariff evasion reduction in the intra-regional trade. Another interesting feature is related to the difference in channels used to evade tariff for the intra and inter-regional cases. In the former case, underreport of quantities was the main channel used to evade tariffs, while in the later the underreport of unit price was the adopted channel. Given that the customs are the same for both types of imports, the results reflect the existence of differences between imports inside and outside the production networks. Given that production network members promote large volumes and high frequency trade, it is expected that customs officers should be more used to the correct unit price of the imported products. However, opening the containers, inspecting how many items were imported and the weight of each imported variety, especially in the case of tiny parts and components, is a more complicated task to perform. These facts could explain the difference in channels adopted for the tariff evasion in intra and inter-regional trade.

5.2 Trade gap, quantity gap, unit price gap, and mislabeling by machinery sector

In this subsection our interest is to use the heterogeneity between machinery sectors to analyze if the previous results depend or not on the machinery characteristics. We restrict our study to the two most important sectors of machinery: electric machinery and transport equipment. Based on the physical characteristic of each sector`s parts and components (electric machinery ones tend to be tinier than the transport equipment ones) we can test if the practice of underreporting imported quantities is more common for one type of machinery than the other.

Following the same pattern of the exercises in the previous subsection, Tables 5 and 6 present the results for electric machinery and transport equipment respectively. Columns 1-2 in Table 5 reveal a weak relationship between tariff and trade evasion for electric machinery, while mislabeling coefficient is statistically insignificant. In column 3 the tariff coefficient is positive and statistically significant in the inter-regional imports, while the F statistic reveals no statistically significant relation in the intra-regional imports. Results in column 4 indicate the existence of a statistically significant relation between tariff and trade evasion just in inter-regional imports of electric machinery final products. A one percentage point increase in the tariff leads to an increase in the trade gap of 0.9% in inter-regional trade of final products. The F statistic reveals that there is no statistical significant relation between tariff and trade gap for intra-regional imports and inter-regional import of parts and components.

== Table 5 ==

Columns 5-7 focus on the quantity gap. In column 5 the tariff coefficient is positive and statistically significant at the 10% level, indicating the existence of a weak relation between tariff level and tariff evasion. In the next column the inter-regional tariff coefficient is statistically insignificant, while the intra-regional one is statistically significant at the 1% level. In column 7 we identify that a one percentage point increase in the tariff of electric machinery leads to an increase in the quantity gap of 1.4% for intra-regional trade of parts and components. The coefficient for the inter-regional trade of final products is statistically significant, but at the 10% level, indicating a remote possibility of tariff evasion through quantity underreport, while no statistical relation is found for inter-regional trade of parts and components and intra-regional trade of final products.

Next, in columns 8-10 we focus on the unit price gap. In column 9 we observe that the coefficient for the tariff is positive and statistically significant, while the combined marginal effect for intra-regional imports is negative and statistically significant, indicating that inter-regional trade of electric machinery is more prone to tariff evasion through misreport of unit price. In column 10 the results indicate that evasion through misreport of price unit is a practice more common in inter-regional trade of parts and components, followed by inter-regional import of final products and intra-regional import of parts and components.

From the electric machinery results we can conclude that intra-regional trade of electric machinery is less prone to tariff evasion. We also observe that unit price misreport is the main channel used to evade import tariffs in the inter-regional trade, while the electric machinery parts and components intra-regional trade evasion occurs mainly through the misreport of traded quantities.

According to our hypothesis the intra-regional tariff evasion through quantity underreport was possible for electric machinery parts and components, because they are small and numerous, been harder of keeping track of the correct imported quantities. Nevertheless, if this fact is correct we expect that intra-regional imports of transport equipment should be less exposed to tariff evasion through quantity underreport, given that parts and components in this sector are in general big and consequently easier of been tracked. Table 6 expose the results for transport equipment. The first four columns reveal that no statistically significant relation is found for the tariff coefficient. In column 2 the coefficient for tariff on similar products is statistically significant at the 5% level, revealing that mislabeling could be a channel used to evade tariffs. In the columns referent to quantity gap all coefficients of interest are statistically insignificant or the F statistic reveals that the relations are not statistically different from zero. The exception is the coefficient for the inter-regional import of final products that is weakly statistically significant and negative. From these columns we can conclude that misreport of quantity is hardly a channel used to evade transport equipment import tariff. In the last two columns of the table we identify evidences of tariff evasion in transport equipment. In column 9 the tariff coefficient is statistically significant and positive at the 5% level for the inter-regional import of final products, while the coefficient for the interaction of tariff and intra-regional trade dummy is negative and statistically significant at the 1% level. In the next column the coefficients reveal that inter-regional imports of final products are exposed to tariff evasion, been positive and statistically significant at the 1% level. On the opposite side, the coefficient for intra-regional import of final products is negative, but statistically significant at the 5% level. The coefficients for inter and intra-regional import of parts and components are statistically insignificant.

The results for transport equipment reveal that, compared to electric equipment, this sector hardly suffers with tariff evasion. Evidences were found of imports of final products been exposed to tariff evasion through unit price misreport. No evidences were found that intra-regional imports, in special the parts and components one, suffer with tariff evasion through the quantity misreport channel.

== Table 6 ==

This subsection confirms that intra-regional trade is less prone to tariff evasion than inter-regional trade. The disaggregation of the data in parts and components and final products by machinery sector confirms that, in general, the misreport of unit price is the main channel used to evade tariffs in inter-regional import. On the intra-regional import case we also found some evidence of unit price misreport and strong evidence of quantity misreport for electric machinery parts and components, corroborating the proposed hypothesis.

6. Robustness check

6.1 Production network products dummy

In the previous section it was analyzed the impact of import tariff rates on import tariff evasion depending on characteristics such as intra or inter-regional trade, the type of product (parts and components or final product), and machinery sector. The main objective of these exercises was to verify if trade related to production networks is less prone to tariff evasion or not. In this subsection we address the same question employing a more refined definition to separate the data in products with higher probability of been part of production networks and a group of non-production network products. Based on the definition of production networks we expect that countries engaged on it maintain stable and intensive trade flows of given products, what allow us to propose two definitions of production network dummies. In the less stringent one the dummy assumes value of one when there is a stable and intensive trade relation involving intra-regional countries. In other words, a given country must import a given product from other East Asian country (intra-regional trade) for at least three consecutive years (a stable trade relation) and the share of import of this product from this given country has to exceed a given threshold (an intensive trade relationship).[12] The second production network dummy has a similar definition, but the products are restricted just to parts and components. This restrictive definition is imposed, because it is not possible to distinguish production network imports from consumption imports. In other words, some countries offshore the assemble process and then import the final product in order to add some final value, through activities like packaging, marketing, and distribution, before exporting it to the final consumer. However, we cannot differentiate these cases from cases where the product is imported and consumed in the domestic market.

[12] We define the import intensity by calculating the share of product *k* imported by country *j* from country *i* in period *t* over all imports of product *k* by country *j* in period *t* ($share_{ijkt} = (Import_{value})_{ijkt} / (Import_{value})_{jkt}$). We assume different levels of threshold varying from at least 5% to 25%.

The first two columns of the top panel of Table 7 contain the results for trade gap considering products with a threshold of at least 25% share. We observe that a one percentage point increase in the tariff leads to 0.4 % increase in the trade gap for production network products and 0.7% for non-production network products. However, the result for production network products is statistically significant just at the 10% level. This result provides a weak evidence that production network products suffer from tariff evasion. Besides this, we observe that production network products are less prone to tariff evasion than non-production network ones. For the more stringent definition a similar tariff increase leads to a growth in the trade gap of 0.6% for non-production and production network products. Nevertheless, the coefficient for production network products is statistically insignificant, indicating the inexistence of tariff evasion. The next two columns report the coefficients for quantity gap. As already verified, this channel was adopted as the main option to promote tariff evasion in East Asian intra-regional trade of parts and components. Observing the coefficients we verify a weak relation between non-production network products and tariff evasion, a coefficient of 0.3% at the 10% level, while for production network products a one point percentage increase in tariffs leads to 0.7% increase in quantity gap. When we limit production network products just to parts and components this relation becomes stronger, growing to 1.0%, while the coefficient for non-production network products becomes statistically insignificant. On the opposite side, observing the coefficients for unit price gap we discover that non-production network products have positive and statistically significant coefficient, while production network ones are negative. This result indicates that production network products are less prone to tariff evasion through unit price misreport than non-production network products.

== Table 7 ==

Relaxing the definition of trade intensity to share thresholds of 15% and 5% does not alter much the results. The main difference is that the trade gap coefficients for production network products become statistically significant at the 5% level. The results confirm that production network products are less prone to tariff evasion and indicate that production network tariff evasion happens mainly through quantity underreport, while for non-production network trade it concentrates on unit price underreport.

6.2 Comparison with Latin America

In this subsection we promote a comparison with the Latin American case in order to verify the existence or not of similar patterns. The objective of this exercise is to confirm if the results found were typical from production network organization or not. The first reason to choose Latin America is because it is also a region composed by few high-income and many middle-income countries.[13] Another reason is the existence of many studies in the economic field comparing both regions and their development patterns. The third and most important reason is the fact that, although there are machinery industries in both regions, it is known that differently from East Asia, Latin American regional integration and machinery production networks are still underdeveloped. Thus, it is expected that in a comparison between both regions this difference manifest itself through patterns that reveal more dissimilitude than similitudes in the machinery import tariff evasion patterns.

[13] According to the available information from World Bank in 2016, Chile and Uruguay are classified as high-income countries; Argentina, Brazil, Colombia, Costa Rica, Ecuador, Panama, Paraguay, Peru, Venezuela (upper-middle-income countries), Bolivia, El Salvador, Guatemala, Honduras and Nicaragua (lower-middle-income countries) are classified as middle-income countries.

The coefficients in Table 8 are higher than the ones in Table 4. In the first column we verify that a one percentage point increase in the tariff leads to 1.1% increase in the total trade value gap. In the next column we observe a negative and statistically significant coefficient at the 1% level for similar products, indicating that mislabeling the import as a lower-taxed similar product is also a channel used to evade import tariffs in Latin America. Column 3 reveals that a one percentage point increase in the tariff rate leads to an increase of 1.1% in the inter-regional trade gap and 1.3% in intra-regional case. In the fourth column we observe that separating parts and components from final products the former has lower coefficients. Differently from the East Asian case, the tariff impact on the trade gap is similar for intra and inter-regional trade, with just inter-regional trade of parts and components suffering slightly less from trade evasion. This indicates that the origin of the imports, if it is inter or intra-regional, does not influence much in the tariff evasion. The next three columns reveal that the majority of the tariff evasion happens through underreport of quantities with intra-regional trade of parts and components been the only exception. Once again the origin of the trade does not affect the coefficients for final products that are very similar. Coefficients in column 9 show that just in the case of intra-regional trade there is import tariff evasion. The last column confirms that intra-regional imports suffer more from tariff evasion through misreport of unit prices, with parts and components been the most affected. Coefficients for the inter-regional trade are statistically significant, but at the 10% level, while both coefficients for final products are negative and close to zero.

A comparison between East Asian and Latin American results disclose the existence of different patterns in tariff evasion. We observe that coefficients for Latin America are higher than the East Asian ones. We also identify differences in the channels employed to evade tariffs. First, strong evidences of tariff evasion through misclassification were found in Latin America, while the same does not apply to the East Asian case. Second, in Latin America the coefficients for misreport of quantities and unit prices are statistically significant for almost all cases, indicating that all channels were employed to evade tariff. Finally, the most interesting result is the fact that, in general, inter and intra-regional import coefficients do not differentiate much, indicating that the origin of the imports does not matter for tariff evasion. The only exception applies to the fact that unit price misreport is more important than quantity misreport for the intra-regional import of parts and components.

== Table 8 ==

Next, we explore the heterogeneity between different machinery sectors. Tables 9 and 10 contain the results for electric machinery and transport equipment. Once again the coefficients are slightly higher than the East Asian ones. We observe that a one percentage increase in the import tariff leads to 0.9% increase in the trade gap for electric machinery and 0.9% for transport equipment. Mislabeling is also a tariff evasion channel utilized in both sectors. For electric machinery, evasion through quantity underreport occurs for the final products independent of the origin of the imports, while unit price misreport happens for the intra-regional import of parts and components at the 1% level and inter-regional import of final products at the 10% level. For transport equipment, evasion through unit price underreport is concentrated in the imports of parts and components, independent of the product origin, while quantity underreport is verified just in inter-regional imports of final products.

== Table 9 ==

== Table 10 ==

The results in this subsection reveal the existence of different patterns of tariff evasion between East Asia and Latin America. In addition, we observe no clear pattern of differences in intra and inter-regional import tariff evasion in Latin America, while in the East Asian case the intra-regional imports are less prone to tariff evasion than the inter-regional ones. Furthermore, for the Latin American case all channels were employed to evade the import tariff, while in the East Asian case the channels were chosen according to the exporter region and if final products or parts and components were been imported.

7. Concluding remarks

This paper contributes to the production network and tariff evasion literature by examining if the environment created by the development of machinery production networks affected the levels of import tariff evasion inside and outside this production structure. We followed Fisman and Wei's (2004) approach to estimate the relationship between import tariff rate and tariff evasion for the East Asian countries intra and inter-regional import of machinery products. In this exercise we considered the differences in tariff evasion between parts and components and final products. We also analyzed the differences in tariff evasion between the two main machinery sectors: electric machinery and transport equipment.

The econometric estimations revealed that inter-regional imports are, in general, more prone to tariff evasion than intra-regional ones. This evidence is in accordance with the hypothesis that the business environment necessary for the engagement in production networks favor the reduction in tariff evasion. The study of the different channels available to evade tariffs and the heterogeneity between different machinery sectors and product types revealed that quantity underreport is a practice more common to intra-regional imports of electric machinery parts and components. On the opposite side, underreport of unit prices was the main channel employed to evade tariffs in the inter-regional import case.

The employment of dummies with the purpose of improving the data classification in production and non-production network products resulted in very similar outcomes, with production network products been less prone to tariff evasion and having quantity underreport as the main channel employed to evade tariffs. In contrast, the unit price underreport was the main channel employed to evade tariffs in East Asian imports of non-production network products.

Finally, a comparison between the import tariff evasion patterns of East Asia and Latin America revealed that in the latter case, a region where machinery production network is still underdeveloped, the coefficients are higher than in the former one. Besides this, there were no clear differences between Latin American intra and inter-regional import tariff evasion. Furthermore, for the Latin American case all channels were employed to evade the import tariff. The prevalence of dissimilitude in the tariff evasion patterns between the two regions endorse the hypothesis that the patterns found in the East Asian case are specific of production network.

Figure 1 – Distribution of East Asian countries HS 6-digit level machinery products import tariff rates

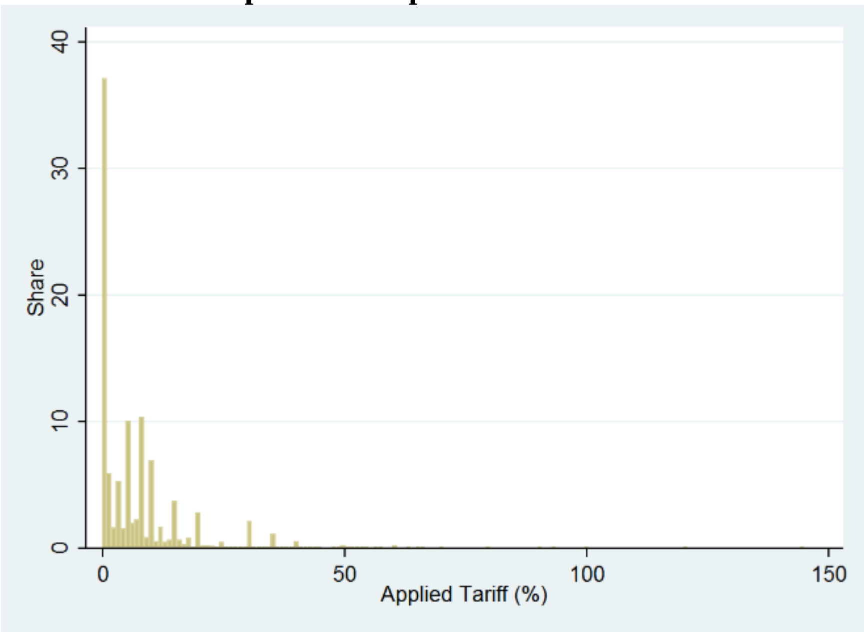

Table 1 – Trade gap summary statistics of zero and non-zero import tariff products

Zero tariff products	Mean	Median	SD	Min	Max	Observations
All	-0.071	-0.033	2.221	-16.758	15.375	750379
P&C	-0.130	-0.055	2.307	-16.758	15.335	371434
Final	-0.012	-0.016	2.131	-16.238	15.375	378945
Non-Zero tariff products	Mean	Median	SD	Min	Max	Observations
All	0.095	0.017	2.248	-15.323	15.583	570087
P&C	0.075	0.022	2.292	-15.323	15.583	343492
Final	0.126	0.013	2.179	-14.583	13.054	226595

Table 2 – Trade gap summary statistics of non-zero import tariff products according to machinery sector

Electric Machinery	Mean	Median	SD	Min	Max	Observations
All	0.038	-0.014	2.366	-14.583	14.875	193378
P&C	-0.038	-0.051	2.377	-14.193	14.875	130771
Final	0.196	0.063	2.335	-14.583	12.897	62607
Transport Equipment	Mean	Median	SD	Min	Max	Observations
All	0.247	0.076	2.394	-12.849	12.661	15122
P&C	0.262	0.109	2.512	-12.849	12.661	9560
Final	0.222	0.035	2.177	-11.282	10.444	5562

Table 3 – Trade gap summary statistics of non-zero import tariff products according to exporter region

Intra-regional	Mean	Median	SD	Min	Max	Observations
All	0.250	0.103	2.282	-15.323	15.583	186737
P&C	0.245	0.115	2.345	-15.323	15.583	106489
Final	0.258	0.091	2.196	-14.583	12.897	80248
Inter-regional	**Mean**	**Median**	**SD**	**Min**	**Max**	**Observations**
All	0.020	-0.019	2.228	-13.620	13.838	383350
P&C	-0.001	-0.018	2.264	-13.620	13.838	237003
Final	0.054	-0.020	2.167	-12.654	13.054	146347

Table 4 – Effect of tariff rate, regional trade, and product type on import tariff evasion

		Trade Gap				Quantity Gap			Unit Price Gap		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.006**	0.008***	0.008***	0.010***	0.003	0.001	0.004	0.003***	0.007***	0.006***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)
Tariff*PC					-0.003			-0.005			0.002
					(0.003)			(0.003)			(0.002)
Tariff*Intraregional				-0.006***	-0.010***		0.005*	0.001		-0.011***	-0.011***
				(0.002)	(0.002)		(0.002)	(0.003)		(0.001)	(0.001)
Tariff*Intraregional*PC					0.007**			0.008**			0.000
					(0.003)			(0.003)			(0.002)
Tariff on Similar Products			-0.004*								
			(0.002)								
Tariff+Tariff*Intra=0 F stat				1.04	0.01		7.12	3.03		18.18	16.32
p-value				0.307	0.916		0.008	0.082		0.000	0.000
Tariff+Tariff*PC=0 F stat					7.15			0.25			48.99
p-value					0.007			0.620			0.000
Tariff+Tariff*Intra+Tariff*PC +Tariff*IntraxPC=0 F stat					2.48			6.05			5.73
p-value					0.115			0.014			0.017
Combined Effects											
Inter-regional	Final	0.006***	0.008***	0.008***	0.010***	0.003	0.001	0.004	0.003***	0.007***	0.006***
	P&C				0.007***			-0.001			0.008***
Intra-regional	Final			0.002	0.000		0.006***	0.005*		-0.004***	-0.005***
	P&C				0.004			0.008**			-0.003**
Tariff on Similar Products			-0.004*								
R^2		0.064	0.066	0.064	0.064	0.066	0.066	0.066	0.114	0.115	0.115
Observations		570087	520069	570087	570087	570087	570087	570087	570087	570087	570087

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 5 – Effect of tariff rate, regional trade, and product type on electric machinery import tariff evasion

		Trade Gap				Quantity Gap			Unit Price Gap		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.006*	0.007*	0.008**	0.009**	0.006*	0.004	0.007*	-0.001	0.004**	0.002
		(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.001)	(0.002)	(0.002)
PC					-0.188***			0.396***			-0.585***
					(0.039)			(0.043)			(0.019)
Tariff*PC					-0.003			-0.007			0.004*
					(0.005)			(0.006)			(0.002)
Intraregional				-0.224	-0.215		-0.411*	-0.411*		0.187*	0.196*
				(0.211)	(0.213)		(0.217)	(0.219)		(0.109)	(0.110)
Tariff*Intraregional				-0.005*	-0.011***		0.007**	-0.002		-0.012***	-0.009***
				(0.003)	(0.004)		(0.003)	(0.005)		(0.002)	(0.002)
Tariff*Intraregional*PC					0.011**			0.016***			-0.005*
					(0.004)			(0.005)			(0.003)
Tariff on Similar Products			-0.002								
			(0.004)								
Tariff+Tariff×Intra=0 F stat				0.53	0.22		7.98	2.00		30.63	15.02
p-value				0.467	0.637		0.005	0.159		0.000	0.000
Tariff+Tariff×PC=0 F stat					1.66			0.01			8.12
p-value					0.198			0.905			0.005
Tariff+Tariff×Intra+Tariff×PC +Tariff×IntraxPC=0 F stat					1.66			8.26			19.67
p-value					0.199			0.004			0.000
Combined Effects											
Inter-regional	Final			0.008**	0.009**		0.004	0.007*		0.004**	0.002***
	P&C	0.006*	0.007*		0.006	0.006*		0.000	-0.001		0.006***
Intra-regional	Final			0.003	-0.002		0.011***	0.005		-0.008***	-0.007
	P&C				0.006			0.014***			-0.008***
Tariff on Similar Products			-0.002								
R^2		0.069	0.072	0.069	0.069	0.067	0.067	0.067	0.137	0.137	0.138
Observations		193378	175805	193378	193378	193378	193378	193378	193378	193378	193378

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 6 – Effect of tariff rate, regional trade, and product type on transport equipment import tariff evasion

		Trade Gap				Quantity Gap			Unit Price Gap		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.003	0.000	0.004	-0.001	0.000	-0.003	-0.009*	0.004	0.008**	0.008***
		(0.006)	(0.006)	(0.007)	(0.005)	(0.005)	(0.006)	(0.005)	(0.003)	(0.003)	(0.003)
PC					0.182			0.029			0.153
					(0.307)			(0.386)			(0.211)
Tariff*PC					0.016*			0.018*			-0.002
					(0.010)			(0.009)			(0.004)
Intraregional				-2.477***	-2.493***		-7.730***	-7.739***		5.254***	5.246***
				(0.843)	(0.842)		(0.498)	(0.496)		(0.433)	(0.441)
Tariff*Intraregional				-0.003	0.001		0.009	0.016**		-0.012***	-0.015***
				(0.007)	(0.006)		(0.007)	(0.006)		(0.003)	(0.003)
Tariff*Intraregional*PC					-0.019*			-0.029***			0.011***
					(0.010)			(0.010)			(0.004)
Tariff on Similar Products			0.011**								
			(0.005)								
Tariff+Tariff×Intra=0 F stat				0.06	0.00		1.33	1.51		3.07	5.73
p-value				0.805	0.982		0.251	0.221		0.082	0.018
Tariff+Tariff×PC=0 F stat					1.58			0.63			1.77
p-value					0.211			0.429			0.186
Tariff+Tariff×Intra+Tariff×PC +Tariff×IntraxPC=0 F stat					0.05			0.23			0.21
p-value					0.829			0.635			0.651
Combined Effects											
Inter-regional	Final			0.004	-0.001		-0.003	-0.009*		0.008**	0.008***
	P&C	0.003	0.000		0.015	0.000		0.009	0.004		0.006
Intra-regional	Final			0.001	0		0.006	0.007		-0.004*	-0.007**
	P&C				-0.003			-0.004			0.002
Tariff on Similar Products			0.011**								
R^2		0.089	0.097	0.089	0.089	0.099	0.099	0.1	0.124	0.126	0.127
Observations		15122	12390	15122	15122	15122	15122	15122	15122	15122	15122

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 7 – Effect of tariff rate on production and non-production network products import tariff evasion

	25% share threshold					
	Trade Value Gap		Quantity Gap		Unit Price Gap	
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.007***	0.006***	0.003*	0.003	0.004***	0.003***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
PN_1 dummy	1.339***		1.250***		0.089***	
	(0.034)		(0.036)		(0.018)	
Tariff*PN_1	-0.003		0.004		-0.006***	
	(0.002)		(0.002)		(0.001)	
PN_2 dummy		1.266***		1.154***		0.112***
		(0.048)		(0.052)		(0.025)
Tariff*PN_2		0		0.007**		-0.007***
		(0.003)		(0.003)		(0.001)
Tariff+Tariff×PN_1=0 F stat	3.09		6.65		4.9	
p-value	0.079		0.010		0.027	
Tariff+Tariff×PN_2=0 F stat		2.49		6.57		6.8
p-value		0.114		0.010		0.009
	Combined Effects					
Trade	0.007***	0.006***	0.003*	0.003	0.004***	0.003***
PN	0.004*		0.007**		-0.002**	
PN_2		0.006		0.010**		-0.004***
R^2	0.078	0.072	0.076	0.071	0.114	0.114
Observations	570087	570087	570087	570087	570087	570087

	15% share threshold					
	Trade Value Gap		Quantity Gap		Unit Price Gap	
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.007***	0.006***	0.004*	0.002	0.004***	0.003***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
PN_1 dummy	1.397***		1.313***		0.085***	
	(0.031)		(0.034)		(0.016)	
Tariff*PN_1	-0.003		0.003		-0.006***	
	(0.002)		(0.002)		(0.001)	
PN_2 dummy		1.231***		1.124***		0.107***
		(0.044)		(0.048)		(0.022)
Tariff*PN_2		-0.001		0.007**		-0.008***
		(0.003)		(0.003)		(0.001)
Tariff+Tariff×PN_1=0 F stat	3.45		7.04		4.92	
p-value	0.063		0.008		0.026	
Tariff+Tariff×PN_2=0 F stat		2.89		8.28		9.37
p-value		0.089		0.004		0.002
	Combined Effects					
Trade	0.007***	0.006***	0.004*	0.002	0.004***	0.003***
PN	0.004*		0.007***		-0.002**	
PN_2		0.005*		0.009***		-0.005***
R^2	0.083	0.074	0.08	0.073	0.114	0.114
Observations	570087	570087	570087	570087	570087	570087

(Continue on next page)

Table 7 (Continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	5% share threshold					
	Trade Value Gap		Quantity Gap		Unit Price Gap	
	(1)	(2)	(3)	(4)	(5)	(6)
Tariff	0.008***	0.006***	0.004*	0.002	0.004***	0.004***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
PN_1 dummy	1.551***		1.471***		0.080***	
	(0.030)		(0.032)		(0.015)	
Tariff*PN_1	-0.004*		0.004*		-0.007***	
	(0.002)		(0.002)		(0.001)	
PN_2 dummy		1.174***		1.099***		0.075***
		(0.041)		(0.044)		(0.020)
Tariff*PN_2		0.001		0.008***		-0.007***
		(0.002)		(0.003)		(0.001)
Tariff+Tariff×PN_1=0 F stat	4.67		10.31		8.15	
p-value	0.030		0.001		0.004	
Tariff+Tariff×PN_2=0 F stat		5.43		11.46		7.47
p-value		0.020		0.000		0.006
	Combined Effects					
Trade	0.008***	0.006***	0.004*	0.002	0.004***	0.004***
PN	0.004**		0.008***		-0.003***	
PN_2		0.007**		0.01***		-0.003***
R^2	0.093	0.077	0.088	0.076	0.114	0.114
Observations	570087	570087	570087	570087	570087	570087

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 8 – Effect of tariff rate, regional trade, and product type on import tariff evasion in Latin America

		Trade Gap			Quantity Gap			Unit Price Gap			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.011***	0.020***	0.011***	0.013***	0.010***	0.011***	0.015***	0.001	0.000	-0.002*
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
PC					-1.219***			-2.728***			1.509***
					(0.077)			(0.099)			(0.046)
Tariff*PC					-0.005**			-0.009***			0.004***
					(0.002)			(0.003)			(0.001)
Intraregional				-1.113***	-1.116***		0.137	0.152		-1.250***	-1.268***
				(0.415)	(0.414)		(0.468)	(0.467)		(0.216)	(0.215)
Tariff*Intraregional				0.002	0		-0.001	0.002		0.002**	-0.001
				(0.002)	(0.002)		(0.002)	(0.003)		(0.001)	(0.001)
Tariff*Intraregional*PC					0.004			-0.006*			0.010***
					(0.003)			(0.003)			(0.001)
Tariff on Similar Products			-0.019***								
			(0.002)								
Tariff+Tariff×Intra=0 F stat				39.18	35.31		22.43	40.54		6.33	6.11
p-value				0.000	0.000		0.000	0.000		0.012	0.014
Tariff+Tariff×PC=0 F stat					13.34			5.39			3.23
p-value					0.000			0.020			0.073
Tariff+Tariff×Intra+Tariff×PC +Tariff×IntraxPC=0 F stat					20.66			0.29			59.23
p-value					0.000			0.588			0.000
Combined Effects											
Inter-regional	Final	0.011***	0.020***	0.011***	0.013***	0.010***	0.011***	0.015***	0.001	0.000	-0.002*
	P&C				0.008***			0.006**			0.002*
Intra-regional	Final			0.013***	0.013***		0.010***	0.017***		0.002**	-0.003**
	P&C				0.012***			0.002			0.011***
Tariff on Similar Products			-0.019***								
R^2		0.065	0.068	0.065	0.065	0.088	0.088	0.088	0.143	0.143	0.143
Observations		864512	763650	864512	864512	864512	864512	864512	864512	864512	864512

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 0.1%, 1% and 5% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 9 – Effect of tariff rate, regional trade, and product type on Latin American electric machinery import tariff evasion

		Trade Gap				Quantity Gap			Unit Price Gap		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.009***	0.016***	0.007**	0.009**	0.008**	0.008*	0.013***	0.001	-0.001	-0.004*
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.002)	(0.002)	(0.002)
PC					2.902***			3.088***			-0.187***
					(0.045)			(0.045)			(0.023)
Tariff*PC					-0.003			-0.008*			0.005**
					(0.004)			(0.004)			(0.002)
Intraregional				0.057	0.05		-0.008	0.058		0.065	-0.009
				(58.237)	(.)		(.)	(.)		(79.896)	(.)
Tariff*Intraregional				0.005	0.006		-0.001	0.004		0.006**	0.003
				(0.004)	(0.005)		(0.005)	(0.006)		(0.002)	(0.002)
Tariff*Intraregional*PC					-0.003			-0.010*			0.007***
					(0.004)			(0.005)			(0.002)
Tariff on Similar Products			-0.023***								
			(0.003)								
Tariff+Tariff×Intra=0 F stat				10.22	9.28		2.75	8.88		7.1	0.13
p-value				0.001	0.002		0.0982	0.003		0.008	0.714
Tariff+Tariff×PC=0 F stat					2.64			1.09			0.25
p-value					0.105			0.297			0.615
Tariff+Tariff×Intra+Tariff×PC +Tariff×IntraxPC=0 F stat					5.05			0.06			18.32
p-value					0.025			0.814			0.000
Combined Effects											
Inter-regional	Final	0.009***	0.016***	0.007**	0.009**	0.008**	0.008*	0.013***	0.001	-0.001	-0.004*
	P&C				0.006			0.005			0.001
Intra-regional	Final			0.012***	0.015***		0.007*	0.017***		0.005***	-0.001
	P&C				0.009**			-0.001			0.011***
Tariff on Similar Products			-0.023***								
R^2		0.078	0.082	0.078	0.078	0.096	0.096	0.096	0.137	0.137	0.137
Observations		270662	236322	270662	270662	270662	270662	270662	270662	270662	270662

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Table 10 – Effect of tariff rate, regional trade, and product type on Latin American transport equipment import tariff evasion

		Trade Gap				Quantity Gap			Unit Price Gap		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff		0.009***	0.013**	0.011***	0.013***	0.008**	0.010***	0.013***	0.001	0.001	0.000
		(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)
PC					0.192**			-0.094			0.286***
					(0.081)			(0.086)			(0.040)
Tariff*PC					-0.011**			-0.016***			0.006**
					(0.005)			(0.006)			(0.002)
Intraregional				-0.345	-0.355		0.241	0.28		-0.586	-0.635
				(0.506)	(0.505)		(0.711)	(0.713)		(0.514)	(0.516)
Tariff*Intraregional				-0.010**	-0.010**		-0.008**	-0.007		-0.002	-0.003
				(0.004)	(0.004)		(0.004)	(0.005)		(0.002)	(0.002)
Tariff*Intraregional*PC					0.004			-0.002			0.006**
					(0.006)			(0.006)			(0.003)
Tariff on Similar Products			-0.009**								
			(0.005)								
Tariff+Tariff×Intra=0 F stat				0.09	0.45		0.15	1.03		0.13	1.20
p-value				0.762	0.503		0.697	0.313		0.716	0.275
Tariff+Tariff×PC=0 F stat					0.22			0.18			3.99
p-value					0.641			0.670			0.048
test Tariff+Tariff×Intra+Tariff×PC +Tariff×IntraxPC=0 F stat					0.17			1.84			6.89
p-value					0.676			0.177			0.010
Combined Effects											
Inter-regional	Final	0.009***	0.013***	0.011***	0.013***	0.008**	0.010***	0.013***	0.001	0.001	0.000
	P&C				0.002			-0.003			0.006**
Intra-regional	Final			0.001	0.003		0.002	0.006		-0.001	-0.003
	P&C				-0.004			-0.012			0.009***
Tariff on Similar Products			-0.009**								
R^2		0.081	0.086	0.081	0.081	0.094	0.094	0.095	0.177	0.177	0.178
Observations		96073	83122	96073	96073	96073	96073	96073	96073	96073	96073

Note: Standard errors, clustered by product, are listed in brackets. ***, **, * denotes significance at the 1%, 5% and 10% level, respectively. Given a restriction of space, the coefficients of secondary variables are omitted.

Reference

Athukorala, P. (2011) Production Networks and Trade Patterns in East Asia: Regionalization or Globalization? *Asian Economic Papers*, 10 (1), 65-95.

Baldwin, R. (2011) 21st Century Regionalism: Filling the Gap between 21st Century Trade and 20th Century Trade Rules. *Centre for Economic Policy Research Policy Insight*, 56 (May).

Bhagwati, J. (1964) On the under-invoicing of imports. *Bulletin of the Oxford University, Institute of Statistics*, 2, 389–397.

Bhagwati, J. (1967) Fiscal policies, the faking of foreign trade declarations, and the balance of payments. *Bulletin of the Oxford Bulletin of Economics and Statistics*, 29 (1), 61-77.

Bouët, A., & Roy, D. (2012) Trade Protection and Tax Evasion: Evidence from Kenya, Mauritius and Nigeria, *The Journal of International Trade & Economic Development*, 21 (2), 287-320.

Epaphra, M. (2015) Tax rates and tax evasion: evidence from missing imports in Tanzania. *Business and Economics Journal*, 06 (2).

Fisman, R. & Wei, S. J. (2004) Tax rates and tax evasion: evidence from "missing imports" in China. *Journal of Political Economy*, 112 (2), 471–496.

Javorcik, B. S. & Narciso, G. (2008) Differentiated products and evasion of import tariffs, *Journal of International Economics*, 76 (2), 208-222.

Javorcik, B. S. & Narciso, G. (2017) WTO accession and tariff evasion, *Journal of Development Economics*, 125, 59-71.

Jean, S. & Mitaritonna, C. (2010) Determinants and pervasiveness of the evasion of customs duties. *CEPII, WP*, No. 2010-26.

Kellenberg, D. & Levinson, A. (2016) Misreporting trade: tariff evasion, corruption, and auditing standards. *NBER Working Paper*, No. 22593.

Kimura, F. & Obashi, A. (2010) International Production Networks in Machinery Industries: Structure and Its Evolution. Working Papers DP-2010- 09, Economics Research Institute for ASEAN and East Asia (ERIA).

Kume, H.; Piani, G., and Miranda P. (2011) Tarifas de importação e evasão fiscal no Brasil. *Economia Aplicada*, 15 (1), 65-82.

Levin, J. & Widell, L. M. (2014) Tax evasion in Kenya and Tanzania: evidence from missing imports. *Economic Modelling*, 39, 151-162.

Lin, C. H. (2017) The Evasion Gap, Tariff Rates, and International Production Networks. Mimeo.

Mishra, P.; Subramanian, A. and Topalova, P. (2008) Policies, Enforcement, and Customs Evasion: Evidence from India, *Journal of Public Economics*, 92 (10-11), 1907–1925.

Pritchett, L. & Sethi, G. (1994) Tariff rates, tariff revenue, and tariff reform: some new facts. *World Bank Economic Review*, 8 (1), 1–16.

Rauch, J. (1999) Networks versus Markets in International Trade, *Journal of International Economics* 48, 7–35.

Sequeira, S. (2012) Advances in Measuring Corruption in the Field. In *New Advances in Experimental Research on Corruption*. Bingley, U.K.: Emerald Publishing.

Shleifer, A. & Vishny, R. W. (1993) Corruption. *Quarterly Journal of Economics*, 108 (3), 599–617.

United Nations Commodity Trade Statistics Database. UN COMTRADE. Retrieved December, 2016, from http://comtrade.un.org/db/

World Integrated Trade Solution (WITS). Retrieved December, 2016, from http://wits.worldbank.org/

Appendix

Table A.1 – Country List by Regions

Region	Name	Region	Name	Region	Name
NAFTA	Canada	EU	Malta	ROW	Cote d'Ivoire
NAFTA	Mexico	EU	Netherlands	ROW	Croatia
NAFTA	USA	EU	Poland	ROW	Egypt
East Asia	Brunei Darussalam	EU	Portugal	ROW	Georgia
East Asia	Cambodia	EU	Romania	ROW	Ghana
East Asia	China	EU	Slovakia	ROW	Iceland
East Asia	China, Hong Kong	EU	Slovenia	ROW	India
East Asia	Indonesia	EU	Spain	ROW	Israel
East Asia	Japan	EU	Sweden	ROW	Jamaica
East Asia	Malaysia	EU	United Kingdom	ROW	Kyrgyzstan
East Asia	Myanmar	Latin America	Argentina	ROW	Mali
East Asia	Philippines	Latin America	Bolivia	ROW	Mauritius
East Asia	Rep. of Korea	Latin America	Brazil	ROW	Morocco
East Asia	Singapore	Latin America	Chile	ROW	New Zealand
East Asia	Thailand	Latin America	Colombia	ROW	Niger
East Asia	Vietnam	Latin America	Costa Rica	ROW	Nigeria
EU	Austria	Latin America	Ecuador	ROW	Norway
EU	Bulgaria	Latin America	El Salvador	ROW	Oman
EU	Czech Rep.	Latin America	Guatemala	ROW	Rep. of Moldova
EU	Cyprus	Latin America	Honduras	ROW	Russian
EU	Denmark	Latin America	Nicaragua	ROW	Saudi Arabia
EU	Estonia	Latin America	Panama	ROW	Senegal
EU	Finland	Latin America	Paraguay	ROW	Sudan
EU	France	Latin America	Peru	ROW	Switzerland
EU	Germany	Latin America	Uruguay	ROW	Rep. of Macedonia
EU	Greece	Latin America	Venezuela	ROW	Tunisia
EU	Hungary	ROW	Albania	ROW	Turkey
EU	Ireland	ROW	Algeria	ROW	Uganda
EU	Italy	ROW	Australia	ROW	Ukraine
EU	Latvia	ROW	Azerbaijan	ROW	Tanzania
EU	Lithuania	ROW	Cameroon	ROW	Zambia