# Does Trade Facilitation Matter in Bilateral Trade?

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**Abstract**

This paper evaluates the effect of different aspects of trade facilitation in developed and developing countries through an augmented gravity model and uses the latter to estimate ad valorem equivalents (AVEs) of administrative barriers to trade. Trade facilitation is defined as measures that aim at making international trade easier by eliminating administrative delays, simplifying commercial procedures, increasing transparency, security and incorporating new technologies in trade. I use a two-step analysis to do this. First, I precisely determine the predicted time related to trade facilitation aspects using the Doing Business database (World Bank). Then, the predicted time to export and to import are introduced in the gravity model and its outcome is used to estimate AVEs of the administrative barriers to trade. The results show that internet, bureaucracy, corruption and geographic variables significantly affect the transaction time to import and to export. Time to import has a higher negative impact on trade than that to export. When sectoral characteristics are taken into account, some perishable (food and beverages), seasonal (wearing apparels) and high-value added products appear to be more sensitive to transaction time than other products. Such results are also confirmed by the values of the AVEs.

JEL classification: F10, F12, F15

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# 1 Introduction

"**Making international trade *easier***" is the most straight forward definition of trade facilitation. However, the term "trade facilitation‘" encompasses various important aspects such as: simplification of commercial procedures; harmonization of commercial rules; transparent information and procedures; the recourse to new technologies to promote trade and make payments more secure, reliable as well as quicker. For the World Customs Organization, trade facilitation is: "*the avoidance of unnecessary trade restrictiveness. This can be achieved by applying modern techniques and technologies, while improving the quality of controls in an internationally harmonized manner*". Therefore, it is noteworthy that trade facilitation does not take traditional barriers into account: neither tariffs, nor non-tariff barriers. It incorporates new transaction costs, institutional impediments, administrative delays, etc. In summary, these barriers can be called "*Non-official barriers*" because they are not classified in an official framework between governments and organizations.

Two groups of reasons help to explain the importance of incorporating trade facilitation in gravity models, starting with economic ones. After reducing tariff and non-tariff barriers, trade partners have discovered that there exists other impediments to trade (OECD, 2002a). Reduction of such non-official barriers is likely to have more impact on trade than the reduction of classical ones. Moreover, the increased commercial regimes complexity, often referred as a "Spaghetti Bowl", the increased interdependency of supply chains as well as the delays of import delivery have turned into a severe constraint on production. On the other side, the cost of non-facilitation is very high since non-official barriers account for 2 to 15% of the value of the exchanged goods (OECD, 2002a). A number of previous papers have evidenced the importance of non-visible barriers, for instance Cernat (2001) supports the idea that the key to the African trade enigma lies in trade facilitation. Finally, the welfare coming from the elimination of those non-official barriers is greater the more the restrictions being addressed waste real resources rather than generate rents that are captured by interest groups (quota rents) or governments (tariff revenues). Hence, as trade facilitation measures may be largely resource wasting and redundant and as there is neither rents nor revenues for a country to loose by removing restrictions, benefits would

be greater from eliminating them than if the measures would be creating rents.

These economic reasons explain why a majority of countries that are part of the World Trade Organization (WTO) have launched trade facilitation initiatives. In November 2001, during the Doha Development Round, many issues have been negotiated such as improving market access for developing countries, Singapore issues, liberalization of environmental goods and services and the access of developing countries to medicines. Trade facilitation was included in the agenda of the round as one of the Singapore issues. More specifically, the focus was on the following aspects: the simplification of trade procedures, the promotion of technical assistance and the limited capacities of developing countries. Hence, the Doha Ministerial Declaration recognizes the importance of "*further acceleration of expedition, delivery and clearance of goods, including goods in transit, and the need for technical assistance and an increased capacity-building in this area*" (WTO, 2002). At the Fourth Ministerial Conference in Doha, ministers agreed that "*negotiations will take place after the Fifth Session of the Ministerial Conference on the basis of a decision to be taken, by explicit consensus, at that session on modalities for negotiations*" (OECD, 2003). In Hong Kong, there was not a real success regarding the trade facilitation process. This is due to the fact that developing countries are not ready to adopt a legal draft on the substantive provisions of the agreement before more progress is made on technical assistance and capacity building. These successive meetings show to what extent trade facilitation represents a debatable issue in the WTO agenda while it is still an unfinished business due to the complexity of its aspects and the disagreement between different countries.

In order to assess the impact of trade facilitation on bilateral trade, this paper uses a gravity model. The latter has become for long an essential tool for measuring the impact of tariff and non-tariff barriers on the flow of goods and services (Anderson, 1979; Bergstrand, 1989 and 1990 and Baier and Bergstrand, 2001). Gravitational framework is appropriate to study trade facilitation for two reasons. First, it allows to determine the impact of administrative barriers on bilateral trade and compare their effect to traditional barriers. Second, its outcome can be used to compute ad-valorem equivalents of the administrative barriers to have better insights of there magnitude.

The empirical literature on trade facilitation could be classified in three main groups. The first includes studies that emerged in the wake of Mc Callum's work (1995) where

models were used to quantify border effects. This literature has known theoretical advances by Head and Mayer (2001a and 2001b), Feenstra (2002) and Anderson and van Wincoop (2003). Fontagné et al. (2004 and 2007) introduced in their model a term called the "border related costs" that takes tariff and non-tariff barriers (quantitative restrictions, administrative barriers, technical barriers and sanitary as well as phytosanitary measures) into account. All these improvements have reinforced the theoretical foundation of gravity models, narrowing the gap between theoretical and empirical findings. Nevertheless, trade facilitation was not explicitly included since it was introduced either in the border effect term or with other border related costs.

The second group of studies encompasses models that treat just one aspect of trade facilitation, which are referred to "mono-dimensional models" in this paper. For instance, Freund and Weinhold (2000) examined the impact of internet on trade, Hummels (2001) and Djankov et al. (2006) investigated the effect of time on trade, Limao and Venables (2000) analyzed the effect of efficient infrastructure on bilateral trade and last but not least, Dutt and Traca (2007) studied the effect of corruption.

The last group of empirical studies includes models that incorporate several aspects of trade facilitation, named "multi-dimensional models". Pioneered by Wilson, Mann and Otsuki (2002, 2003 and 2004) and Kim et al. (2004), these authors quantified the impact of trade facilitation measures through a gravity model taking ports efficiency, e-business intensity, regulatory and customs environments into account. They first applied this model on APEC countries, then extended it to a larger sample of countries.

In this paper, I conduct a theory-based empirical analysis of the impact of trade facilitation on bilateral trade. First of all, I use a gravity model based on theoretical foundations related to monopolistic competition and border effect model, including trade facilitation aspects. Obviously, poor theoretical foundations make the coefficients difficult to interpret[1]. Second, I take several aspects of trade facilitation into account to have a complete picture of administrative barriers. To do so, I perform the analysis in two steps. The advantage of such a method is to have a precise measurement of trade facilitation. It also avoids introducing many collinear variables in the gravity model as it will be

[1]For instance, in this model, the impact of trade facilitation aspects can be decomposed in two parts: the impact of trade facilitation itself and the impact of the elasticity of substitution. If this point is not taken into account, the effect of trade facilitation aspects will be underestimated.

shown later. This is why in the first step, I estimate the transaction time to import and to export which allows to shed light on its determinants: documents (capturing the impact of time-increasing bureaucracy), the internet (as a proxy for the technological intensity that reduces time), geographic variables (like the fact of being landlocked that hinders trade), corruption (as a proxy for customs fraud) and the number of procedures to start a business (that shows to what extent the institutional environment is efficient). In a second step, I introduce the predicted time to export and to import in the gravity model to determine its effect on bilateral trade. Such a mechanism helps to prevent an overestimation of the impact of administrative barriers since I introduce the predicted time related only to trade facilitation aspects. The empirical implications of the model are investigated for bilateral and sectoral trade data in order to assess which products are more sensitive than others. Exports and imports delays of sensitive products may cause many losses, for instance: products may perish, tastes may change, etc., and this may further increase the cost of non-facilitation.

Finally, adopting the methodology of Kee et al. (2009) in estimating the AVEs of non-tariff barriers, I use the gravity model outcome to compute AVEs of time to export and that to import. This is a quite important contribution since the AVEs have been estimated for non-tariff barriers (Kee et al, 2009), for services (Park, 2002 and Walsh, 2006) and for time in transport (Hummels, 2001) but never for non-official barriers. The difference between Hummels (2001)'s AVEs and mine is that the former estimates the ad-valorem impact of ocean and air shipping costs using a discrete choice model. In this paper, I consider a different definition of time that a transaction takes to fill documents, overcome geographic barriers and face corruption. This can give a better idea about the administrative or the non-official barriers to trade. One of the most important findings is that the AVEs of perishable, seasonal and high value-added goods are much higher than other manufactured ones. From a policy implication standpoint, those AVE's are crucial to determine to what extent countries welfare should improve once such barriers are eliminated.

This paper is organized as follows: Section 2 is devoted to some stylized facts of trade facilitation. Section 3 develops the theoretical foundations and exposes the econometric specification of the model. Section 4 presents the data. Section 5 discusses the results.

Section 6 estimates the AVEs for the non-official barriers to trade. Section 7 concludes.

# 2 Stylized Facts

According to the Doing Business database[2] developed by the World Bank (2006), Figure 1 shows the relationship between the number of documents to be filed and the transaction time to export and to import in some selected countries. Obviously, a country with an important bureaucracy involving many documents, has a long delay to export or to import. For instance, in Zimbabwe, an exporter needs to submit 9 documents in order to go ahead with his transaction while an importer needs to file 15 of them. The time to export is about 42 days and 66 days to import. By contrast, all these aspects are much lower in Hong Kong or in Singapore.

[Figure 1 about here]

Such customs procedures may also be duplicative as paperwork and data requirements have to be submitted in the destination country while they have already been submitted to local authorities in the home country or vice versa. That is why it is important to take into account such aspects for both the exporter and the importer to assess the simultaneous effect of *their administrative barriers* on *their bilateral trade*.

Table 1 exhibits the average number of days and that of documents, the internet widespread and the corruption intensity for developed and developing countries. It shows to what extent these countries are heterogenous with respect to trade facilitation aspects. The gap in the number of exports documents between developed and developing countries is not very significant (6.9 and 7.1 respectively). By contrast, there is a pronounced difference in the time to import as the latter is three times bigger in a developing country with respect to a developed one. The difference is even more evident on the internet widespread and the corruption intensity.

[Table 1 about here]

[2]This dataset contains several sections, the largest being "Trading Across Borders" as it brings together seven indicators related to procedures incorporated in trade. These indicators are: number of days to export and to import, number of documents required for exports and imports, the cost of imports and exports and the ease of doing business. Only the time and document aspects are taken into account.

Regarding geographical aspects, Raballand (2003) estimated that the fact of being landlocked reduces trade by more than 80%. For these countries and at equal distances, transportation costs are on average 35% higher than those of non-landlocked. Being landlocked increases transaction costs due to many delays until the product reaches its destinations. In other terms, the imported (exported) product transits in many countries from its origin (or its landlocked origin) to its landlocked destination (its destination). A large part of this cost may be explained by bureaucracy and time length of trade. Table 2 shows evidence on the differences between landlocked and not landlocked countries. The average of time to export of the former is 36 days versus 22 days for the latter. It is even worse for the time to import with 44 days for landlocked countries and 26 days for the others. The same analysis applies to the number of documents. So, while computing AVEs, geographical impediments should be taken into account.

[Table 2 about here]

Time and documents are correlated as they both reflect more complicated procedures. Their correlations varies between 0.6 to 0.8. The exclusion of documents in the regressions may cause time variation across countries to reflect both time and documents inefficiencies channel of influence. Hence, an omitted variables bias may be present. Furthermore, if the document variables are introduced in the regression to distinguish between bureaucracy and the length impact on trade, a problem of multicollinearity reduces the estimator efficiency by increasing its standard error. That is why I suggest a two-steps estimation to avoid biased (if I omit documents) or non-efficient (if I introduce them in the regression) results. As transaction time depends on many aspects, the first step predicts the time to import (and the time to export) as a function of the number of documents to import (to export), the internet widespread of the importer (exporter), the corruption intensity of the importer (exporter) and its geographic situation. As mentioned before, such a mechanism not only avoids multicollinearity problem, but also takes into account the share of time that is related only to trade facilitation. In a second step, I introduce the predicted values of the time to import and that to export in the gravity model[3] to estimate in a later stage AVEs of those impediments.

[3]For the sake of robustness check, a second way to deal with the multicollinearity issue is to use the factor analysis method. The latter allows us to estimate an index called "TF" for trade facilitation taking into account the previous aspects, namely the documents to export and to import, the time to export

# 3 Theory

This paper uses the model initially developed by Fujita et al. (2000) and Anderson and van Wincoop (2003) and extends it to take into account trade facilitation aspects. These authors develop a gravity model from a monopolistic competition framework. Following Head and Mayer (2002a), to avoid the estimation difficulties related to price terms, I work with log odds ratios between bilateral imports and domestic sales. Thus, the nuisance term related to prices will cancel out. This model has been slightly modified by Fontagné et al. (2007) by introducing a term called "border related costs". This term includes all tariff and non-tariff barriers. The originality of this paper is that it disaggregates this term into several parts. The first part is related to tariff barriers, the second one is dedicated to the impact of preferential trade agreements and the third one explicitly incorporates trade facilitation aspects.

The theoretical foundation of the gravity model is the Dixit-Stiglitz-Krugman model of trade under monopolistic competition. The main assumptions of the monopolistic competition model relies on a representative consumer that maximizes a Constant Elasticity of Substitution (CES) utility function. The consumption basket in country $i$ is defined by the bilateral preference term $a_{ij}$ and the consumption $c_{ijh}$ of variety $h$ from country $j$ with $\sigma$ being the elasticity of substitution between varieties, $n_j$ the number of varieties coming from country $j$ and $p_{ij}$ the consumer price. Therefore, the maximization problem is given by:

$$maxU_i = [\sum_{j=1}^{N}\sum_{h=1}^{n_j}(a_{ij}c_{ijh})^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

s.c.

$$y_i = \sum_{i}\sum_{h=1}^{n_j} p_{ij}c_{ijh} \quad (2)$$

Hence, the CIF value of imports $m_{ij}$ of country $i$ coming from country $j$ is given by

and to import, the internet widespread of the exporter and the importer, corruption as well as their geographic situation. The advantage of the first method (two-steps estimation) is that it allows us to estimate the AVEs for administrative barriers. The second way (factor analysis) eliminates completely the problem of multicollinearity as it summarizes all of the trade facilitation aspects in a one index but it has the usual drawbacks that the results are difficult to interpret.

$m_{ij} = c_{ij}p_{ij}$. The price term $p_{ij}$ can be disaggregated into two parts, the plant price $p_j$ of country $j$ to which are added the transaction costs $\tau_{ij}$ between countries $i$ and $j$ as follows $p_{ij} = p_j\tau_{ij}$. Finally, the expenditure $m_i$ on all goods coming from all countries including the home country are given by $m_i = \sum_k m_{ik}$

The solution of the maximization problem in (1) subject to the constraint (2) for both imports and internal flows gives:

$$m_{ij} = \frac{a_{ij}^{\sigma-1} n_j p_{ij}^{1-\sigma}}{\sum_k a_{ik}^{\sigma-1} n_k p_{ik}^{1-\sigma}} m_i \tag{3}$$

$$m_{ii} = \frac{a_{ii}^{\sigma-1} n_i p_{ii}^{1-\sigma}}{\sum_k a_{ik}^{\sigma-1} n_k p_{ik}^{1-\sigma}} m_i \tag{4}$$

Dividing these two equations then disaggregating the price term into two parts (plant price and transaction costs) yields the relative imports term $\frac{m_{ij}}{m_{ii}}$:

$$\frac{m_{ij}}{m_{ii}} = (\frac{a_{ij}}{a_{ii}})^{\sigma-1} \frac{n_j}{n_i} (\frac{p_j}{p_i})^{1-\sigma} (\frac{\tau_{ij}}{\tau_{ii}})^{1-\sigma} \tag{5}$$

Turning to the supply side of the model, firms are characterized by a production function with increasing returns to scale and identical technology. The firm $j$ uses labor $l_j$ as a simple production factor $l_j = F + \gamma q_j$ with $F$ being the fixed cost of labor, $\gamma$ the inverse of the firm productivity and $q_j$ the production of firm $j$. Finally, the profits $\pi_j$ of firm $j$ are given by:

$$\pi_j = p_j q_j - w_j l_j \tag{6}$$

where $w_j$ represents the wage paid by firm $j$. Replacing the labor cost equation in (6), and through the pricing equation and the free-entry condition, the representative firm output equilibrium is given by the following equation:

$$q_j = \frac{F(\sigma - 1)}{\gamma} \tag{7}$$

With identical technologies $q_j = q \; \forall j = 1, ..., N$, the production value $\nu_j$ of industry $j$

is calculated as follows:

$$\nu_j = qp_j n_j \tag{8}$$

$$\nu_i = qp_i n_i \tag{9}$$

Dividing (8) by (9) and rearranging yields:

$$\frac{n_j}{n_i} = \frac{\nu_j p_i}{\nu_i p_j} \tag{10}$$

Transaction costs include transport costs measured by the bilateral distance between the countries $i$ and $j$ ($d_{ij}$), some dummies capturing whether one country was a colony of the other at some point in time, whether the two have been colonized by a same third country ($Comcol_{ij}$) or whether the two countries share a common border ($Conti_{ij}$). The last part of transaction costs is the border related one ($brc_{ij}$) between two countries :

$$\tau_{ij} = d_{ij}^{\delta} \exp(\rho_1 Col_{ij} + \rho_2 Comcol_{ij} + \rho_3 Conti_{ij})(1 + brc_{ij}) \tag{11}$$

These border related costs consist of tariff costs $t_{ij}$ between $i$ and $j$, non-tariff barriers which are composed of the presence of a Preferential Trade Agreement ($PTA_{ij}$) between $i$ and $j$ (equals 1 if $i$ and $j$ belong to the same $PTA$), and the trade facilitation aspects $\ln(\widehat{Time}_{imp,i})$ and $\ln(\widehat{Time}_{exp,j})$ (the estimated logarithms of the time to import and that to export respectively):

$$\begin{aligned}(1 + brc_{ij}) = (1 + t_{ij})[&\exp(\eta E_{ij} + \theta PTA_{ij} \\ &+\mu_1 \ln(\widehat{Time}_{imp,i}) + \mu_2 \ln(\widehat{Time}_{exp,j})]\end{aligned} \tag{12}$$

with $E_{ij}$ is the intercept.

Preferences are composed of a random part $e_{ij}$ and a systematic one showing the home bias $\beta$.

$$a_{ij} = \exp[e_{ij} - (\beta - \lambda L_{ij})(E_{ij} + PTA_{ij})] \tag{13}$$

A dummy variable $L_{ij}$ is added, being equal to 1 if $i$ and $j$ share the same language and zero otherwise. If $L_{ij}$ changes from 0 to 1, the home bias changes from $\beta$ to $\beta - \lambda$.

Combining the natural logarithm of equation 5 with the elements developed above will result in the following equation:

$$\begin{aligned}\ln(\frac{m_{ij}}{m_{ii}}) &= (\sigma-1)\ln(\frac{a_{ij}}{a_{ii}}) + \ln(\frac{n_j}{n_i}) \\ &\quad +(1-\sigma)\ln(\frac{p_j}{p_i}) + (1-\sigma)\ln(\frac{\tau_{ij}}{\tau_{ii}}) \end{aligned} \tag{14}$$

Then transaction costs and preferences in (14) are replaced by their values in (11), (12) and (13). I further simplify by stating that $L_{ii} = 0$; $E_{ii} = 0$; $PTA_{ii} = 0$; $t_{ii} = 0$; $Conti_{ii} = 0$, $Col_{ii} = 0$; $Comcol_{ii} = 0$ and suppose that $\ln(\widehat{Time}_{imp,i}) = 0$ for internal flows. Indeed, such impediments only concern international flows. Finally, the estimable model that is used in the second step of estimation is then given by:

$$\begin{aligned}\ln(\frac{m_{ij}}{m_{ii}}) &= \ln(\frac{\nu_j}{\nu_i}) - \sigma\ln(\frac{p_j}{p_i}) + \delta(1-\sigma)\ln(\frac{d_{ij}}{d_{ii}}) + (1-\sigma)\ln(1+t_{ij}) + (\sigma-1)\lambda L_{ij} \\ &\quad -(\sigma-1)(\theta-\eta)PTA_{ij} + (\sigma-1)[\rho_1 Col + \rho_2 Comcol + \rho_3 Conti_{ij}] \\ &\quad +(1-\sigma)\mu_1\ln(\widehat{Time}_{imp,i}) + (1-\sigma)\mu_2\ln(\widehat{Time}_{exp,j}) \\ &\quad -(\sigma-1)(\eta+\beta)E_{ij} + \epsilon_{ij} \end{aligned} \tag{15}$$

where: $(1-\sigma)$: is a negative coefficient when $\sigma$ is greater than 1 implying that higher transaction costs decrease trade flows.

$(\sigma-1)(\eta-\beta)$: the border effects which are not related to a PTA membership,

$(\sigma-1)(\theta-\beta)$: the supplementary trade due to a PTA membership,

$(\sigma-1)\mu_1$ and $(\sigma-1)\mu_2$: the variation in trade due to trade facilitation aspects.

$\epsilon_{ij}$: the discrepancy term equals to $(\sigma-1)(e_{ij}-e_{ii})$.

In the first step concerning the estimation of time to export and to import, I regress the former (the latter) on many control variables, namely the number of documents of the exporter $Doc_{exp,j}$ (of the importer $Doc_{imp,i}$), the internet widespread in the exporter $Internet_j$ (in the importer $Internet_i$), the fact that the exporter (importer) is being landlocked $Land_j$ ($Land_i$) or an island $Isld_j$ ($Isld_i$), the corruption in the exporter $Cor_j$ (the importer $Cor_i$) and the number of procedures requested to start a business for the exporter $Proc_j$ (for the importer $Proc_i$). A dummy variable for tariffs $Tar_{ij}$ (equals to 1 when there are tariff barriers between $i$ and $j$ and 0 otherwise) is added to the determinants

of the time to import. The rationale behind those variables is as follows. First, documents capture the impact of bureaucracy that increases time. The internet is a proxy for the technological intensity or e-commerce that should reduce transaction time. Moreover, the fact of being landlocked increases time and hence hinders trade, corruption variable captures the intensity of customs fraud and finally, the number of procedures to start a business describes the efficiency of the institutional environment. The dummy variable of tariffs shows to what extent more tariff barriers may increase the inspection time. Hence, the equations I estimate are given by:

$$\begin{aligned} \ln(Time_{exp,j}) &= \ln(Doc_{exp,j}) + \ln(Internet_j) + \ln(Proc_j) \\ &\quad \ln(Cor_j) + Land_j + Isld_j + \omega_j \qquad (16) \\ \ln(Time_{imp,i}) &= \ln(Doc_{imp,i}) + \ln(Internet_i) + \ln(Proc_i) \\ &\quad \ln(Cor_i) + Land_i + Isld_{,i} + Tar_{ij} + \omega_i \qquad (17) \end{aligned}$$

where $\omega$ is the discrepancy term. Once the time to export and the time to import are predicted, they are introduced in equation (15) to estimate their impact on bilateral trade. Therefore, the coefficients of the predicted time to export and to import reflect only the effect of trade facilitation aspects.

# 4 Data

The sample includes several developed and developing countries. Following the World Bank classification, 28% of the sample are low-income countries, 50% are lower- and upper-middle income ones and finally 22% are high-income ones, distributed between OECD and non-OECD countries. The difference in countries incomes allows to take into account the state of trade facilitation in developing and developed countries.

Data have been collected from several sources. To begin with, my dependent variable in the first step is the logarithm of the time to export (to import) taken from the "Doing Business" database constructed by the World Bank. Regarding the time determinants, the number of documents to export (to import) and the number of procedures to start a

business for the exporter (the importer) are taken also from "Doing Business". The internet widespread is taken from the World Development Indicators (WDI). Corruption variable comes from the corruption perceptions index developed by Transparency International. Geographic variables are taken from the CEPII Distance[4] database.

For the gravity model, the dependant variable is the ratio between bilateral and internal flows. It is constructed from the "Trade and Production" dataset available on the CEPII website that covers manufacturing sectors (three digits level). The same database has been used for the other independent variables, namely relative production and tariffs. Other classic gravitational variables, for instance contiguity, common language, distance, common colonizer, etc. come from the CEPII Distance database. Recall that once the time to export and to import are estimated from the first step, they are introduced in the gravity equation as independent variables. For more details on the variables definition, construction and sources, see Appendix 1.

# 5 Estimation Results

## 5.1 Determinants of Time to Trade

Table 3 presents the determinants of transaction time. It is quite obvious that bureaucracy increases significantly the time to trade. A 10% increase in the number of documents to import (to export) increases the time to import by 6.2% (to export by 8.1%). To capture the institutional environment in the country, I also introduce the number of procedures to start a business and the corruption intensity. The former does not have a significant effect on time. As to fraud, a 10% increase in transparency reduces time to import by 4.4% and that to export by 4.9%.

[Table 3 about here]

Moreover, the fact of being landlocked makes trade transactions lengthier due to many transit costs that waste time and generate additional costs, implying that ocean transportation is significantly cheaper. However, the fact of being landlocked may be overcome

[4]Centre d'Etudes Prospectives et d'Informations Internationales. This dataset is available on the CEPII website: `http://www.cepii.fr/francgraph/bdd/distances.htm`

if landlocked countries improve their trade facilitation aspects, especially through infrastructure improvements which is the case in Sub-Saharan Africa. The fact of being an island should decrease time thanks to maritime facilities and the presence of ports. Yet, I do not find a significant effect of being an island on time to trade. This may be explained by two reasons. First, islands are normally far which increases the transaction time. In addition, being an island does not guarantee lower level of time without good infrastructure and efficient ports to facilitate the transportation of exported products from production locations to ports and the imported ones from ports to local markets.

Finally, the internet widespread reduces significantly the time to trade: an increase in the internet intensity by 10% reduces the time to import by 1.2% (to export by 0.8%). Therefore, computerized customs authorities would have an important contribution to reducing the transaction time and hence to boosting trade.

In conclusion, this model has a high explanatory power since the independent variables taken into account explain about 78% and 87% of the variation of the time to export and to import respectively.

## 5.2 To What Extent Do Trade Facilitation Aspects Affect Bilateral Trade?

Table 4 displays the results of the gravity model. The analysis will be divided into two parts. The first one includes usual results in line with the literature on gravity (same sign and almost similar values of coefficients). The second one will discuss trade facilitation results. It is noteworthy that sectoral dummies have been added to the regressions in order to capture sectoral specific characteristics.

Regarding the first group of results, I find a coefficient equals to 0.78 for relative production. This coefficient is slightly lower than one but positive and significant. Distance (-0.72) and relative prices (-0.29) have a negative impact on bilateral trade. Contiguity, PTA, colonial links, common colonizer and common languages seem to boost trade significantly (with coefficients equal to 1.7, 0.85, 1.34, 1.13 and 0.27 respectively)[5]. Tariffs have

[5]When standard errors are clustered by country pairs, common language has a significant and positive effect on trade. When they are clustered by exporter and importer, this effect becomes insignificant. However, for all the other variables, results do not change whether I cluster by country pairs or by exporter and importer.

a significantly negative impact on relative imports (-0.16). This coefficient is relatively low comparing to the one obtained in other studies for two reasons. First, the dataset I use has not a sufficiently disaggregated level of flows since I have adopted the three-digits one. Second, other studies neglected trade facilitation aspects and consequently, the tariffs coefficient captures not only the effect of tariff barriers but also other impediments to trade. Interestingly, this coefficient that gives the substitution elasticity is crucial to the analysis as all the coefficients of the trade facilitation variables result from the interaction between the trade facilitation measure and this elasticity of substitution. Such a point should be taken into account to compute the precise effect of trade facilitation aspects as will be shown later. Finally, the constant is significantly high. It reports the border effect among countries that do not belong to a PTA.

[Table 4 about here]

The results presented in Column 1 in Table 4 show the effect of trade facilitation aspects on bilateral trade using the observed time, while Column 2 presents the results using the estimated time. It is worth mentioning that the impact of the latter is higher than the former because the observed time is a raw measure of time while the estimated time takes the effect of trade facilitation aspects into account. Consequently, once time is precisely estimated in order to reflect trade facilitation issues, its effect increases (by 30% for time to import and 24% for that to export). Comparing the two procedures reveals that the impact of the time to import is almost the double of that to export. A one day increase in the number of days to import (to export) reduces trade by 1.24% (0.70%). My results are slightly higher than Hummels (2001) who found that each day saved in shipping time is worth 0.8% ad-valorem for manufactured goods. This is explained by the fact that Hummels (2001) did not take into account the trade facilitation aspects that could affect time, especially the number of documents that explains almost 70% of the transaction time variation. The effect of trade facilitation is even higher when its estimates are computed precisely. As mentioned before, the trade facilitation coefficients ($\mu(1-\sigma)$) consist of two parts: the elasticity of substitution $(1-\sigma)$ and the trade facilitation coefficient $\mu$. Hence, the latter must be divided by the tariff coefficient to get $\mu_1$ and $\mu_2$ which represent the real impact of trade facilitation aspects. The results show that the elasticity of substitution

has, on average a value of 1.2. When the coefficient of the time to export is 0.7, its $\mu$ is 4.3. Similarly, while the coefficient of the time to import coefficient is 1.2, its $\mu$ is 7.7. It is quite obvious that the impact of trade facilitation aspects is then underestimated when such a decomposition is not taken into account.

Column 3 in Table 4 displays the interaction between tariffs and administrative barriers. Such an interaction has a significantly negative impact on relative imports. As it is shown in Figure 2, the higher the tariff, the more impeding the time to import. Therefore, trade facilitation and trade liberalization are complementary rather than substitutes. This shows that trade facilitation (through the investment in public goods, such as transport and communications infrastructure) can greatly enhance the ability of firms and individuals to take advantage of the opportunities that may be created by tariff reduction.

[Figure 2 about here]

This section has presented the effect of trade facilitation on an aggregated level. The next section exhibits the specific effect of trade facilitation on each sector since the latter has asymmetric effects on different products.

## 5.3 Which Products Are the Most Sensitive to Trade Facilitation Aspects?

As a matter of fact, not all products are affected by trade facilitation in the same way. Some products are more sensitive to trade facilitation than others, such as perishable goods (foods and agricultural goods), seasonal products (garments), products with short market lifetime (high technology products) and intermediate goods used in the production process. Consequently, I found it more convenient to run the regressions for different manufacturing sectors. The arising problem concerns the product coverage of the two databases. "Trade and Production" covers manufacturing sectors (300), while "Doing Business" only covers some specific products[6]. However, the regressions are performed even for the sectors that are not included in the Doing Business database. The intuition here is to use the Doing

[6]For more details about the product assumptions, see Appendix 1. It is noteworthy that the results do not change even if the products that are not compatible with Doing Business assumptions are eliminated.

Business variables as a proxy for all manufacturing sectors in order to evaluate the impact of trade facilitation aspects on traded products.

Generally, it is worth noting that the time to import has a stronger effect on many sectors than the time to export. More particulary, beverages and food are highly sensitive to import time. Undoubtedly, such perishable products need fast clearance and quick delivery. An interesting result regarding food, as well as textiles and wearing apparels, is the one associated with the impact of contiguity. It is evident that, as time matters for such products, the trade of food and garments will increase if two countries share a common border. The reason is simple: food will perish and garments must be quickly delivered in order to be used in the corresponding season, not after. By contrast, the results show that many products are either not sensitive to trade facilitation such as tobacco, or weakly sensitive such as furniture.

[Tables 5 and 6 about here]

Last but not least, many high value-added products, like transport and electrical equipments, are found to be highly affected by the transaction time. This result seems to be a bit paradoxical because, presumably, those products should not be sensitive to trade facilitation. Moreover, they are neither perishable, nor seasonal. Nonetheless, they have a crucial role in the production process as they are used either as inputs for other industries or to transport intermediate inputs and exported goods from production locations to ports and imported ones from ports to markets. In addition, some of these sectors (that are either intermediate or high value-added products) need a lot of documents in order to guarantee their conformity to the international standards of high-technology products, which in turn increases the transaction time and consequently decreases trade. Professional and scientific equipments are also highly sensitive to time since they have a short market lifetime (for instance computers).

In sum, it is quite clear that the impact of trade facilitation is greater for highly value-added products, perishable, seasonal and intermediate goods. Thus, it covers a quite important range of products. That is why it will generate high gains through quicker (less time and documents) and more computerized (more technology) trade procedures.

# 6 Estimating Tariff Equivalents of Trade Facilitation

Many studies underlined the fact that developing countries would capture two thirds of the gains from a Doha Development Agreement on trade facilitation. In order to evaluate the impact of trade facilitation, tariff equivalents should be calculated. The latter is more appropriate to determine the value of administrative barriers than other techniques. Kee et al. (2009) argue that the literature relies on outcome measures, such as import shares that may summarize the impact of all the trade policy instruments. Yet, they may capture other things not related to the barriers such as macroeconomic shocks. Another approach that is based on some ad-hoc criteria relies on tariffs and assumes that all other instruments are correlated with them. This is why I use a more appropriate technique by estimating the ad-valorem equivalents of the administrative barriers. Such methodology generates precise and consistent figures of the restrictiveness of these barriers.

To do so, I follow the methodology adopted by Kee, Nicita and Olarreaga (2009) where they estimate AVEs for non-tariff barriers based on a gravity model. Similarly, I rely on the gravity model presented above to compute AVEs for administrative barriers. To make trade facilitation aspects comparable with AVEs, I have to transform the quantity impact into price equivalents. This yields the AVEs of the time to export $ave^{Time}_{exp,j,n}$ and the time to import $ave^{Time}_{imp,i,n}$ noted as $ave^{Time}_{exp,j,n} = dlog(p_{j,n})$ and $ave^{Time}_{imp,i,n} = dlog(p_{i,n})$ respectively. Hence, the gravity equation is differentiated with respect to $\widehat{Time}_{imp,i,n}$ and $\widehat{Time}_{exp,j,n}$:

$$\frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(\widehat{Time}_{imp,i,n})} = \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(p^d_{i,n})} . \frac{d\ln(p^d_{i,n})}{d\ln(\widehat{Time}_{imp,i,n})} = \varepsilon_{i,n} . ave^{Tim}_{imp,i,n} \tag{18}$$

$$\frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(\widehat{Time}_{exp,j,n})} = \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(p^d_{j,n})} . \frac{d\ln(p^d_{j,n})}{d\ln(\widehat{Time}_{exp,j,n})} = \varepsilon_{j,n} . ave^{Time}_{exp,j,n} \tag{19}$$

where $\varepsilon_{j,n}$ is the import demand elasticity of good $n$ in country $j$ and $p^d_{j,n}$ the domestic price in country $j$.

Hence, solving (18) and (19) for $ave^{Time}_{exp,j,n}$ and $ave^{Time}_{imp,i,n}$ , I get:

$$ave^{Time}_{imp,i,n} = \frac{1}{\varepsilon_{i,n}} . \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(\widehat{Time}_{imp,i,n})} \quad ; ave^{Time}_{exp,j,n} = \frac{1}{\varepsilon_{j,n}} . \frac{d\ln(\frac{m_{ij,n}}{m_{ii,n}})}{d\ln(\widehat{Time}_{exp,j,n})} \tag{20}$$

In other terms, the AVEs can be computed by taking the ratio between the coefficient of the predicted time to export (and that to import) and the elasticity of demand as follows:

$$ave^{Time}_{imp,i,n} = \frac{(\sigma-1)\mu_1^{Time_{imp,i,n}}}{\varepsilon_{i,n}} \quad ; ave^{Time}_{exp,j,n} = \frac{(\sigma-1)\mu_2^{Time_{exp,j,n}}}{\varepsilon_{j,n}} \tag{21}$$

This yields the ad valorem equivalent of one day to export and to import. To determine the AVE specific to each country, the AVE of one day is multiplied by the number of days to export and to import available in the "Doing Business" dataset. I have calculated the AVEs for manufacturing products at the three-digits level (ISIC-3) for some 138 countries[7]. Table 7 presents the aggregated AVEs for different sectors while Table 8 compares them for developed and developing countries.

[Tables 7 and 8 about here]

Some sectors have higher ad-valorem tariffs than others. Perishable and seasonal products are more impacted by the time to import than the time to export. For instance, the figures for food (perishable) are respectively 8.4% and 18.5% for the time to export and the time to import. The AVEs of beverages are higher with some 29.5% for the time to import and 19.5% for that to export. Similarly, garments (seasonal goods) are highly sensitive to the time to import with 49.3%. High value-added and intermediate products are more affected by the time to export than that to import. For professional and scientific equipments as well as electrical machines, the time to export is about 26.2% and 28.1% respectively, with lower figures for the time to import (13.2% and 24.4% respectively). Finally, products not belonging to any of the previous groups are not sensitive to trade facilitation, such as tobacco which is neither sensitive to the time to export nor to the time to import. On the country level, the calculated AVEs displayed in Table 8 show that the difference between developed and developing countries is very pronounced since the average of the AVE of the time to export (to import) is 4.9% (7.9%) for the former and

[7]Ad valorem tariff equivalent for the whole sample are available upon request.

17.6% (34.2%) for the latter. The best practise among developed countries is the Unites States with 0.94% and 0.84% for the time to import and to export respectively followed by Japan. For developing countries, Brazil is found to be the best practise with 3.59% and 2.17% for the time to import and to export respectively. By contrast, the figures of the worst performances are found in the cases of Slovenia (with 16.7% and 20.1% for the time to export and to import respectively) among developed countries and Chad (with 54.4% and 128.5% respectively) among developing ones.

For the sake of robustness checks, I have computed the AVEs using the elasticities of substitution that has been estimated from my model. The Spearman's rank correlation coefficient between the AVEs computed using Kee et al. (2008) elasticities and those estimated using the estimated ones is 0.88 for time to export and 0.86 for time to import. This shows that both of the two versions of AVEs are quite close[8]. Yet, using the estimated elasticities generates higher AVEs since the elasticities values are lower than those of Kee et al. (2008).

# 7 Conclusion

The present paper quantifies the impact of numerous trade facilitation aspects on bilateral trade. It makes empirical contributions related to the impact of trade facilitation on bilateral trade. First, a theoretical gravity model that explicitly includes trade facilitation aspects has been estimated. Second, the outcome of the gravity model is used to estimate AVEs of the administrative barriers. The novelty of those time estimates is that they reflect the share of time explained by bureaucracy, internet, corruption and geographical aspects. In other words, only the aspects related to trade facilitation are considered. The main findings show that internet, bureaucracy, corruption and geographic variables significantly affect the transaction time to import and to export. Time to import has a higher negative impact on trade than time to export. When sectoral characteristics are taken into account, some perishable (food and beverages), seasonal (wearing apparels) and high-value added products appear to be more sensitive to transaction time than others. Such results are also confirmed by the values of the AVEs.

[8]For more details, see Tables 11 and 12 in Appendix 3.

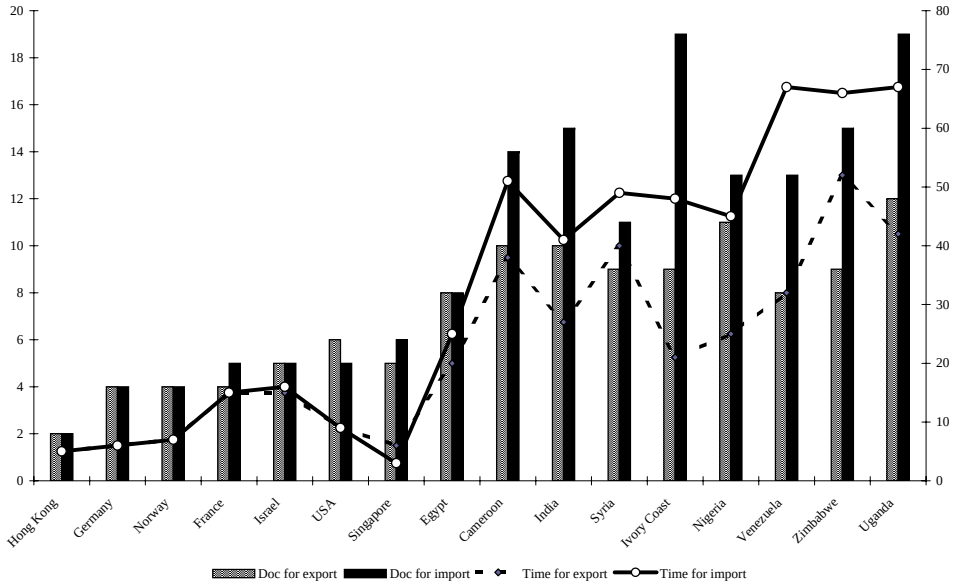
From a policy implication point of view, this study gives quite important results. First, as more documents imply lengthier time, the initiative of a "paperless world" is crucial for trade facilitation. Reducing or even eliminating paper documents that could be replaced electronically and submitted through a single window would highly simplify trade procedures, reduce the time of inspection as well as the delivery of imported products. Recall that impediments induced by red tape costs do not have any rent or revenue loss once they are dismantled. Thus, welfare implications are quite high since administrative costs are, *de jure*, a "deadweight loss". Last, trimming down such impediments would benefit to all trade partners, which is not the case of tariff elimination due to loss of tariff receipts. Yet, customs fraud may be perceived as a rent generated by those barriers and therefore, *de facto*, eliminating non-official barriers could reduce the welfare of public officials working in the custom authorities. As a policy implication, governments should increase their wages or provide them with financial incentives in order to reduce corruption and hence facilitate trade (Jean and Mitaritonna, 2010).

The main shortcomings of this paper are strictly related to data issues. First, regarding the infrastructure quality, many aspects must be taken into account such as port efficiency, paved roads, and so on, in order to have a more precise estimation of their impact on trade flows. Furthermore, this model should be estimated using panel data if data availability allows to do so. Finally, AVEs of the time to export and to import should be estimated for agriculture and services in order to determine to what extent such products are more or less sensitive to trade facilitation. The latter could hence be used in policy modeling, especially computable general equilibrium models.

# Tables and Figures

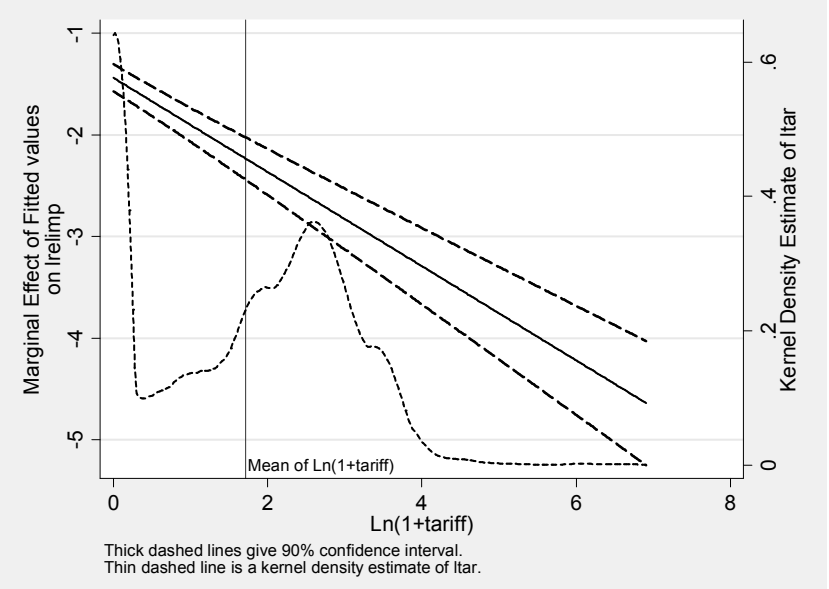
## 1. Descriptive Statistics

Figure 1:
Document and Time for Export and Import




Source: Doing Business, the World Bank.

Figure 2:
Interaction between Tariffs and Time to Import




Source: Constructed by the author.

Table 1: Time and Documents for Developed and Developing countries

| Variable | Developing | Developed |
|---|---|---|
| Exporter Doc for Exp. | 6.96 | 7.16 |
| Importer Doc for Imp. | 9.89 | 6.04 |
| Exporter Time for Exp. | 25.65 | 27.42 |
| Importer Time for Imp. | 37.96 | 12.93 |
| Internet widespread | 0.84 | 4.45 |
| Transparency (CPI) | 3.20 | 7.41 |

Source: Constructed by the author from "Doing Business", the World Bank and Transparency International, 2006.

Table 2: Time and Document for Landlocked and Not landlocked countries

| | Landlocked | | | Not Lanlocked | | |
|---|---|---|---|---|---|---|
| Variable | Mean | Min | Max | Mean | Min | Max |
| Doc. for exp. | 7.47 | 4 | 14 | 6.66 | 3 | 14 |
| Time for exp. | 36.37 | 6 | 89 | 21.83 | 5 | 102 |
| Doc. for imp. | 9.35 | 4 | 19 | 8.47 | 1 | 18 |
| Time for imp. | 43.55 | 6 | 104 | 26.1 | 3 | 101 |

Source: Constructed by the author from "Doing Business", the World Bank, 2006.

# 2. Regressions Results

Table 3: First Step: Estimating Time to Export and to Import

| | (1) Ln(Time Exp.) | (2) Ln(Time Imp.) |
|---|---|---|
| Landlocked Imp. | | 0.161** |
| | | (0.0635) |
| Island imp. | | 0.171 |
| | | (0.125) |
| Ln(Internet Imp.) | | -0.125*** |
| | | (0.0197) |
| Ln(Doc. Imp.) | | 0.623*** |
| | | (0.0853) |
| Ln(Procedure Imp.) | | 0.0594 |
| | | (0.0689) |
| Ln(Corruption Imp.) | | -0.440*** |
| | | (0.0907) |
| Tariff Dummy | | 0.0155 |
| | | (0.0433) |
| Landlocked Exp. | 0.275*** | |
| | (0.0677) | |
| Island Exp. | 0.0684 | |
| | (0.124) | |
| Ln(Internet Exp.) | -0.0768*** | |
| | (0.0256) | |
| Ln(Doc. Exp.) | 0.813*** | |
| | (0.112) | |
| Ln(Procedure Exp.) | -0.0367 | |
| | (0.0760) | |
| Ln(Corruption Exp.) | -0.499*** | |
| | (0.104) | |
| Constant | 2.215*** | 2.286*** |
| | (0.346) | (0.341) |
| Observations | 59239 | 56127 |
| R-squared | 0.786 | 0.874 |

Notes: (i.)Robust standard errors in parentheses.
(ii.) Standard errors are clustered by exporter in column 1 and by importer in column 2.
(iii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.
(iv.) Corruption is measured by the corruption perception index ranked from 0 (most corrupted) to 10 (least corrupted).

Table 4: Second Step: Impact of Trade Facilitation on Bilateral Trade

| | (1) Ln (Rel. Imp.) (obs. time) | (2) Ln (Rel. Imp.) (est. time and clust by pairs) | (3) Ln (Rel. Imp.) (est. time and clust by exp and imp) | (4) Ln (Rel. Imp.) (est. time and interaction) |
|---|---|---|---|---|
| Ln(Rel. Prod.) | 0.779*** | 0.779*** | 0.779*** | 0.782*** |
| | (0.0119) | (0.0124) | (0.0341) | (0.0122) |
| | | | (0.0270) | |
| Ln(Rel. Dist.) | -0.709*** | -0.707*** | -0.707*** | -0.738*** |
| | (0.0387) | (0.0393) | (0.0698) | (0.0393) |
| | | | (0.0884) | |
| Ln(Rel. Price) | -0.242*** | -0.292*** | -0.292*** | -0.278*** |
| | (0.0825) | (0.0870) | (0.159) | (0.0858) |
| | | | (0.108) | |
| Ln(Tariff+1) | -0.241*** | -0.161*** | -0.161*** | -0.372*** |
| | (0.0339) | (0.0358) | (0.0576) | (0.0437) |
| | | | (0.0649) | |
| Contiguity | 1.532*** | 1.694*** | 1.694*** | 1.607*** |
| | (0.248) | (0.277) | (0.322) | (0.272) |
| | | | (0.274) | |
| Common Lang. | 0.314* | 0.274* | 0.274 | 0.372** |
| | (0.162) | (0.160) | (0.231) | (0.157) |
| | | | (0.220) | |
| Colony | 1.418*** | 1.344*** | 1.344*** | 1.239*** |
| | (0.215) | (0.204) | (0.218) | (0.201) |
| | | | (0.205) | |
| Com. Col. | 1.098*** | 1.133*** | 1.133*** | 1.080*** |
| | (0.207) | (0.223) | (0.290) | (0.221) |
| | | | (0.209) | |
| PTA | 0.891*** | 0.847*** | 0.847*** | 0.896*** |
| | (0.128) | (0.133) | (0.169) | (0.127) |
| | | | (0.198) | |
| Ln(Time Imp.) | -0.950*** | | | |
| | (0.0661) | | | |
| Ln(Time Exp.) | -0.543*** | | | |
| | (0.0573) | | | |
| Ln($\widehat{TimeImp.}$) | | -1.239*** | -1.239*** | -1.438*** |
| | | (0.0837) | (0.126) | (0.0812) |
| | | | (0.223) | |
| Ln($\widehat{TimeExp.}$) | | -0.698*** | -0.698*** | -0.676*** |
| | | (0.0810) | (0.252) | (0.0800) |
| | | | (0.104) | |
| Ln($\widehat{TimeImp.}$)*Ln(Tar) | | | | -0.463*** |
| | | | | (0.0510) |
| Constant | -0.678** | -2.110*** | -2.110*** | -0.834* |
| | (0.325) | (0.437) | (0.777) | (0.447) |
| | | | (0.759) | |
| Sector Dummies | YES | YES | YES | YES |
| Observations | 59239 | 56127 | 56127 | 56127 |
| R-squared | 0.594 | 0.589 | 0.589 | 0.595 |

Notes: (i.) Robust standard errors in parentheses.
(ii.) Standard errors are clustered by country pairs in columns 1, 2 and 4. In column 3, they are clustered by exporter (standard errors shown in the first row) and importer (those shown in the second row).
(iii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.

Table 5: Impact of Trade Facilitation variables on the sectoral level (1)

| | Food 311 | Beverages 313 | Tobacco 314 | Textiles 321 | Wearing 322 | Leather prod. 323 | Furniture 332 | Paper prod 341 | Chemicals 352 | Petro. Ref. 353 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) |
| Ln(Rel. Prod.) | 0.738*** | 0.794*** | 0.741*** | 0.767*** | 0.883*** | 0.635*** | 0.637*** | 0.795*** | 0.741*** | 0.824*** |
| | (0.0338) | (0.0446) | (0.0938) | (0.0274) | (0.0519) | (0.0542) | (0.0452) | (0.0266) | (0.0350) | (0.0397) |
| Ln(Rel. Dist.) | -0.233*** | -0.528*** | -0.658 | -0.939*** | -0.758*** | -0.609*** | -0.600*** | -0.934*** | -0.560*** | -0.657*** |
| | (0.0854) | (0.112) | (0.410) | (0.0898) | (0.119) | (0.184) | (0.133) | (0.0875) | (0.0695) | (0.127) |
| Ln(Rel. Price) | -0.349 | -0.297 | 0.243 | -2.127*** | -2.027*** | -0.273 | -0.0968 | -0.398 | 0.0313 | 0.00875 |
| | (0.455) | (0.323) | (0.489) | (0.262) | (0.367) | (0.342) | (0.356) | (0.325) | (0.222) | (0.306) |
| Ln(Tariff+1) | -0.262*** | -0.184 | 0.0796 | -0.175** | -0.316*** | -0.577*** | -0.184 | -0.197* | 0.0151 | -0.386*** |
| | (0.0913) | (0.119) | (0.259) | (0.0736) | (0.0719) | (0.161) | (0.127) | (0.101) | (0.106) | (0.130) |
| Contiguity | 2.704*** | 2.146*** | 1.895* | 1.850*** | 1.195** | 0.704 | 0.897* | 1.502*** | 3.055*** | 2.414*** |
| | (0.499) | (0.551) | (1.034) | (0.380) | (0.524) | (0.670) | (0.472) | (0.311) | (0.571) | (0.538) |
| Common Lang. | 0.689 | -0.146 | -0.929 | 0.105 | -0.282 | -0.420 | 1.177*** | -0.752 | 1.482*** | 0.745 |
| | (0.490) | (0.485) | (0.627) | (0.247) | (0.345) | (0.444) | (0.294) | (0.532) | (0.362) | (0.567) |
| Colony | 1.037** | 2.464*** | 2.031*** | 1.368*** | 0.354 | 2.271*** | 0.804* | 1.773*** | 1.992*** | 0.807 |
| | (0.432) | (0.463) | (0.491) | (0.519) | (0.284) | (0.538) | (0.418) | (0.362) | (0.317) | (0.575) |
| Com. Col. | 1.581*** | 1.131** | 2.025** | 0.114 | 1.601*** | 1.648*** | 1.032*** | 1.749*** | 1.078*** | 0.400 |
| | (0.484) | (0.540) | (0.808) | (0.381) | (0.432) | (0.560) | (0.352) | (0.380) | (0.312) | (0.974) |
| PTA | 1.247*** | 0.622** | 0.416 | 0.554** | 0.501* | 0.792** | 1.040*** | 1.065*** | 1.015*** | 1.053*** |
| | (0.313) | (0.316) | (1.161) | (0.263) | (0.296) | (0.366) | (0.263) | (0.245) | (0.216) | (0.312) |
| Ln($\widehat{TimeImp.}$) | -1.000*** | -1.342*** | -0.0348 | -1.941*** | -2.290*** | -0.870*** | -1.786*** | -0.844*** | -1.230*** | -1.202*** |
| | (0.152) | (0.201) | (0.400) | (0.177) | (0.340) | (0.286) | (0.301) | (0.262) | (0.218) | (0.272) |
| Ln($\widehat{TimeExp.}$) | -0.557** | -1.052*** | -0.867** | -1.053*** | 0.317 | -0.286 | -0.140 | -0.962*** | -0.586** | -1.535*** |
| | (0.228) | (0.240) | (0.394) | (0.176) | (0.324) | (0.257) | (0.243) | (0.206) | (0.234) | (0.179) |
| Constant | -2.493*** | -0.557 | -6.007*** | 5.043*** | 2.938*** | 0.0926 | 0.337 | 0.674 | -2.742*** | 3.019*** |
| | (0.892) | (0.943) | (1.896) | (0.599) | (0.715) | (1.258) | (1.165) | (0.726) | (0.667) | (0.976) |
| Observations | 2610 | 2475 | 688 | 2713 | 1309 | 1896 | 1659 | 3310 | 2706 | 2428 |
| R-squared | 0.482 | 0.430 | 0.480 | 0.631 | 0.657 | 0.411 | 0.424 | 0.580 | 0.576 | 0.670 |

Notes: (i.)Robust standard errors in parentheses.
(ii.)Standard errors are clustered by country pair.
(iii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.

Table 6: Impact of Trade Facilitation variables on the sectoral level (2)

| | Rubber prod | Plastic | Iron steel | Non-fer Met | Fab. Metal | Machinery | Elect mach | Transport | Prof sci equi | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| | 355 | 356 | 371 | 372 | 381 | 382 | 383 | 384 | 385 | 390 |
| | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) | Ln (Rel. Imp.) |
| Ln(Rel. Prod.) | 0.973*** | 0.735*** | 0.790*** | 0.624*** | 0.792*** | 0.769*** | 0.731*** | 0.865*** | 0.737*** | 0.680*** |
| | (0.0410) | (0.0408) | (0.0355) | (0.0710) | (0.0339) | (0.0293) | (0.0353) | (0.0385) | (0.0514) | (0.0450) |
| Ln(Rel. Dist.) | -0.977*** | -0.958*** | -1.026*** | -0.563*** | -0.913*** | -0.643*** | -0.614*** | -0.827*** | -0.241* | -0.0667 |
| | (0.0820) | (0.114) | (0.154) | (0.204) | (0.0890) | (0.0823) | (0.126) | (0.153) | (0.131) | (0.112) |
| Ln(Rel. Price) | 0.326 | -1.794*** | -0.0495 | 1.431** | -0.634** | -0.115 | -1.522*** | 0.111 | 0.104 | -1.077*** |
| | (0.477) | (0.385) | (0.361) | (0.678) | (0.305) | (0.323) | (0.400) | (0.471) | (0.253) | (0.348) |
| Ln(Tariff+1) | -0.00612 | -0.201* | 0.206 | 0.203 | -0.239** | -0.107 | -0.366*** | 0.169 | -0.0227 | -0.314* |
| | (0.136) | (0.119) | (0.150) | (0.213) | (0.113) | (0.0935) | (0.134) | (0.107) | (0.107) | (0.174) |
| Contiguity | 0.771 | 2.243*** | 1.334*** | 2.995*** | 1.479*** | 1.176*** | 1.122** | 1.078* | 1.034** | 1.723*** |
| | (0.559) | (0.748) | (0.501) | (0.477) | (0.332) | (0.374) | (0.444) | (0.587) | (0.433) | (0.495) |
| Common Lang. | 0.133 | 0.891*** | -0.505 | 0.783* | 0.374* | 0.579*** | -0.337 | -0.116 | 0.359 | 1.917** |
| | (0.276) | (0.287) | (0.320) | (0.407) | (0.218) | (0.196) | (0.279) | (0.352) | (0.310) | (0.957) |
| Colony | 1.463*** | 1.479** | 1.307*** | 1.682** | 1.373*** | 1.230*** | 1.616*** | 1.002*** | 1.444*** | 0.795 |
| | (0.521) | (0.622) | (0.409) | (0.748) | (0.249) | (0.370) | (0.316) | (0.354) | (0.282) | (0.612) |
| Com. Col. | 0.978* | 1.356*** | 1.863*** | 2.910*** | 1.288*** | 1.527*** | 0.774* | -0.395 | 1.407*** | 1.288 |
| | (0.566) | (0.376) | (0.582) | (0.544) | (0.448) | (0.311) | (0.449) | (0.884) | (0.379) | (0.938) |
| PTA | -0.0398 | 1.170*** | 0.708 | 0.0739 | 0.641** | 0.856* | 0.581* | 0.613 | 0.376* | 1.939*** |
| | (0.332) | (0.226) | (0.619) | (0.398) | (0.301) | (0.467) | (0.324) | (0.389) | (0.201) | (0.428) |
| Ln($\widehat{TimeImp.}$) | -2.272*** | -1.044*** | -0.782** | -2.129*** | -1.140*** | 0.267 | -1.042*** | -2.422*** | -0.363* | -1.303*** |
| | (0.248) | (0.236) | (0.340) | (0.448) | (0.275) | (0.309) | (0.342) | (0.391) | (0.205) | (0.304) |
| Ln($\widehat{TimeExp.}$) | -0.819*** | -0.883*** | -0.544* | -0.724* | -0.799*** | -1.655*** | -1.554*** | -1.432*** | -1.077*** | -1.575*** |
| | (0.202) | (0.241) | (0.305) | (0.405) | (0.175) | (0.257) | (0.283) | (0.333) | (0.179) | (0.359) |
| Constant | 5.390*** | 0.521 | -0.478 | 3.386*** | 0.985 | 0.282 | 4.230*** | 6.655*** | -0.894 | 2.663** |
| | (0.764) | (0.927) | (1.871) | (1.279) | (0.739) | (0.843) | (1.234) | (0.964) | (0.662) | (1.301) |
| Observations | 2691 | 3200 | 1541 | 986 | 2791 | 2064 | 1914 | 1873 | 1262 | 1527 |
| R-squared | 0.666 | 0.614 | 0.533 | 0.472 | 0.631 | 0.779 | 0.609 | 0.664 | 0.745 | 0.445 |

Notes: (i.)Robust standard errors in parentheses.
(ii.)Standard errors are clustered by country pair.
(iii.) ***, ** and * represent respectively statistical significance at the 1%, 5% and 10% levels.

Table 7: Estimating Ad Valorem Equivalents For Time of Trade: By Sectors

| Sector | AVE Time Imp. (%) | AVE Time Exp. (%) |
|---|---|---|
| Food | 18.56 | 8.42 |
| Beverage | 29.51 | 19.47 |
| Tobacco | 0.01 | 7.75 |
| Textiles | 34.07 | 16.06 |
| Wearing Apparel | 49.32 | 0.02 |
| Leather | 15.91 | 0.02 |
| Footwear | 51.65 | 0.02 |
| Wood | 4.52 | 0.01 |
| Furniture | 53.72 | 0.03 |
| Paper | 17.40 | 16.42 |
| Printing and Publishing | 36.70 | 15.46 |
| Industrial chemicals | 14.87 | 9.57 |
| Other Chemicals | 27.72 | 31.34 |
| Petroleum refineries | 20.52 | 11.62 |
| Misc. Petro./ coal | 27.70 | 13.58 |
| Rubber | 65.77 | 20.05 |
| Plastic | 28.39 | 21.25 |
| Iron and Steel | 12.80 | 7.55 |
| Non Ferrous Metal | 46.61 | 14.17 |
| Fab. Metal | 24.73 | 14.09 |
| Machinery expect electric | 0.02 | 27.17 |
| Machinery electric | 24.42 | 28.09 |
| Transport | 32.60 | 16.36 |
| Prof and Scientific equi | 13.24 | 26.22 |
| Other Industries | 37.02 | 34.30 |

Source: Constructed by the author from the regressions results.
Note: AVEs are in percentage.

Table 8: Estimating Ad Valorem Equivalents For Time of Trade: By Countries

| | Developing | | | Developed | | |
|---|---|---|---|---|---|---|
| | Mean | Minimum | Maximum | Mean | Minimum | Maximum |
| Time to Imp. | 37 | 9 | 102 | 13 | 3 | 34 |
| Time to Exp. | 31 | 9 | 89 | 12 | 5 | 28 |
| AVE time Imp. | 34.15 | 3.59 | 128.48 | 7.98 | 0.94 | 20.13 |
| AVE Time Exp. | 17.57 | 2.17 | 54.44 | 4.91 | 0.89 | 16.98 |

Source: Constructed by the author from the regressions results.
Notes: (i.) Time to export and that to import are recorded in days.
(ii.) AVEs are in percentage.

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# Appendix 1: Data Description

This appendix presents the definition as well as the source of each variable used in the database. Data have been collected from several sources. Regarding the trade facilitation variables, "Doing Business"[9] has been used. This dataset compiles procedural requirements for exporting and importing a standardized cargo of goods by ocean transport. Every official procedure for exporting and importing the goods is recorded from the contractual agreement between the two parties to the delivery of goods along with the time and cost necessary for completion. All documents required for clearance of the goods across the border are also recorded. For further details, check `www.doingbusiness.org`.

## First Step: Time Determinants

### Dependent Variable

The logarithm of the **Time** to export and to import have been used in the first step estimation. It is recorded in calendar days. The time calculation for a procedure starts from the moment it is initiated and runs until it is completed. If a procedure can be accelerated for an additional cost, the fastest legal procedure is chosen. It is assumed that neither the exporter nor the importer wastes time and that each commits to completing each remaining procedure without delay. Procedures that can be completed in parallel are measured as simultaneous procedures but with the same time frame for completion.

### Independent Variable

For trade bureaucracy, **documents to export and to import** have been used. "Doing Business" defines them as all documents required to export and import the goods. It is assumed that the contract has already been agreed upon and signed by both parties. These documents include bank documents, customs declaration and clearance documents, port filing documents, import licenses and other official documents exchanged between concerned parties. Documents filed simultaneously are considered different documents but with the same time frame for completion.

[9]This part presents the scope and the description of Doing Business. It is available on www.doingbusiness.org

**The number of procedures to start a business** is taken from the Doing Business database. It gives all the procedures that an entrepreneur needs to carry out to obtain all the necessary permits, to notify and file with all requisite authorities and hence to launch a legally operating firm involved in industrial or commercial activity.

**The corruption** variable comes from the Corruption Perceptions Index (CPI) developed by Transparency International. It is based on 13 independent surveys and indicates the perceived level of public-sector corruption in a country. While the CPI is ranked from from 0 (most corrupted) to 10 (least corrupted), it is used as a proxy of customs fraud.

**The Internet** variable comes from the World Development Indicators database available on the World Bank web site. This variable determines the number of internet users per 1000 people and is the best proxy for technological intensity. Thus, it is used as a proxy for the intensity of e-commerce.

**Geographic variables** (the fact of being landlocked or an island) are taken from the Distance dataset available on the CEPII website.

## Second Step: Gravity Model

### Dependant Variable

The dependant variable is the ratio between bilateral and internal trade flows as explained below:

**Bilateral Flows:** The data used is a cross section in 2004. It comes comes from CEPII's[10] "Trade and Production" database[11]. The mirror flows, available in Nicita and Olarreaga (2001), were used along with the CEPII database on international trade (BACI)[12], which is also based on COMTRADE data.

**Internal Flows**: Internal trade flows are in current US$ and are calculated as the difference between domestic primary and secondary sector production minus exports. This variable comes also from "Trade and Production".

[10] They are available on CEPII's website.

[11] As the available data from "Trade and Production" end in 2004 and the available data from "Doing Business" start in 2006, these two databases have been merged under the following assumption: institutional variables of "Doing Business" would not vary much between 2004 and 2006, making their combination possible.

[12] BACI is the new CEPII world database for international trade analysis at the product-level.

**Explanatory Variables**

**Tariff and Production Data**: First, the original data (Nicita and Olarreaga, 2001) come from the United Nations sources: COMTRADE and UNIDO. Despite a wide covering, the World Bank files contain a lot of missing values for production figures in recent years. This is the reason why the Trade and Production database was largely extended using more recent versions of the UNIDO CD-ROM together with OECD STAN data for OECD members.

**Distance Variable**: comes from the distance database developed by the CEPII. The methods used in this database allow to generate many indicators on internal distance, weighted distance, etc. This allows us to estimate the model derived in Section 5. In my model, I use the relative distance defined as the ratio between bilateral and internal distance. The former is the distance between two capitals and the latter is a proxy of average distance between producers and consumers in a country. It is computed as follows $d_{ii} = 0.67\sqrt{area/\pi}$. For further details regarding this measure, see Head and Mayer (2002a).

**Other Classical Gravitational Variables**: come from the CEPII dataset, namely dummy variables indicating whether the two countries are contiguous, share a common language, have had a common colonizer after 1945, have ever had a colonial link. Some other variables are not bilateral but country specific. They are dummies indicating whether a country is landlocked and an island. The variable of belonging to the same PTA comes from the dataset developed by Martin et al. (2008) available on `http://team.univ-paris1.fr/teamperso/mayer/data/data.htm`.

**Relative Prices**: come from the dataset that has been constructed by Gaulier et al. (2008). This dataset is built from the unit value given by the BACI database at the product level. In my regressions, the Laspeyres index is used. Others indices (namely Paasche, Fisher and Tornqvist indices) have been used but the results did not change.

**Robustness Check Variables**: As mentioned before, in order to eliminate multi-

collinearity issues, the factor analysis method is used. The idea behind is to calculate one index taking all of the trade facilitation aspects into account. It is quite obvious that the results remain robust because trade facilitation aspects have a highly significant and negative effect on bilateral trade. The coefficients of the other variables remain significant, with the same sign and almost the same values. Moreover, for the sake of robustness check and studying the impact of more aspects of trade facilitation, the Institutional Profiles database have been used[13]. It is worth mentioning that customs efficiency has a positive and significant effect on trade. By contrast, transaction security appears to reduce trade by 11% because after the 9-11 events developed countries imposed many constraints in order to secure trade. These constraints reduced trade flows coming from developing countries. Fraud has a significant negative effect on trade. The internet widespread remains significant and boosts trade. A very important result is the one concerning geographical variables (being landlocked or an island). Once I control for many trade facilitation aspects, these variables become non-significant. Hence, more trade facilitation means overcoming trade barriers induced by geographical impediments. The results using the factor analysis and the Institutional Profiles database are available upon request.

[13]Institutional Profiles (2001) is a survey conducted by researchers based at the French Ministry of the Economy, Finance and Industry (MINEFI) and the French Development Agency (AFD) in the countries covered (51 developed and developing countries). Data have been collected through a questionnaire describing the institutional characteristics of these countries and was split in 4 sections: section A is related to the institutional environment, section B to the market for goods and services, section C concerns the financial system and section D the labor market as well as social interactions. Out of the legion of indicators included in the database, only 14 have been chosen based on their appropriateness to trade facilitation.

# Appendix 2: Lists of Countries and Sectors

Table 9: List of Countries by code iso-3

| Country | Country | Country | Country | Country |
|---|---|---|---|---|
| Afghanistan | Costa Rica | India | Mongolia | Sao Tome and Principe |
| Angola | Czech Rep. | Ireland | Mozambique | Suriname |
| Albania | Germany | Iran | Mauritania | Slovakia |
| United Arab Emirates | Djibouti | Iraq | Mauritius | Slovenia |
| Argentina | Dominica | Iceland | Malawi | Sweden |
| Armenia | Denmark | Israel | Malaysia | Swaziland |
| Antigua and Barbuda | Dom. Rep. | Italy | Namibia | Seychelles |
| Australia | Algeria | Jamaica | Niger | Syria |
| Austria | Ecuador | Jordan | Nigeria | Chad |
| Azerbaijan | Egypt | Japan | Nicaragua | Togo |
| Burundi | Eritrea | Kazakstan | Netherlands | Thailand |
| Belgium and Luxembourg | Spain | Kenya | Norway | Tajikistan |
| Benin | Estonia | Kyrgyzstan | Nepal | East Timor |
| Burkina Faso | Ethiopia | Cambodia | New Zealand | Tonga |
| Bangladesh | Finland | Kiribati | Oman | Trinidad and Tobago |
| Bulgaria | Fiji | Saint Kitts and Nevis | Pakistan | Tunisia |
| Bosn. and Herzeg. | France | Korea | Panama | Turkey |
| Belarus | Micronesia | Kuwait | Peru | Taiwan |
| Belize | Gabon | Lao Rep. | Philippines | Tanzania |
| Bolivia | United Kingdom | Lebanon | Palau | Uganda |
| Brazil | Georgia | Liberia | Papua New Guinea | Ukraine |
| Brunei Darussalam | Ghana | Saint Lucia | Poland | Uruguay |
| Bhutan | Guinea | Sri Lanka | Puerto Rico | United States of America |
| Botswana | Gambia | Lesotho | Portugal | Uzbekistan |
| Cen. Afr. Rep | Guinea-Bissau | Lithuania | Paraguay | St Vinc. and Grenad |
| Canada | Greece | Luxembourg | Romania | Venezuela |
| Switzerland | Grenada | Latvia | Russia | Viet Nam |
| Chile | Guatemala | Morocco | Rwanda | Vanuatu |
| China | Guyana | Moldova, Rep.of | Saudi Arabia | Samoa |
| Côte d'Ivoire | Hong Kong | Madagascar | Sudan | Yemen |
| Cameroon | Honduras | Maldives | Senegal | Serbia and Mont. |
| Congo | Croatia | Mexico | Singapore | South Africa |
| Colombia | Haiti | Marshall Isl. | Solomon Islands | Congo Demo. Rep. |
| Comoros | Hungary | Macedonia | Sierra Leone | Zambia |
| Cape Verde | Indonesia | Mali | El Salvador | Zimbabwe |

Source: Constructed by the author from Trade and Production database.

Table 10: List of Manufacturing Sectors by code

| Code | Sector | Code | Sector |
|---|---|---|---|
| 311 | Food products | 354 | Misc. petrol./coal prod. |
| 313 | Beverages | 355 | Rubber products |
| 314 | Tobacco | 356 | Plastic products |
| 321 | Textiles | 361 | Pottery china earthenware |
| 322 | Wearing apparel | 362 | Glass and products |
| 323 | Leather products | 369 | Other non-metal min. prod. |
| 324 | Footwear | 371 | Iron and steel |
| 331 | Wood products except furniture | 372 | Non-ferrous metals |
| 332 | Furniture except metal | 381 | Fabricated metal products |
| 341 | Paper and products | 382 | Machinery except electrical |
| 342 | Printing and publishing | 383 | Machinery electric |
| 351 | Industrial chemicals | 384 | Transport equipment |
| 352 | Other chemicals | 385 | Prof. and sci. equipment |
| 353 | Petroleum refineries | 390 | Other manufactured products |

Source: Constructed by the author from Trade and Production database

# Appendix 3: Robustness Check for AVEs using the estimated $\sigma$

Table 11: AVEs using the Estimated Elasticities: by Sectors

| Sector | AVE Time Exp. | New AVE Time Exp. | AVE Time Imp. | New AVE Time Imp. |
|---|---|---|---|---|
| Food | 8.83 | 11.59 | 18.34 | 24.44 |
| Beverage | 19.95 | 23.34 | 29.48 | 34.96 |
| Tobacco | 8.87 | 24.74 | 0.01 | 0.03 |
| Textiles | 16.30 | 23.54 | 34.90 | 50.95 |
| Wearing Apparel | 0.02 | 0.02 | 48.75 | 53.67 |
| Leather | 4.52 | 4.76 | 16.04 | 17.01 |
| Footwear | 0.02 | 0.02 | 54.00 | 45.35 |
| Wood | 0.01 | 0.02 | 4.27 | 6.90 |
| Furniture | 0.02 | 0.02 | 52.21 | 46.52 |
| Paper | 16.56 | 21.11 | 16.87 | 21.75 |
| Printing and Publishing | 14.79 | 15.63 | 36.26 | 38.52 |
| Industrial chemicals | 9.23 | 10.08 | 14.62 | 16.00 |
| Other Chemicals | 30.97 | 29.09 | 28.23 | 26.75 |
| Petroleum refineries | 11.19 | 25.56 | 19.54 | 44.88 |
| Misc. Petro./ coal | 15.15 | 24.67 | 27.02 | 44.30 |
| Rubber | 20.33 | 21.38 | 65.80 | 69.64 |
| Plastic | 20.51 | 19.31 | 28.33 | 26.81 |
| Iron and Steel | 7.33 | 18.00 | 12.15 | 30.37 |
| Non Ferrous Metal | 13.76 | 23.86 | 47.20 | 82.38 |
| Fab. Metal | 14.34 | 16.94 | 23.72 | 28.38 |
| Machinery expect electric | 26.96 | 39.27 | 0.02 | 0.03 |
| Machinery electric | 29.12 | 29.88 | 22.59 | 23.53 |
| Transport | 16.53 | 45.27 | 32.25 | 89.89 |
| Prof and Scientific equi | 27.55 | 27.66 | 10.86 | 10.95 |
| Other Industries | 34.55 | 31.49 | 33.32 | 30.58 |

Source: Constructed by the author from the regressions results.
Note: (i.) AVEs are in percentage.
(ii.) AVEs of Time to export and to import are computed using the elasticities of Kee et al. (2008).
(iii.) New AVEs of Time to export and to import are computed using the estimated elasticities from the gravity model

Table 12: AVEs using the Estimated Elasticities: by Countries

| | Developing | | | Developed | | |
|---|---|---|---|---|---|---|
| Variable | Mean | Min | Max | Mean | Min | Max |
| New AVE Time Imp. | 41.5 | 10.1 | 114.4 | 14.2 | 3.4 | 38.1 |
| AVE Time Imp. | 33.6 | 3.5 | 126.9 | 7.8 | 0.9 | 19.8 |
| New AVE Time Exp. | 23.1 | 6.7 | 66.0 | 8.7 | 3.7 | 20.8 |
| AVE Time Exp. | 18.0 | 2.2 | 55.5 | 5.0 | 0.9 | 17.5 |

Source: Constructed by the author from the regressions results.
Note: AVEs are in percentage.