



LE GROUPE LA POSTE

**THE DRIVERS OF CROSS-BORDER PARCEL
DELIVERY PRICES:
AN ECONOMETRIC STUDY AT THE EU LEVEL**

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July 2016‡

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‡ We sincerely thank Werner Stengg, Sofia Margariti, Anouk Dolfen, Nestor Duch-Brown, Bertin Martens and all experts of national postal operators who helped us to collect data; Fiona Hamilton and Marcella Mooren for their helpful comments. All errors remain yours.

1. Introduction

According to the European Commission, one of the biggest obstacles of e-commerce development is the high costs of cross-border delivery. She considers that cheaper and more transparent pricing could encourage more retailers to sell online, for the benefit of EU consumers who could save over €11 billion each year by shopping online.

The Commission considers the big differences between prices for cross-border parcel delivery between various EU countries just don't make sense and discourage retailers and consumers from selling and buying across the EU. According to her, the differences do not always reflect the underlying cost of the parcel delivery.

The Commission rests on an econometric study on letter and parcel prices done by Claes and Vergote (2015) to support its claims. According to this study, cross-border parcel prices would be almost 5 times higher than their domestic counterparts and economic drivers would explain less than 50% of the variability observed in the price differential between cross-border and domestic parcel products provided by the national postal operators in 25 EU Member States.

This implicitly presumes that more than 50% of the price differential between domestic and cross-border postal products is not justified on economic grounds and is an unfair profit for postal products delivery operators. In particular, the European Commission emphasizes that the price of a 2kg standard parcel with no extra features, such as 'track & trace' or particular speed, could be very high in one direction and reasonable in another one and considers that this difference is not justified on the ground of domestic prices[§]. Here, the Commission forgets that cross-border prices cannot be appreciated from domestic ones for several reasons we will explain in the following sections.

The Commission points also that there can exist huge differences when sending a parcel from two countries with similar characteristics to the same destination by taking the example of Belgium and the Netherlands, two neighboring countries with a price for domestic parcel delivery just below €7. The Commission remarks that sending a 2kg package from Belgium to Spain would cost you €26.10 whereas the same package sent from the Netherlands to Spain would cost only €13. Here, again, the difference can be explained by exogenous factors misunderstood in the econometric study.

In the following, we will briefly summarize Claes and Vergote (2015) study in section 2 and highlight its caveats in section 3. We will suggest some improvements to better understand how cross-border postal products delivery prices are set and present our own econometric estimations of the relationship between these tariffs and their drivers in section 4.

[§] She takes the example of Austria and Italy, where the domestic price of a 2 kg standard parcel is €4.44 in Austria, €9.00 in Italy, the price of sending this type of parcel from Austria to Italy is €14 whereas in the other direction, the price raises to €25.

2. A brief summary of Claes and Vergote work

Claes and Vergote (2015) try to explain the relative gap between domestic and cross-border prices of various postal products (letters and parcels). The study is based on the analysis of a panel of domestic and international products offered by national postal operators. The authors selected a list of 986 products classified as “standard”^{**} or “premium”^{††} products in different weight categories, assumed allowing e-retailers to send goods purchased online to final consumers, from the public NPOs’ catalog. The listed products are then paired: a domestic product is associated with its cross-border (expected) twin.

From this panel of products and their associated public prices, the authors analyze the factors influencing the difference between the cross-border price set by operator of country *i* to send a given postal product to country *j* and its domestic price, divided by the domestic price (in other words, the relative cross-border price differentials) by means of a linear regression including three types of explanatory (or exogenous) variables:

- Variables which characterize the postal product: the presence of add-on services like track and trace; the fact that the product is a standard or a premium product; its weight.
- Variables which characterize the cross-border pricing strategy of the postal operator in the sending country: does it apply a single zone tariff or does it discriminate between destination countries?
- Variables which characterize the sending and the destination countries: the authors distinguish what they call the “peripheral”^{‡‡} countries from “large”^{§§} countries (the former are expected to have lower cross-border volumes) and take into account the fact that some exchanging countries are neighbors (in order to take into account the distance between the sending and destination countries). They consider the scale of bilateral commercial exchanges between countries (the destination country’s share of the sending country’s exports and imports). They also consider the structure of the postal market in the sending and receiving countries (the date of liberalization, the fact that some postal operators operate at the international level through a subsidiary), the cost of labor and the demographic features of the countries (population density).

Most of the results and conclusions coming from the regression are logical. Focusing on parcels, the regressions tend to prove that, all other things being equal:

- The presence of track and trace for cross-border products (whereas this option is absent for its domestic counterpart) increases the cross-border price differential; this can be explained by the fact that track-and-trace option increases the cost of delivery.
- Higher weights lead to higher price differentials since heavier items are more costly to deliver.

^{**} Defined as postal products sent by businesses to consumers (residential products) at home.

^{††} Characterized by expedited delivery, track-and-trace, proof of delivery and insurance.

^{‡‡} In the periphery, authors include Portugal, Latvia, Lithuania, Greece, Bulgaria, Malta, Romania and Croatia. The authors constructed a dummy variable equal to 1 when both the sending and the destination countries belong to the periphery.

^{§§} The UK, the Netherlands, Italy, Germany, France and Spain. The authors constructed a dummy variable equal to 1 when both the sending and the destination countries are large countries.

- Premium products have, on average, lower cross-border price differentials, since they are already more expensive at domestic level than standard products.
- Cross-border price differentials are higher for items sent between small peripheral markets and on the contrary lower for items sent between large countries and between neighbors; these results are related to the presence of economies of scale which reduces costs and to the positive impact of distance on cost in the latter case.
- Higher labor costs in the sending country decrease the cross-price differential, since this increases the cost of delivery of domestic items more than cross-border items.
- The relative cross-border parcel price differential is lower in countries in which liberalization occurs earlier; increased competition on both domestic and cross-border parcel markets reduces the relative cross-border price differential.
- The relative cross-border parcel price is lower when the sending country is more densely populated.
- The zoning strategies do not affect cross-border price differentials.
- Operators which have an international subsidiary, tend to set lower cross-border prices (due to the reducing-cost impact of vertical integration).

The main drawback of this study is that only 42% of the variability in relative cross-border parcel price differentials is explained by exogenous variables, implicitly assuming that the remaining variability is not justifying by economic rationales.

We will see that this allegation is incorrect: the lack of fit of the regression and the importance of unexplained part seems to be related to the model specification and the omission of important drivers of cross-border parcel cost (and price).

3. Some concerns on the methodology and the data used by Claes and Vergote

3.1 The endogenous variable used in the econometric study (the public list prices) is not the right one regarding the objective of the study but is the best proxy

First of all, the main weakness of the study lies in the fact that the authors used the public list prices. These prices are not the prices really paid by e-retailers as explained by Copenhagen Economics (2016). So, the prices used in the study do not allow drawing any conclusion on the relationship between e-commerce development and delivery tariffs of goods purchased online.

While public list prices provide information on the maximum price set by postal operators for single-piece products, e-retailers generally will negotiate the rates that they will finally paid regarding the volume^{***} and the characteristics of the parcels they give to the parcel delivery operator.

A mystery shopping experiment conducted by Copenhagen Economics (2016) revealed that there is actually a low correlation between the prices charged by e-retailers to e-shoppers and the corresponding postal operator's public listed price.

Yet, it is precisely these negotiated tariffs which are relevant to know if they are really prohibitive and disconnected to the costs incurred by delivery operators to provide such services (in other

^{***} One of the characteristics of the parcel delivery activity is the presence of fixed costs that leads to a decrease in handling unit costs as volume increases.

words, if they are real obstacles to the development of cross-border e-commerce). However, we must admit that it is definitely very difficult, even impossible, to collect information on the negotiated tariffs (the real shipping costs paid by e-retailers): they fall within business confidentiality.

Obstacles to the development of cross-border e-commerce, if any, could have other origins. In particular, they could come from the e-retailers pricing strategy. Indeed, online retailers are free to make profits or losses on delivery service offered to e-consumers: shipping fees could be a source of revenue for e-retailers (shipping fees paid by e-consumers are higher than shipping costs paid by e-retailers to the parcel delivery operator) or e-retailers could choose to subsidize the delivery of the goods purchased at distance for marketing or competitive reasons. This decision depends on their business strategy. In this context, an “excessive” high shipping fee could be the result of a high margin set by the e-retailer on the delivery service and not the result of an “excessive” profit made by the delivery operator. So it would be interesting to study also this side of the market. But again, it is very impossible to collect data on the pricing strategy of e-retailers. The unique public data, the shipping fees displayed by the e-retailers on their websites (paid by e-consumers) do not provide any information about the level of their margins on this service.

At the end, the prices used in the econometric analysis, considered as reflecting the rates charged by delivery operators to e-retailers, give only an approximate upper bound of the price differential between domestic and cross-border shipments. That being said, we have to accept the fact that public list prices are the better available proxy to tackle the issue but we must keep in mind that they overestimate the true shipping costs incurred by e-retailers.

3.2 Some products analyzed in this study are irrelevant regarding the objective of the study and the heterogeneity between products is underestimated

As said by the authors themselves, for price comparison between products to be meaningful, it is desirable that these products are as similar as possible, within each country and across all countries. But, when looking in more detail the French case for instance, the choice of some domestic products and their cross-border counterparts seems surprising. Indeed, products typically used by businesses (the right ones to consider in this study) are sometimes compared to products devoted to individuals (see table 1).

Table 1: French products selected in the econometric study

	Domestic	Cross-border
Standard letter	Priority letter purchased by individuals	International letter purchased by businesses
Premium letter	Registered letter for businesses	International registered letter for individual
Standard parcel	Colissimo France for individuals	Colissimo international
Premium parcel	Colissimo France for individuals + registration and reception advice options	Colissimo international + ad valorem compensation (€150) and reception advice options

Beyond some cases of dubious matching of domestic and cross-border products regarding the objective of the study, the authors take into account only three characteristics of products to differentiate domestic and cross-border offers and estimate their impact on the price differential: the weight, whether the product is premium (or not) and the presence (or not) of a track-and-trace option.

However, European postal operators offer very heterogeneous products and the qualitative features of postal products are an important driver of parcel price variability. As emphasized by J. Campbell in a report for the EU Commission (WIK, 2004, p. 152): *“for parcel services, price comparisons are significantly more complex because there is much more variation between parcel products offered by European USPs. Very different tariffs are available for parcels depending on, among other things, weight, size, routing time, destination, and mode of collection. Some of these offerings could be considered express products, reflecting the blurring boundaries between the parcels and express segments. (...) Some tariffs include universal delivery while others do not. Routing times for parcels also vary substantially. These differences in service have a significant effect on the cost of parcel delivery that may explain some of the variation in parcel tariffs.”*

So, as noticed by Borsenberger et al. (2012), *“comparing parcel prices without taking into account quality through their characteristics seems to be misleading”*. From a hedonic price function for domestic parcels belonging to the USO scope, the authors conclude that *“the most qualitative relevant characteristics of parcels impacting the price charged to consumers are weight, speed of delivery, six-days-a-week throughout the territory home delivery, second presentation, return to sender, online franking, cash-on-delivery, insurance and advice of receipt”*.

In the current study, it would be relevant to consider more features of the postal products offered in the various EU countries in order to make the estimation of the price differential between domestic and international offers more robust. One may assume that including more features to differentiate the products would reduce the unexplained part of the price differential observed.

Unfortunately, in our own econometric study, we were unable to collect a complete database on other products characteristics for the whole set of products considered here.

3.3 Some data are erroneous

When checking the Commission’s database, some surprising figures or outliers appear. For instance, the price for sending a 250g premium letter from Croatia to an EU country is set at € 8.45 in the database used by Claes and Vergote. After a check on Hrvatska pošta’s website, it appears that the right price is € 4.87. So we asked national postal operators to check information contained in the Commission’s database and to make corrections when needed. The changes and comments made by national postal operators regarding the database could be found in annex A.

3.4. Some key exogenous variables are forgotten or misunderstood

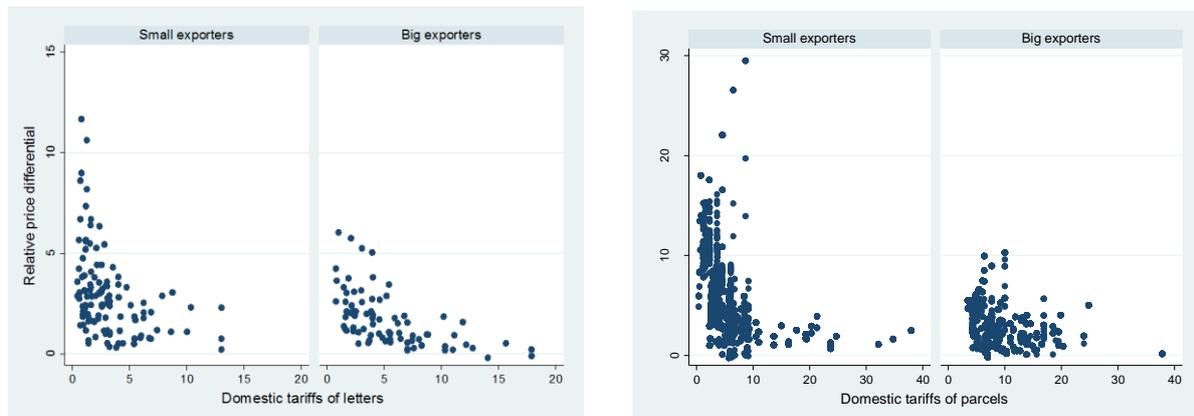
In our opinion, some key variables explaining the gap between domestic and cross-border tariffs are left out, expanding artificially the unexplained (considered as “unjustified”) part of the price differential.

a) Volumes and economies of scale

Claes and Vergote (2015) model does not allow to properly catch the impact of volumes and their associated economics of scale on cross-border tariffs. They include in their modelization variables on bilateral e-commerce which catch only the relative part of each destination into imports and exports of the sending country. Such variables do not allow to distinguish “big” from “small” exporter countries and to correctly estimate the economies of scale that postal operators benefit when sending letters or parcels abroad.

Indeed, a clear difference appears graphically in the relationship between domestic and cross-border tariffs for these two groups of countries: operators which operate in “big” exporter countries set lower cross-border tariffs than operators operating in “small” exporters countries. This is logically related to the presence of economies of scale in postal activities.

Figure 1: Relative letters/parcels price differentials in big and small exporter countries



On average, the relative price differential between domestic and cross-border letters prices is equal to 1.65 in “big” exporter countries and 2.78 in “small” ones. Regarding the relative price differential in the parcel segment, the respective figures are 2.93 in “big” exporter countries and 4.50 in “small” ones.

In order to try to tackle this issue, in our own econometric model, we use data from Cardona, Duch Brown and Marteens (2015) to properly distinguish small from big exporters and thus capture economies of scales.

b) The uniformity of tariffs

Another shortcoming of the study is related to the issue of uniformity of cross-border tariffs.

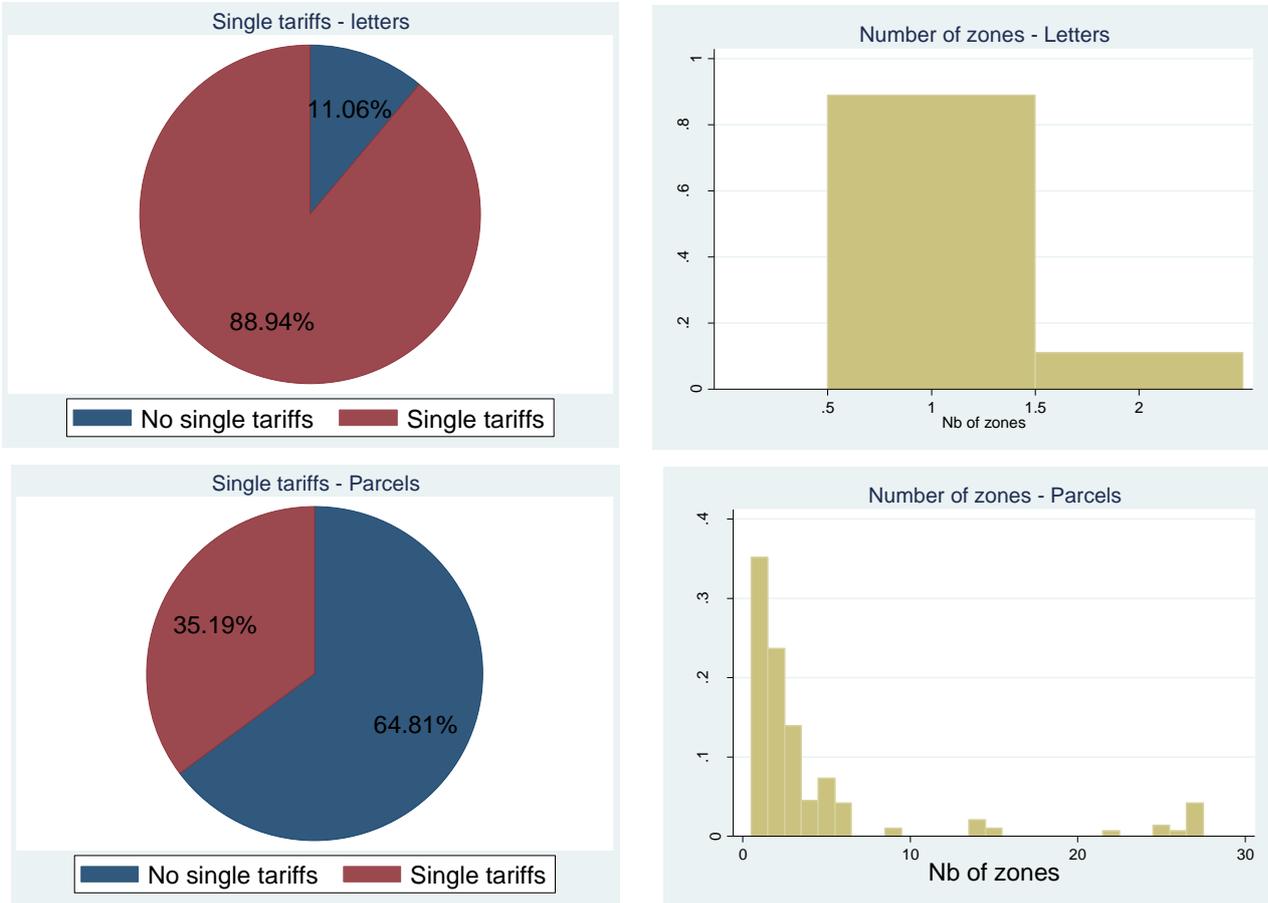
In the majority of cases, national postal operators use a unique price throughout the whole EU for letters by convenience. On the 199 cross-border letter items contained in the sample, only 11% are non-uniform: five countries differentiate the tariffs of their letters according to the destination country (Bulgaria, Slovakia, Portugal, Croatia and Spain) by distinguishing two areas.

The differentiation of prices according to the destination is more likely for parcels: near 65% of cross-border parcel products included in the sample have non-uniform tariffs. The number of pricing areas is highly variable (in theory, until 27 different pricing areas could be distinguished). We observe the majority of operators distinguish between 1 and 6 pricing zones (see figure 2). We could classify countries in three groups regarding their pricing strategy:

- Group 1: Austria, Denmark, France, Germany, Slovenia, Sweden, the UK and Malta – which offer a single parcel tariff for all destination throughout the EU;
- Group 2: Croatia, Czech Republic, Finland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Portugal, Romania, Slovakia and Spain – which differentiate all the prices of the parcel products considered in the study;
- Group 3: Belgium, Bulgaria, Greece, Hungary and Poland – which differentiate the prices of some parcel products contained in the sample according to the destination.

The fact that only two EU postal operators (the Lithuanian and the Romanian operators) sometimes offer a specific tariff for each destination for some products could explain why the estimated coefficients associated with the various features of the destination country are either non-statistically significant or non-consistent with the expected effect in Claes and Vergote’s study. According to us, it would be more relevant to consider that cross-border tariffs are based on the mean value of the characteristics of all countries belonging to the same zoning area, rather than on the individual characteristic of the destination country (we will verify this intuition in our econometric estimations).

Figure 2: Price discrimination



c) Competition intensity on domestic market

Claes and Vergote (2015) include a dummy that treats countries that liberalized before 2010 differently from the others in order to take into account of the influence of the level of competition in mail markets on cross-border price differentials. The link between the competition intensity and the fact that markets are liberalized for a more or less long period is very thin.

We suggest using information contained in the last Report from the Commission to the European Parliament and the Council on the application of the Postal Services Directive. According to this report, in thirteen Member States (Bulgaria, Estonia, Croatia, Germany, Latvia, Lithuania, the Netherlands, Romania, Slovakia, Slovenia, Poland, UK and Sweden), competitors had achieved over 5% of the letters market. On the parcel market, in 6 Member States, NPO have market shares less than 10% and in 7 Member States, their market shares are between 10% and 20% (see tables 2 and 3).

Table 2: Level of end-to-end and access competition in 2013

Member State	Year of full market opening	More than 5% end-to-end competition by volume	More than 5% access competition by volume
Austria	2011	No	No
Belgium	2011	No	No
Bulgaria	2011	Yes	No
Cyprus	2013	No	No
Czech Republic	2013	No	No
Denmark	2011	No	No
Estonia	Before 2008	Yes	No
Finland	Before 2008	No	No
France	2011	No	No
Germany	Before 2008	Yes	Yes
Greece	2013	No	No
Hungary	2013	No	No
Ireland	2011	No	No
Italy	2011	No	No
Latvia	2013	Yes	No
Lithuania	2013	Yes	No
Malta	2013	No	No
Netherlands	2009	Yes	No
Poland	2013	Yes	No
Portugal	2012	No	No
Romania	2013	Yes	No
Slovakia	2012	Yes	No
Slovenia	2011	No	Yes
Spain	2011	Unknown*	Unknown
Sweden	Before 2008	Yes	No
United Kingdom	Before 2008	No	Yes

Source: Commission staff working document accompanying the Report from the Commission to the European Parliament and the Council on the application of the Postal Services Directive (2015), pp. 53.

Table 3: Market Share of Universal Service Providers in Domestic Parcel and Express Markets (2011)

<10% market share	10-20% market share	>20% market share
Bulgarian Post (BG)	bpost (BE)	Österreichische Post (AT)
Cyprus Post (CY)	Croatian Post (HR)	Česká pošta (CZ)
ELTA (EL)	An Post (IE)	Deutsche Post DHL (DE)
Correos (ES)	Poste Italiane (IT)	PostDanmark/PostNord
Polish Post (PL)	Lithuanian Post (LT)	(DK)
CNPR Compania Nationala	Latvijas Pasts (LV)	Eesti Post (EE)
Posta Româna (RO)	MaltaPost (MT)	Itella (FI)
		La Poste (FR)
		Magyar Posta (HU)
		PostNL (NL)
		CTT Correios (PT)
		Posten/PostNord (SE)
		Slovenian Post (SI)
		Slovenska Posta (SK)
		Royal Mail Group (UK)

Source: Commission staff working document accompanying the Report from the Commission to the European Parliament and the Council on the application of the Postal Services Directive (2015), pp. 64.

3.5 The econometric model specification is dubious

The independent variable used by Claes and Vergote (2015) is the relative cross-border price differential, that is to say the difference between the cross-border price for a delivery service of a letter or a parcel (of different weight) sent from country i to country j and the price set by the postal operator for a national sending through country i , divided by this domestic price.

The choice made by the authors to study a relative price differential implies that expensive domestic products could be considered as perfectly similar with cheap domestic products. Consider for example, a product A sold at €1 on the domestic market and its cross-border counterpart sold at €2 and a product B sold at €15 on the domestic market and its cross-border counterpart sold at €30. In both cases, the relative price differential studied is equal to 1. In other words, an absolute price differential of €1 will be considered as similar as an absolute price differential of €15. However, the impact on demand of a differential of €1, as well as its determinant, would certainly not be similar to a differential of €15, leading to econometric misspecification issues.

Moreover, the choice of a ratio as the explained (or dependent) variable in the regression is highly controversial from a theoretical point of view. An extensive body of the econometric literature¹⁰ indeed emphasizes that using ratios as independent variables may not only lead to misinterpretations of the results but also contribute to spurious findings.

First, let us have a look on the difficulty to interpret the econometric models. The relative price differential is a ratio, which is made up of two variables, the international price and the domestic

¹⁰ See, for instance, the seminal papers of Pearson (1897), "On a form of spurious correlation which may arise when indices are used in the measurement of organs", *Proceedings of the Royal Society of London*, pp. 489-498; Neyman (1952), *Lectures and Conferences on Mathematical Statistics and Probability* (2 ed.), US Department of Agriculture: Washington DC; Kronmal (1995), "Storks, babies and linear-models - a response to Kronmal - reply", *Journal of the Royal Statistical Society, Series A Statistics in Society*, vol. 158, pp. 623-625.

price (of a given product).¹¹ Estimating simultaneously two variables through a unique ratio is a highly complex exercise which could lead to ambiguous economic interpretations:

- First, from a theoretical perspective, does the ratio capture a structural change in the relation between the numerator and the denominator (i.e. a change in the proportionality between domestic and international tariffs) or a change in the numerator's magnitude after controlling for differences in size across the sample? In the first case, the ratio aims at assessing the nature of the relationship between the numerator and the denominator, while in the latter case, it aims at normalizing the numerator.
- Second, from a practical perspective, how do we interpret the results? For instance, does a 1€ increase in the labor cost in the sending country affects the domestic tariff, the international tariff or both? Since we only observe a change in the ratio, the model does not permit to disentangle those effects. In other words, while the numerator and the denominator of the ratio may be affected in a different manner by the independent variables, the model does not give any insights of these various effects, leading to irrelevant interpretations.

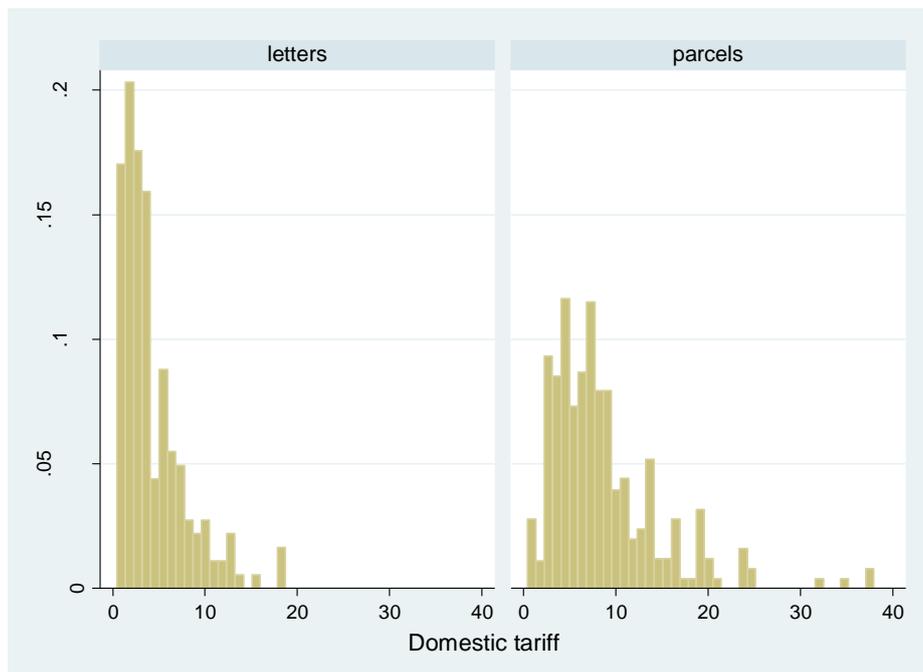
Moreover, several studies have demonstrated that the use of ratios as dependent variable in econometric modelization raises various unusual problems and leads, most of the time, to spurious regressions: *"the creation of ratio can influence the magnitudes and direction of correlations and the stability, efficiency and bias of regression coefficients"* (Wiseman, 2009). Describing in details all the econometrical issues related to the use of ratios is of course beyond the scope of the paper. However, let us mention the following simple problem, presented in Franz (2007), which is very likely to occur in the data we have: any ratio y/x has a singularity at $x = 0$; thus, if the denominator is "too close" to zero, the estimate of the ratio goes astray (to infinity) and has no economic sense anymore. Figure 3 shows that many domestic tariffs are "close" to zero, indicating that Claes and Vergote's results should be interpreted with a lot of caution.

Other issues and controversies are summarized in Wiseman (2009). In summary, the main message of the literature on spurious regressions is consensual: conditions under which ratios are proved to be superior to alternative specifications are very limited. In line with these recommendations, we suggest two alternative modellings:

- A first step would consist in basically investigating the drivers of international parcel delivery tariffs, which are of primary interest. Thus, we estimate the level of international prices depending on the characteristics of the products, the sending country and the destination country. This specification allows assessing the extent to which economic rationales explain the level of international tariffs.
- We can then go one step further and explore the relationship between international and domestic tariffs. To do so, we follow the recommendations of the above mentioned literature on spurious regressions and regress the international tariffs on the domestic tariffs. This model may allow assessing the nature of the relation between international and domestic prices, all else being equal.

¹¹ In addition, the dependent variable used by Claes and Vergote is not just dividing one variable by another: it accounts for the difference between the two variables divided by one of the two.

Figure 3: Distribution of domestic tariffs



4. Our own econometric results

As we saw in the preceding sections, Claes and Vergote’s econometric study has several drawbacks. We suggest here some way to improve the results. First of all, we reproduce Claes and Vergote’s study with the data reviewed by postal operators (see section 3.3 and annex A for details). Following the recommendations of the literature on spurious econometrics, we then produce alternative modelizations in the two last subsections: a first one exploring the determinants of cross border pricing; a second one dealing with the relationship between domestic and cross border tariffs.

4.1 Reproducing Claes and Vergote’s models with verified data

Some national postal operators have carried out a check of the database employed in Claes and Vergote’s analysis. Most of the time, these postal operators have pointed out that 1) the domestic products and their cross-border counterparts are not comparable, 2) the selected products do not have the characteristics they are supposed to have. These shortcomings have impacts on the analysis and the conclusion drawn. It appears that selecting the right product may lead to substantial price changes.

Using the corrected database which contains the changes made by the national postal operators, we derive the following conclusions:

- The relative price differential is still equal to 2.24 for letters. However, it drops from 3.71 to 3.26 for parcels.
- When reproducing the econometrical models of Claes and Vergote, we obtain very similar results (see annex B): the estimated coefficients and the explanatory power of the set of

independent variables (see the value of the goodness of fit measure – the adjusted R^2) are very close.

- A notable difference with Claes and Vergote’s results is that in our models, the estimated coefficient associated with the variable “Perequation” has a negative sign and is statistically significant (that is to say, the fact that prices are uniform – which is sometimes a regulatory constraint – reduces the relative price differential between domestic and cross-border prices), whereas in Claes and Vergote (2015), the effect of the variable called “Single Zone Pricing” on the relative price differential is not statistically significant.

As in Claes and Vergote’s study, for this type of specification that tries to explain the relative gap between domestic and cross-border parcel delivery prices, the set of explanatory variables chosen would only explain around 50% of the variation in the relative price differential.

This low explanatory power may lead to two conclusions: either the national postal operators extract large rents on the cross-border segment or the model is not suitable and do not properly assess international price variations. In the following sections, we will provide strong arguments in favor of the latter conclusion.

4.2 What are the drivers of letters and parcels international tariffs?

We first aim at better understanding the drivers of cross-border parcel delivery service prices. Following the hedonic pricing literature (see, e.g., Rosen [1974], Vanslebrouck et al. [2005]), we use a log-linear econometric method to determine how different explanatory variables influence a single dependent variable (the cross-border prices). We therefore estimate the following model:

$$\log(\text{International Tariff}_i) = \beta + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki} + \varepsilon_i$$

- Where $\beta, \beta_1, \dots, \beta_k$ are the parameters to be estimated by the model,
- ε_i is the error term,
- $x_{1i}, x_{2i}, \dots, x_{ki}$ are a set of explanatory variables.

Before presenting and interpretation the results of this model, we describe our explanatory variables.

a) Description of the explanatory variables

As Claes and Vergote did, we introduce a first set of explanatory variables to account for the characteristics of the products (see table 4) and a second set to account for the characteristics of the sending country (see table 5).

Table 4: Variables which capture the characteristics of the products

Name of the variable	Description of the variable
<i>T&T international</i>	Takes the value 1 if the international product has the Track and Trace option, 0 otherwise
<i>Premium</i>	Takes the value 1 if it is a premium product, 0 otherwise
<i>Product 0.25kg</i>	Takes the value 1 if it is a 0.25kg product, 0 otherwise
<i>Product 0.5kg</i>	Takes the value 1 if it is a 0.5kg product, 0 otherwise
<i>Product 1kg</i>	Takes the value 1 if it is a 1kg product, 0 otherwise
<i>Product 2kg</i>	Takes the value 1 if it is a 2kg product, 0 otherwise
<i>Product 5kg</i>	Takes the value 1 if it is a 5kg product, 0 otherwise
<i>Product 10kg</i>	Takes the value 1 if it is a 10kg product, 0 otherwise

Table 5: Variables which capture the characteristics of the sending country

Name of the variable	Description of the variable
<i>Perequation</i>	Takes the value 1 if international tariffs are uniform (from a geographic point of view), 0 otherwise
<i>Domestic labor cost</i>	Domestic labor cost (in €)
<i>Domestic country area</i>	Size of the domestic country (in square km)

We also aim at capturing the way international tariffs are influenced by the characteristics of the destination country. However, contrary to Claes and Vergote (2015), we take into account the zoning strategies of postal operators in terms of pricing (see paragraph b in section 3.4). Thus, we do not consider in our model the characteristics of each destination country separately but the average characteristics of the destination countries making up a given “pricing zone”. In other words, we include in the right hand side of the equation the average characteristics of the destination areas (making up of several countries) as defined in the postal operator’s zoning strategy. Corresponding variables are presented in Table 6.

Table 6: Variables which capture the characteristics of the destination zone

Name of the variable	Description of the variable
<i>Destination labor cost</i>	Average labor cost of the zone in which the destination country belongs to (in €)
<i>Destination population density</i>	Average population density of the destination zone in which the destination country belongs to (inhab./km ²)
<i>Distance btw capitals</i>	Distance between the capitals of the sending and the destination country (in km); constructed by Mayer and Zignano (2011)
<i>Vol. bilateral exports</i>	Volume of online bilateral exports from the destination to the sending country (in €) ¹²

Most of our explanatory variables are similar to those used by Claes and Vergote (2015). The changes we introduced are explained in details in Appendix C.

By contrast to Claes and Vergote (2015), we additionally aim at assessing the influence of markets' competitive intensity. We therefore add a set of variables which captures the degree of competition. These variables are presented in Table 7.

Table 7: Variables which capture the degree of competition

Name of the variable	Description of the variable
<i>Access Competition_Letters</i>	Takes the value 1 if the market share of the alternative delivery operators using the last-mile delivery infrastructure of the incumbent on the letter market exceeds 5%, 0 otherwise.
<i>E2E Competition_Letters</i>	Takes the value 1 if the market share of the alternative delivery operators operating on an end-to-end basis on the letter market exceeds 5%, 0 otherwise.
<i>Market share_Parcels</i>	A continuous variable reflecting the market share of the national postal operator on the domestic parcel market (equals to 0 if the market share is lower than 10%, to 1 if the market share is comprised between 10% and 20%, to 2 if the market share is higher than 20%).

b) Interpretation of the results

Results of our estimates are presented in table 8. Model (2.1) and model (2.2) display respectively regression results for letters and parcels.

¹² We built our variable thanks to the data from Cardona, Duch Brown and Marteens (p. 31, 2015), Institute for Prospective Technological Studies Digital Economy Working Paper (2015-06).

Table 8: Drivers of cross border prices

	LETTERS (2.1) Log (international tariff)	PARCELS (2.2) Log (international tariff)	
<i>Constant</i>	1.420*** (0.201)	1.821*** (0.0328)	
Characteristics of the products	<i>T&T international</i>	0.221*** (0.0109)	0.0303** (0.0123)
	<i>Premium</i>	0.350*** (0.0103)	0.285*** (0.00963)
	<i>Product 0.5kg</i>	0.262*** (0.0124)	0.0422*** (0.0156)
	<i>Product 1kg</i>	0.646*** (0.0118)	0.0984*** (0.0148)
	<i>Product 2kg</i>	1.107*** (0.0124)	0.242*** (0.0153)
	<i>Product 5kg</i>		0.540*** (0.0160)
	<i>Product 10kg</i>		0.817*** (0.0162)
Characteristics of the sending country	<i>Perequation</i>	-0.0151 (0.0193)	-0.347*** (0.0104)
	<i>Domestic labor cost</i>	0.0161*** (0.000573)	0.0136*** (0.000432)
	<i>Domestic country area</i>	7.01e-07*** (4.38e-08)	5.07e-07*** (3.17e-08)
Characteristics of the destination zone	<i>Destination labor cost</i>	0.0810*** (0.0111)	0.00511*** (0.000788)
	<i>Destination population density</i>	-0.0119*** (0.000662)	-0.000120** (5.94e-05)
	<i>Distance btw capitals</i>	5.01e-05*** (1.41e-05)	0.000341*** (1.31e-05)
	<i>Vol. bilateral exports</i>	-0.000623*** (6.71e-05)	-0.00121*** (6.82e-05)
Competition intensity	<i>Market share_Parcels</i>		0.163*** (0.00742)
	<i>E2E Competition_Letters</i>	-0.184*** (0.0114)	
	<i>Access Competition_Letters</i>	0.141*** (0.0156)	
Observations	5,373	7,275	
Adjusted R-squared	0.773	0.625	

Robust standard errors in parentheses (*** corresponds to $p < 0.01$, ** to $p < 0.05$, * to $p < 0.1$)

We describe below the results of the models which are in line with intuition and expectations we could have on the effects of the various explanatory variables:

- Regarding the characteristics of the products, in general, effects are in line with expectations. Tracked-and-traced, premium and heavier postal products are more expensive.
- We find that setting uniform prices are associated with lower prices for letters and parcels. Note that the estimated coefficient associated with letters is not statistically significant. This could be linked to the low variability in this variable in the case of letters. Indeed, most of postal operators apply the same tariff for delivering letters throughout the EU: only five

postal operators¹³ differentiate their prices according to the destination of the letters by distinguishing only two destination areas (representing 11% of the cross-border letter products included in the sample – against 65% of cross-border parcel products that are price-differentiated according to several (between two and six) destination areas).

- As expected, higher labor costs and larger surface area in the sending country (which may be associated with higher collection costs) lead to higher international tariffs.
- Higher labor costs and lower population density in the destination country (which may be associated with higher delivery costs) actually lead to higher international tariffs.
- Larger distance between the capitals of the sending and the destination country (which may be associated with higher transportation costs) actually lead to higher international tariffs.
- Larger volumes of bilateral exports from the sending to the destination country (which may be associated with larger economies of scales and thus lower unit cost of production) are associated with lower international prices for letters and parcels.
- Variables related to the degree of competition in the sending country have a significant effect on prices: the higher the level of end-to-end competition (i.e. the lower share of the national postal operator), the lower the international prices, confirming expected conclusion. Note that on the letter market, an access-base competition regime tends to increase the cross-border tariffs. In this regard, end-to-end competition seems better.

Despite the fact that we are not able to observe and measure all variables which may have an impact on international tariffs¹⁴, compared to Claes and Vergote’s study, our models better explain the variability observed in cross-border tariffs: the economic drivers we were able to observe explain around 77% of the international price variation for letters and 60% for parcels. This explanatory power should certainly be improved by adding further products and countries characteristics.

4.4 What is the relationship between international and domestic tariffs?

We then suggest going one step further by investigating the nature of the relationship between international and domestic prices. To do so, we follow the recommendations of the above mentioned literature on spurious regressions: we put the domestic tariff in the right hand side of the equation instead of the variables characterizing the sending countries (the labor cost and the demographic density of the sending country clearly drive the level of domestic tariffs)¹⁵ and we estimate the following model:

$$\log(\text{International Tariff}_i) = \beta + \beta_1 \beta x_{1i} + \beta_2 \beta x_{2i} + \dots + \beta_k \beta x_{ki} + \alpha \log(\text{Domestic Tariff}_i) + \varepsilon_i$$

- Where $\alpha, \beta, \beta_1, \dots, \beta_k$ are the parameters to be estimated by the model,
- ε_i is the error term,
- $x_{1i}, x_{2i}, \dots, x_{ki}$ are a set of explanatory variables.

¹³ Bulgaria, Croatia, Portugal, Slovakia and Spain.

¹⁴ For instance, we have in the database many other variables related to the characteristics of the products (whether the product is delivered at home or not, whether the product include an insurance or not, whether the product can be returned to the sender at no charge or not, etc.). However, there are too many missing information to use these variables.

¹⁵ These characteristics of the sending countries are indisputable drivers of the domestic tariff. Not deleting them from the regression would clearly lead to multicollinearity issues.

Results of the estimates are presented in table 9. Model (3.1) and model (3.2) display regression results for letters and parcels respectively.

Table 9: Relationship between international and domestic prices

		LETTERS (3.1)	PARCELS (3.2)
		<i>Log (international tariff)</i>	<i>Log (international tariff)</i>
	<i>Constant</i>	1.351*** (0.122)	1.677*** (0.0311)
Characteristics of the products	<i>T&T international</i>	0.218*** (0.00696)	0.104*** (0.00961)
	<i>Premium</i>	-0.00442 (0.00812)	0.0534*** (0.00918)
	<i>Product 0.5kg</i>	0.163*** (0.00904)	0.0366*** (0.0130)
	<i>Product 1kg</i>	0.384*** (0.0109)	0.0826*** (0.0128)
	<i>Product 2kg</i>	0.725*** (0.0115)	0.198*** (0.0132)
	<i>Product 5kg</i>		0.380*** (0.0131)
	<i>Product 10kg</i>		0.582*** (0.0142)
Characteristics of the sending country	<i>Perequation</i>	-0.0643*** (0.0152)	-0.335*** (0.00911)
	<i>Log(Domestic tariff)</i>	0.524*** (0.00898)	0.479*** (0.00824)
Characteristics of the destination zone	<i>Destination labor cost</i>	0.0791*** (0.00780)	0.00431*** (0.000825)
	<i>Destination population density</i>	-0.00843*** (0.000491)	4.11e-05 (6.29e-05)
	<i>Distance btw capitals</i>	-0.000171*** (1.21e-05)	0.000231*** (1.43e-05)
	<i>Vol. bilateral exports</i>	-0.000713*** (5.66e-05)	-0.00138*** (5.54e-05)
	<i>Market share_Parcel</i>		0.0577*** (0.00670)
Competition characteristics	<i>E2E Competition_Letters</i>	0.0101 (0.00806)	
	<i>Access Competition_Letters</i>	0.144*** (0.0125)	
	Observations	5,373	7,275
	Adjusted R-squared	0.854	0.712

Robust standard errors in parentheses (***) corresponds to $p < 0.01$, ** to $p < 0.05$, * to $p < 0.1$

Compared to models (2.1) and (2.2), results of models (3.1) and (3.2) are quite similar. The main differences we observe lie in the fact that some estimated coefficients become non-significant. In particular, the estimated coefficients associated with the premium characteristic and the end-to-end competition variable for letters, the coefficient associated with the demographic density in the destination country for parcels. On the contrary, the estimated negative coefficient associated with

“perequation” becomes significant for letters. The last change we observe is that the estimated coefficient associated with the distance between capitals become negative for letters. This could be explained by the fact that a high proportion of letters tariffs are uniform.

As expected, the cross-border tariffs of postal products are partially correlated to the price of their domestic counterparts, reflecting the fact that the domestic price is a proxy of the cost of the first part of the shipping process of a cross-border postal item. If the domestic price increases due, for instance, to an increase in labor costs, the collection cost of cross-border items will increase, justifying an increase in international tariff. Cross-border tariffs vary in the same way but in a lower proportion than domestic ones: for letters, we find that an increase in domestic tariffs of 1% would lead to an increase in international tariffs of 0.52%; for parcels, an increase in domestic tariffs of 1% would lead to an increase in international tariffs of 0.48%.

5. Conclusion

Our results are in line with intuition and expectations we could have on the effects of the various explanatory variables:

- Tracked-and-traced, premium and heavier postal products are more expensive and this leads to higher tariffs;
- Uniform prices, in other words, average prices, are associated with lower prices for letters and parcels;
- Cross-border tariffs increase with labor costs, the surface area in the sending country, the distance between the sending and destination countries (since these factors lead to higher collection and transportation costs) and on the contrary, decrease with population density in the destination country (which tends to reduce delivery costs) and the volumes of bilateral exportations between countries (due to economies of scale).

Our results also highlight the fact that end-to-end competition is an important factor explaining the price levels: the higher the intensity of end-to-end competition the lower the international prices. But notice that promoting competition based on mandatory access to third party is detrimental for consumers who face higher tariffs.

Despite the fact that we are not able to observe and measure all variables which may have an impact on international tariffs, our models have a satisfying explanatory power: the economic drivers we were able to observe explain around 77% of the international price variation for letters and 62% for parcels. The fact we explain less variability in parcels than in letters cross-border tariffs could be linked to the fact that parcels delivery service are more heterogeneous than letters one. Yet, we use the same characteristics variables for both types of products. Adding more characteristics to take into account the diversity of parcel offers would certainly increase the explanatory power of our regression model. This is why we could conclude that economic rationales explain **at least** 77% of the variability in cross-border tariffs for letters and **at least** 62% for parcels.

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Appendix A: Changes made by postal operators in the original database

Country	Nature of the comment / if the change
Austria	Change of the prices
Germany	Change of the prices (and removal of the standard parcel products: the operator does not provide any standard parcel service as defined by the study)
Denmark	No change – However, the operator notes it only provides premium parcel services as defined by the study.
Spain	Change of the characteristics of the DPP products.
France	No change –The operator notes that domestic and international products are not comparable.
Greece	Change of the prices and the characteristics of the products
Croatia	Change of the prices and the characteristics of the products (and removal of the ISP products, which do not exist)
Ireland	Change of the prices
Italy	Change of the prices
Poland	No change –The operator notes that domestic and international products are not comparable.
Sweden	No change –The operator notes that domestic and international products are not comparable.
UK	Change of the prices and the characteristics of the products (and removal of the parcel products which do not exist)

Appendix B: Reproducing Claes and Vergote's model with verified data

Model (1.1) and model (1.2) display regression results for letters and parcels respectively. A description of the variables we employ to run model (1.1) and model (1.2) regressions is available in Claes and Vergote (2015).¹⁶

	LETTERS (1.1)	PARCELS (1.2)
	<i>Relative Price Differential</i>	<i>Relative Price Differential</i>
<i>T&T domestic</i>	-0.680*** (0.0646)	-3.730*** (0.177)
<i>T&T international</i>	0.781*** (0.0560)	1.653*** (0.0932)
<i>Premium</i>	-0.427*** (0.0500)	-0.929*** (0.0594)
<i>Product 0.5kg</i>	0.219*** (0.0346)	0.0893 (0.0898)
<i>Product 1kg</i>	0.599*** (0.0437)	0.271*** (0.0898)
<i>Product 2kg</i>	1.387*** (0.0501)	0.630*** (0.0898)
<i>Product 5kg</i>		0.906*** (0.0900)
<i>Product 10kg</i>		1.513*** (0.0918)
<i>Perequation</i>	-0.951*** (0.0943)	-1.286*** (0.0628)
<i>Domestic labor cost</i>	-0.0842*** (0.00162)	-0.0757*** (0.00275)
<i>Domestic population density</i>	0.000592*** (4.77e-05)	-0.00165*** (0.000130)
<i>Early liberalization</i>	0.479*** (0.0379)	-0.821*** (0.0867)
<i>France</i>	-0.0227 (0.0427)	-0.937*** (0.142)
<i>UK</i>	-0.920*** (0.0758)	-1.957*** (0.189)
<i>Periphery</i>	-0.0831 (0.0913)	1.093*** (0.120)
<i>Large countries</i>	-0.280*** (0.0572)	-0.581*** (0.138)
<i>Neighbor</i>	0.117** (0.0510)	-0.500*** (0.0967)
<i>Periphery*Neighbor</i>	-0.222 (0.223)	-1.623*** (0.326)
<i>Destination labor cost</i>	0.000367 (0.00145)	0.00119 (0.00233)
<i>Destination population density</i>	2.96e-05 (6.87e-05)	-9.03e-05 (0.000107)
<i>Online bilateral trade imports</i> ¹⁷	-0.153 (0.277)	-0.344 (0.448)
<i>Online bilateral trade</i>	0.113	0.227

¹⁶ The study is available at the following address: <http://ec.europa.eu/DocsRoom/documents/14647>

¹⁷ We built our variable thanks to the data from Cardona, Duch Brown and Marteens (p.31, 2015), Institute for Prospective Technological Studies Digital Economy Working Paper (2015-06).

<i>exports</i> ¹⁸		
	(0.278)	(0.447)
<i>Constant</i>	4.244***	7.947***
	(0.0999)	(0.198)
Observations	5,373	7,275
Adjusted R-squared	0.529	0.452

Robust standard errors in parentheses (***) corresponds to $p < 0.01$, ** to $p < 0.05$, * to $p < 0.1$

Appendix C: Why and how we have replaced some of the explanatory variables employed in Claes and Vergote's estimates

Explanatory variables used in Claes and Vergote	Explanatory variables we use	Explanation
<i>Periphery, Neighbor, Neighbor*Periphery</i>	<i>Distance btw Capitals</i>	Replacing dummy variables by one single quantitative variables permits to capture more precisely distances effects and to increase the degrees of freedom
<i>Liberalization year 2009, France, UK</i>	<ul style="list-style-type: none"> For letters: <i>End-to-end competition and access competition</i> For parcel: <i>Market shares</i> 	We exploit information provided by the European Commission (2015) ¹⁹ to include more precise measure of market maturity and competition
<i>Large countries, Online bilateral exports, Online bilateral imports</i>	<i>Vol. bilateral exports</i>	Economies of scales are better captured through a quantitative variable than through a percentage (see subsection 3.4 or through a dummy (which contains limited information, by definition)
<i>Domestic population density</i>	<i>Domestic country area</i>	Collection costs are more related to the size than to the density of the domestic country, since the size of the country will drive the location and the number of collection points set up through the territory

¹⁸ Idem.

¹⁹ European Commission (2015), Report from the Commission to the European Parliament and the Council on the application of the Postal Services Directive (Directive 97/67/EC as amended by Directive 2002/39/EC and Directive 2008/6/EC), Commission Staff Working Document Accompanying the document.