SSE Riga Student Research Papers
2015 : 1 (166)

DETERMINANTS OF SERVICE EXPORTS OF LITHUANIA: A GRAVITY MODEL APPROACH

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ISSN 1691-4643
ISBN 978-9984-842-86-8

November 2015
Riga

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Abstract

This paper investigates the determinants of aggregate service exports and the determinants of 7 service subcategories (i.e. transport, travel, communication, computer & information, financial, construction and other business services) of Lithuania using a gravity model and a panel dataset for the 2003-2012 period. First, a general gravity model for total exports is specified. Then, the general gravity model is augmented for each service subcategory by including additional variables that are specific for each service subcategory and that capture the features of each type of service. The results show that GDP of the destination country and a common spoken language exert a positive effect on trade in services. Time zone differences, EU membership and relative human capital are found to have a heterogeneous effect across service subcategories. Also, the significance of physical distance between Lithuania and its partners varies in dependence of the type of service. Remoteness of the destination country is found to be insignificant for the majority of service subcategories, except transport services, other business services, and computer & information services.

Keywords: determinants of exports, exports of services, gravity model

Acknowledgements

We would like to express our gratitude to the supervisor of the thesis Rudolfs Bems for his constructive feedback throughout the process of the research.
Additionally, we would like to thank Zane Cunska and Christopher Rieber for their valuable suggestions regarding the structure of the present paper.

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1. Introduction

Globalization has significantly changed the composition of trade during the last decade and shifted the importance towards service trade. Services have a great impact on overall economic growth, currently accounting for two-thirds of the World's GDP (WTO, 2010). While the shares of primary and secondary sectors of the economy have been shrinking, the share of trade in services is expanding very quickly. With the development of information and communication technology tools, many opportunities have become available for cross-border supply, which has boosted the importance of international trade in services. In addition, service sector contributes to more than half of total employment in industrialized economies (WTO, 2010). However, in spite of the increasing share of trade in services in the global economy, the majority of studies related to international trade have focused on goods trade rather than services trade. With only limited research on service trade, we are short of any proper empirical understanding of the determinants of trade in services. Therefore, our paper fully focuses on the service sector with the purpose to identify the main determinants of services trade, namely exports of services.

Next, although services have different characteristics in comparison to goods, certain service subcategories have features that are sharply different from other service subcategories. For instance, the effect of time-zone differences between the exporting country and its trading partners may differ considerably across various service subcategories. A previous study has revealed that the time-zone difference is negatively correlated with exports of construction services; whereas it has a positive impact on computer related service exports (Kandilov & Grennes, 2010). Thus, in our empirical work, we assess both the determinants of aggregate service exports and the determinants of each of the seven service subcategories. For this, we propose the following research question for the study: "*What are the main factors affecting Lithuania's exports of services and how do these factors differ across the principal service categories*?"

In order to be able to fulfill the main objective of our paper, we have decided to limit the analysis of determinants of service exports to a single country, namely Lithuania. The main argument for this is that it is difficult to obtain detailed and consistent data on exports of services for a great number of countries. Given the issue of data scarcity, we attempt to deepen our knowledge on the topic of service exports by employing the Eurostat dataset, which contains aggregated bilateral service trade flows data and disaggregated data for seven service subcategories. The choice of Lithuania as the focal point of our research is fueled by

two main reasons. First, this country has been widely neglected in the literature on service trade. Most of the previous studies that analyzed service trade do not include Lithuania in the dataset applied for research and even if Lithuania is included in some of the studies it does not represent the central issue of the research. Second, the share of Lithuania's exports of services is higher than average in the world (Eurostat, 2014).

This paper contributes to the existing empirical literature on trade in services in a number of ways. First, we follow the Poisson Pseudo-Maximum Likelihood (PPML) approach suggested by Santos Silva and Tenreyro (2006) in our research rather than the Ordinary Least Squares (OLS) estimation. We employ the PPML approach because the PPML estimator allows us to take into account observations with zero trade flows and to avoid severe biases that result from running an OLS regression.

Second, we make a country specific contribution by applying the gravity model to estimate service export flows between Lithuania and its main trading partners. We employ data for a ten year period from 2003 until 2012 available in the Eurostat database, which allows extending the existing research of bilateral trade flows. In addition, we analyze the determinants of service exports across seven disaggregated service subcategories (transport, travel, other business services, construction, communication, financial and computer and information). Whereas determinants of aggregate services exports were studied in the researches of Grundfeld and Moxnes (2003), Kimura and Lee (2006) and Head, Mayer and Ries (2009), disaggregated analysis has only been employed in a few papers (Walsh, 2006; Kandilov & Grennes, 2010). Moreover, the standard gravity equation in our study is augmented with additional variables for each service category.

The paper is organized as follows. Section 2 reviews the existing literature on the determinants of service trade flows and on the gravity model applications to service trade flows. Section 3 provides a gravity model specification for exports, which will then be estimated using the PPML approach. In section 4, we discuss the results that we have obtained. Lastly, robustness check is conducted in section 5 and a conclusion is given in section 6.

2. Literature review

2.1. Brief introduction

The existing literature on trade in services is scarce and focuses predominantly on the differences between trade in goods and trade in services and how these differences impact previous theoretical findings for trade in goods. For example, Hill (1977) states that a key difference between services and goods is the fact that services have to be consumed and produced at the same time, as services cannot be stored. Deardoff (1985) and Melvin (1989) assert that this characteristic of services challenges the theory behind the law of comparative advantage for trade in services.

However, in the last decade studies on the topic of trade in services have substantially increased. Data on bilateral services, which became available in the OECD database since 2002, facilitated studies on trade in services and have made it possible to quantify the impact of various determinants on trade in services. The most dominant econometric tool applied for the analysis of trade in services is the gravity model. The standard gravity model relates the trade volume to countries' economic sizes (GDP), and distance between two trading partners. With the help of this model, a large body of literature has focused on studying the determinants of aggregate service flows (e.g. Grundfeld and Moxnes (2003); Kimura and Lee (2006); Head, Mayer, and Ries (2009)).

Several researchers attempted to study the determinants of services flows at a disaggregated level (e.g. Walsh, 2006; Kandilov and Grennes, 2010; Shingal, 2010) and their findings seem to suggest that analyzing determinants of trade in services at an aggregate level is not appropriate. Different services have different modes of supply (see Appendix 1), rely on different regulations, and have different market structures (Goswani, Gupta, Mattoo and Saez, 2012). Therefore, the effect of the same determinant may vary for different types of services.

Lithuania was neglected in most of the studies that analyzed services exports. Although the existing research of Kandilov and Grennes (2010) focused on exports from Central and Eastern Europe, the data on Lithuania's exports was presented only in aggregated service exports of the Baltics.

After briefly introducing the trends in the research on the topic of service trade, we turn our attention to the discussion of the theoretical literature on the determinants of aggregate service exports and of the few trials to study determinants of service exports across various service categories.

2.2. Literature review on the determinants of service exports

2.2.1 The role of GDP

The gravity literature corroborates that exports of services are proportional to the market size of origin and destination countries, which is often measured by GDP. The results of positive and significant influence of GDP of the exporting and importing countries on trade in services are consistent and significant across the studies of Grunfeld and Moxnes (2003), Lejour and Verheijden (2004), Shingal (2009) and Kimura and Lee (2006). Additionally, comparing the effect of origin and destination countries' GDPs on services exports Grunfeld and Moxnes (2003) and Lejour and Verheijden (2004) found that home country GDP coefficient is slightly higher than 1, whereas the GDP coefficient for the destination country is less than unity. This finding implies that the domestic market size has a higher influence on trade in services than the market size of the destination country (Lejour & Verheijden, 2004). Revealing a strong home market effect in services trade, Grunfeld and Moxnes (2003) suggest that the effect is in line with the heterogeneous nature of services. Kimura and Lee (2006), however, found a contradicting result regarding the home market effect while testing determinants of exports and imports. Examining exports flows, the authors found that the home country GDP coefficient was larger than the destination country's coefficient on GDP, while the analysis of imports displayed a higher magnitude of the importing country's coefficient on GDP. Thus, contradictory results for exports and imports of services did not allow Kimura and Lee (2006) to confirm the presence of the home market effect in their research. Further, some authors augmented the gravity equation with GDPs per capita alongside GDPs to control for the effect of countries' income on trade flows (Lennon, 2006; Grunfeld & Moxnes, 2003). However, high correlation between GDP and GDP per capita might cause model specification problem; therefore, Kimura and Lee (2006) suggest estimating separate gravity equations with GDPs and GDPs per capita as explanatory variables.

Thus, we incorporate GDPs of the origin and destination countries into the gravity equation (*ln_gdp_o, ln_gdp_d*) and in accordance with gravity literature expect a positive impact of these variables on Lithuania's exports of services.

2.2.2 The role of distance

Subsequent determinant of services exports, distance, is usually interpreted as a proxy for transaction costs and is inversely related to trade flows (Grunfeld & Moxnes, 2003; Head, Mayer & Ries, 2009; Kimura & Lee, 2006; Kox & Lejour, 2005; Lennon, 2006; Mirza and Nicoletti, 2004). Distance is found to be highly significant in Kimura and Lee (2006), Grunfeld and Moxnes (2003), Lennon (2006) and Lejour and Verheijden (2004) studies, which indicates the relevance of physical proximity in service trade. However, literature represents controversy when the effect of distance on service trade is compared to the effect of distance on trade in goods. Kimura and Lee's (2006) findings suggest that the role of distance is stronger for service trade than for goods trade due to a higher importance of physical proximity in service provision. The opposite results are presented in the research of Lejour and Verheijden (2004). When comparing the size of the coefficient for distance for trade in goods and services, the authors found distance to matter less for service trade than for goods trade. The authors also found different effects of distance across various services subcategories: they found distance to be relatively unimportant for financial and communication services, but crucial for business services and retail margins (Lejour & Verheijden, 2004). By disaggregating exports into six subcategories, Kandilov and Grennes (2010) also reveal that the impact of distance varies across export categories. They showed that distance is important for construction services, but it has a dismissive effect for other categories. Studying the determinants of service imports at a sub-sectoral level, Walsh (2006) obtained mixed results regarding the impact of distance across different categories. He found that this variable displays a significant effect only in the case of transport services. Different magnitudes of the distance effect across subcategories outlined in the literature indicate that for some categories (Modes 2, 3, and 4) physical proximity is more relevant, while for other categories (Mode 1) innovation and development of ICTs reduced the importance of distance in services trade. Therefore, the final effect of distance relies on composition of aggregate services (Goswami, Mattoo, & Saez, 2012).

Since transport, travel and other business services depend on physical distance and compose the largest share of Lithuania's service exports we anticipate a negative and significant impact of distance (*ldist*) on export volumes.

2.2.3 The role of time-zone differences

Kandilov and Grennes's (2010) paper suggests that distance is not only a proxy for transportation costs; furthermore, it can reflect time zone differences. Thus, the effect of time zone differences is estimated separately in the studies of services exports by including the relevant variable. In this way, one can decompose the effect of distance into two modules: East-West and North-South distance, where East-West distance is measured by time zone differences and North-South by distance between trading partners (Kandilov & Grennes, 2010). Further, the impact of time zone differences is likely to vary for different types of services, enhancing the provision of services with round-the-clock production (continuity effect) and reducing trade in services that rely on the alignment in office hours (synchronization effect) (Kandilov & Grennes, 2010; Goswami, Mattoo, & Saez, 2012). The time zone difference effect is found positive and significant in Head, Mayer, and Reis (2009) research for financial and miscellaneous business services indicating the dominance of the continuity effect for the respective service categories. Similar results pointing to the dominance of the continuity effect are published in Kandilov and Grennes's (2010) study for aggregate services as well as for financial, computer and information and other business services categories. Conversely, construction services are found to be negatively affected by time zone differences in Kandilov and Grennes's (2010) paper, denoting the importance of synchronization for this type of service.

In the present research, we control for the effect of time difference by including the variable (*tdiff*) and based on the composition of exports we anticipate that either the synchronization effect or continuity effect will dominate.

2.2.4 The role of contiguity

Most of the empirical studies of gravity model contain a dummy variable, adjacency, to evaluate whether common border facilitates international trade (Kimura & Lee, 2006; Lennon, 2006; Lejour & Verheijden, 2004). The variable is found to have a positive and significant impact on trade in services in the studies of Lennon (2006) and Kimura and Lee (2006). Lejour and Verheijden (2004), however, present different results for the inter-provincial trade in Canada and inter-EU trade. They found that adjacency positively affects service exports within the EU and has a negative impact on trade between the neighboring provinces in Canada. Analyzing differences between the impact of contiguity on service and goods trade, contrary to the expected results, Kimura and Lee (2006) found that the coefficient for adjacency is smaller for service exports than for goods exports and loses its

significance in the case of service imports. Similarly, Lennon's (2006) findings confirm that trade in services is less subject to the impact of countries' contiguity than trade in goods. Finally, Walsh (2006) found that the presence of a common border between the exporter and importer has little significance to any category of service exports, except transport services.

Given the gravity literature proposition that countries closer to each other tend to have higher trade volumes, we include the variable *contig*, which denotes the presence of a common border between Lithuania and its trading partners, and anticipate a positive effect on services exports.

2.2.5 The role of a common language

Common language is another widely used determinant of service trade since knowledge of trading partner's language facilitates the establishment of business relationships and enhances services exports through direct communication and translation effect (Goswami, Mattoo, & Saez, 2012). Common language is found to have a positive effect on services exports in the studies of Kimura and Lee (2006), Walsh (2006) and Lennon (2006). The research of Lejour and Verheijden (2004) similarly finds a positive impact of shared language on services exports within Canada and the EU, whereas the effect of shared language on trade in goods is not found significant in the study, which testifies that communication is more relevant in service provision than in goods trade. Assessing the impact of common language across different services subcategories, Walsh (2006) and Lennon (2006) found a significant impact of shared language on trade in commercial services since this service category relies on personal communication.

Consistently with findings of preceding research, we expect a positive and significant impact of the Common Spoken Language Index (*csl_index*) on exports of total services.

2.2.6 The role of trade agreements

Regional agreement dummies are commonly used in the analysis of determinants of service flows. A positive coefficient on this dummy suggests that countries that are members of the same trade agreement trade more. However, theoretical literature presents different results on the importance of trade agreements between exporting and partner countries. On the one hand, several studies attest that regional trade agreements have no impact on volumes

of trade (Walsh (2006); Grunfeld and Moxnes (2003)). Specifically, the findings of Grunfeld and Moxnes (2003) suggest that regional trade agreements (RTA) do not exert a significant effect on export flows because RTAs do not address service trade liberalization. On the other hand, Kimura and Lee (2006) present opposite results for the impact of trade agreements on service trade. They find that the existence of trade agreements between the exporting and importing country affects positively trade in services. In addition, they argue that although the majority of RTAs do not explicitly account for service trade, their presence should promote service trade in an indirect way. Other researchers who find that trade agreements have a positive and significant effect on service trade are Lennon (2006), Mirza and Nicoletti (2004).

For our research, we include a dummy indicating whether Lithuania and the partner country are members of the European Union. We expect this dummy to have a positive sign for aggregate service exports since being members of the same union should promote trade. With reference to disaggregate service exports we expect the sign on the EU dummy to vary in dependence on the type of service and its mode of supply.

2.2.7 The role of institutions

The quality of legal institutions also proves to be an important determinant of international trade. For example, Anderson and Marcouiller (2002) apply the gravity model to show that weak institutions in importing countries hamper trade to a greater extent than tariffs do. Berkowitz, Moeinius and Pistor (2006) show that strong institutions in the exporting country lead to an increase in international trade. This especially applies to products whose features cannot be fully defined in a contract. Finally, Nunn (2007) finds that a country's contracting environment has a higher explanatory power in predicting the global pattern of trade than a country's physical capital and skilled labor combined.

A country's institutional quality should matter not only for goods but also for services. This is proved by Kandilov and Grennes (2010), who find a positive, statistically significant and economically large coefficient on the variable measuring the relative quality of the exporting country's institutions. Their results suggest that the higher the relative quality of exporter's institutions, the higher the service exports. In the same way, Lennon (2006), measuring the quality of institutions for the exporting and importing country by three different proxies, shows that there is a positive relationship between quality of institutions and service exports. Marel (2011) shows that countries with higher institutional quality (rule

of law) export relatively more services that rely on institutional quality. However, when comparing the importance of institutional quality between services and goods, Marel (2011) finds that ensuring mechanisms for contract enforcement are more significant for goods in comparison to services. This result invalidates the assumption that trade in services is characterized by more complex issues than trade in goods and, hence, that institutional quality is critical for service exports.

For our research, we include the time (i.e. days) needed to enforce a contract in the partner country as a proxy for the institutional quality of Lithuania's trading partners. We expect a negative sign for this variable since the longer it takes for a contract to be enforced in the partner country, the weaker is that country's institutional quality.

2.2.8 The role of human capital

A key difference between goods and services is that services are more skill intensive in comparison to goods (Gibbs (1986), Nusbaumer (1987)). Hence, human capital can be an important factor that may help explain patterns of services exports. Such evidence is based on several studies that attest a positive relationship between human capital endowment and exports of services at the aggregate level (Mirza and Nicoletti, 2004) and at the disaggregated level (Arora & Athreye (2002), Lakha (1994) for software service exports; Lennon (2006) for commercial services).

In their study, Mirza and Nicoletti (2004) demonstrate that human capital endowment of both the exporting and importing country, as proxied by the average number of years of schooling, is positively associated with service exports. This serves as a piece of evidence that not only human capital endowment of the exporting country is critical to service trade. The level of education of the population in the partner country is also an important determinant of service exports because the population of the partner country should be able to absorb service exports. In the same manner, Lennon (2006) attempts to measure the effect of human capital endowment, using three different proxies, on service exports and shows that all three variables in both the reporter and partner countries have a positive impact on commercial service exports. Finally, Amin and Mattoo (2008) analyze the relative impact of skilled labor on per capita output in services across fourteen major states in India. As a result, they find that skilled labor availability exerts a positive and significant effect on per capita output in aggregate services.

In our research, we include a variable that measures Lithuania's relative human capital endowment. A positive sign on this variable implies that Lithuania's partners tend to import services with higher skill-intensity than services that are produced domestically.

2.2.9 The role of remoteness

Several studies have included a measure of economic remoteness, which is a GDP-weighted average of the distance of one country to all other trading partners, when studying the determinants of service trade. The inclusion of remoteness is justified by the fact that this variable partially accounts for multilateral resistance terms, which should definitely be considered in a gravity equation as argued by Anderson and van Wincoop (2003). Other studies that argue that remoteness variable should be included when estimating a gravity equation are Brun et al (2005) and Carrere (2006). For example, Kimura and Lee (2006) examine the effect of remoteness on service trade and show that remoteness of both the exporter and importer is positively associated with service exports. Their result implies that the more remote a pair of countries is from the rest of the world, the greater their trade flows. Soloaga and Winters (2000) also find a positive relationship between the degree of "remoteness" of the importer and trade flows.

Following Soloaga and Winters (2000), we include a remoteness indicator for the importing country, which is defined as the average distance of the importing country to Lithuania, weighted by Lithuania's GDP share in world GDP.

3. Methodology

3.1. The gravity equation: theoretical equation

The analysis of bilateral trade flows with the help of the gravity model is a well-established practice. Tinbergen (1962) was the first one who applied this model to illustrate that the size of bilateral trade flows between two countries can be explained by the economic sizes (i.e. as measured by GDP) of the two countries and the distance between them,

$$T_{A,B} \propto \frac{(GDP_A)^{\alpha} * (GDP_B)^{\beta}}{(DISTANCE_{AB})^{\delta}}$$

with α, β, δ ≈ 1. Since then, this model has been widely used for the estimation of international trade flows and has been shown to be stable and robust across numerous studies that used different samples of countries, time series data and methodologies.

One of the criticisms that have been posed to the gravity model is that it lacks a theoretical basis. However, Anderson (1979) and Bergstrand (1985, 1989) had shown that this is not the case and that the model has actually several theoretical justifications. Applying the Amrington (1969) assumption that customers view products as being differentiated by country of origin, Bergstrand and Anderson develop models in which the volume of bilateral trade flows depends on income and transport costs. Later, several researchers (Helpman & Krugman, 1985; Deardoff, 1998; Eaton & Kortum, 2002) proved that the gravity equation can be obtained from several trade models, such as Ricardian, Hecksher-Ohlin, and monopolistic competition models. Hence, the gravity equation constitutes the basis of any model of trade.

In general, the gravity equation is represented by the following expression (*Becchetta et al, 2014)*:

$$X_{ij} = G * S_i * M_j * e_{ij} \quad (1)$$

where X_{ij} - the monetary value of exports from country *i* to *j*, S_i - exporter-specific factors (e.g. exporter's GDP) that represent the aggregate quantity exporters are ready to provide, M_j – importer-specific factors that form the aggregate demand of the importing country (e.g. importing country's GDP), *G* – a variable that is not country-specific (e.g the degree of world liberalization), and e_{it} - the ease of exporter *i* to access market *j* (i.e. the inverse of bilateral trade costs).

A recent study by Anderson and Wincoop (2003) shows the importance of incorporating relative trade costs (multilateral trade-resistance terms (MRT)) in the gravity model. Their study emphasized that estimating S_i and M_j of equation (1) with the GDPs of

exporting and importing country respectively without including MRTs leads to serious biases due to misspecification. Thus, they propose their augmented gravity equation, which takes the following form:

$$X_{ij} = \frac{Y_i Y_j}{Y}\left(\frac{t_{ij}}{\prod_i P_j}\right)^{1-\sigma} \quad (2)$$

where *Y* represents world GDP, $Y_i$and Y_j - GDP of countries *i* and *j* respectively, t_{ij} – the trade cost of country *j* of importing a product *i*, $\sigma > 1$ – elasticity of substitution, $\prod_i$ and P_j - exporter and importer ease of market access or country *i's* outward and country *j's* inward multilateral resistance terms (*Becchetta et al, 2014)*. These terms have low values in the case if a country is isolated from world markets, the level of isolation being measured by physical and policy determinants (e.g. distance from large markets, presence of tariffs, etc.).

In order to estimate a gravity equation, a common procedure is to take the natural logarithms of both sides of the equation and get a log-linear expression that can be approximated by ordinary least squares (OLS) regression. Thus, the gravity equation (2) can be represented by the following log-linear expression:

$$\ln X_{ij} = a_0 + a_1 \ln Y_i + a_2 \ln Y_j + a_3 \ln t_{ij} + a_4 \ln \pi_i + a_5 \ln P_j + \varepsilon_{ij} \quad (3)$$

where $a_0$is a constant, $a_3 = 1 - \sigma$ and ε is the error term.

One advantage of the above specification is that the estimated parameters can be interpreted without any difficulty: they denote elasticities. For instance, the estimated parameter for the GDP would show the % change in trade resulting from a 1% increase in the level of GDP (*Becchetta et al, 2014).*

Another way to estimate the model proposed by Anderson and Wincoop (i.e. equation (2)) is to use a fixed effect approach. A commonly used method is the fixed-effects Poisson Pseudo-Maximum Likelihood (PPML), which was first introduced by Santos Silva and Tenreyro (2006). This particular method will be further applied as the basis for the methodology of our research. The next section will provide a justification for employing the PPML approach instead of applying a simple OLS regression.

3.2. The gravity model specification for exports

In order to examine what are the main determinants of exports of services, we have to specify a gravity equation that is specific for Lithuania and for this we will mostly follow the approach used by Kandilov and Grennes (2010). First, we employ the gravity model specification introduced by Bergstrand (1985) as a base case, in which the dependent

variable PX_{ij}, denoting the size of exports between the two countries *i* and *j*, is a function of the product of each country's GDP ($Y_i$and Y_j respectively) and of the geographical distance between the two trading partners (D_{ij}). Then, for our research Bergstrand's model is extended to include additional factors that may have an impact on trade between country *i* and *j*, (A_{ij}). Thus, the equation takes the following final form:

$$PX_{ij,t} = \frac{\alpha_0 * \left(Y_{i,t}\right)^{\beta_1} * \left(Y_{j,t}\right)^{\beta_2} * e^{\beta_4 * A_{ij,t}} * \varepsilon_{ij,t}}{(D_{ij})^{\beta_3}} \quad (4)$$

where the α and β*'s* represent the parameters to be predicted and ε represents the error term that is assumed to be statistically independent from the variables entering the regression equation, with $E\left[\varepsilon_{ij,t} |\ Y_{i,t}, Y_{j,t}, D_{ij}, A_{ij,t}\right] = 1$. The variable $A_{ij,t}$ denotes a vector of additional factors, the vector consisting of the following seven independent variables: csl_index, contig, hc_ratio, EU membership, time_enforce_cont_d, tdiff, ln_remote_d. A thorough justification of the selected additional variables in the context of Lithuania is provided in the next section.

As discussed in the previous section, a common way of estimating a specified gravity equation is to obtain a log-linear expression for that equation by taking the natural logarithms of all the variables of the equation. Thus, if we apply this approach, we will receive the following expression, which then can be estimated with the help of a simple OLS regression:

$$\ln\left(PX_{ij,t}\right) = \ln(\alpha_o) + \beta_1 \ln\left(Y_{i,t}\right) + \beta_2 \ln\left(Y_{j,t}\right) - \beta_3 \ln\left(D_{ij}\right) + \beta_4 A_{ij,t} + \ln\left(\varepsilon_{ij,t}\right) \quad (5)$$

However, Santos Silva and Tenreyro (2006) argue that employing the above-mentioned estimating approach results in severe biases in the obtained OLS estimates. This occurs due to the error term that is most of the time heteroskedastic. The presence of a heteroskedastic error term means that the expected value of the error term depends on one or more regressors, which is a direct violation of the first assumption of OLS and which leads to inconsistent OLS estimates (UN ESCAP, 2014). Therefore, Santos Silva and Tenreyro provide a solution to this problem and provide another estimation approach which is the Poisson Pseudo-Maximum Likelihood (PPML) approach with the following set of first order conditions:

$$\sum_{ij,t} \left[PX_{ij,t} - e^{\ln(\widehat{\alpha_0}) + \widehat{\beta_1} \ln\left(Y_{i,t}\right) + \widehat{\beta_2} \ln\left(Y_{j,t}\right) - \widehat{\beta_3} \ln\left(D_{ij}\right) + \widehat{\beta_4} A_{ij,t}}\right] X_{ij,t} = 0, \quad (6)$$

where $X_{ij,t} = [1, \ln\left(Y_{i,t}\right), \ln\left(Y_{j,t}\right), \ln\left(D_{ij}\right), A_{ij,t}]$. So, we get estimates for $\ln(\alpha_0), \beta_1, \beta_2, \beta_3,$ and β_4 by running a Poisson panel regression on the volume of exports within the period 2003-2012, denoted by $PX_{ij.t}$, on $X_{ij,t}$. Since we are working with a pseudo-maximum likelihood estimator, it is not required that the trade data follow a Poisson

distribution. The only condition that is required is that the conditional mean has to be defined properly, $E\left[PX_{ij,t}|\ X_{ij,t}\right] = e^{\ln(\widehat{\alpha_0})+\widehat{\beta_1}\ln(Y_i,t)+\widehat{\beta_2}\ln(Y_{j,t})-\widehat{\beta_3}\ln(D_{ij})+\widehat{\beta_4}A_{ij,t}}$. As the PPML estimator does not completely account for heteroskedasticity, interpretation of the estimator will rely on a White robust covariance matrix estimator, as in the study of Kandilov and Grennes (2010).

Besides accounting for heteroskedasticity of the error term, the Poisson estimator has other advantages that prove to be extremely useful when working with trade data and applying a gravity equation for the analysis of that data. First, this estimator is consistent when fixed effects are included in the gravity equation, a property that is uncharacteristic for nonlinear maximum likelihood estimators. This property of the PPML estimator is especially important in the context of models that rely on a gravity equation because they typically require the addition of fixed effects by exporting and importing country.

Second, the PPML estimator by its construction takes into account observations with zero trade flows. Such observations are excluded when running an OLS regression because the natural logarithm of 0 is not defined. However, Haveman and Hummels (2004) show that the presence of zero bilateral trade flows is consistent with the hypothesis of incomplete specialization, since not all states trade all goods with all trading partners. Even though the problem of 0 trade values has been primarily concerned with goods trade, it is also applicable in the context of services trade. Excluding observations that contain 0 values as the OLS method does may result in sample selection bias (UN ESCAP, 2014). Therefore, we can conclude that the property of the PPML estimator to include observations with 0 trade flows without any specific requirements to the base model is beneficial.

Finally, the estimated coefficients from the Poisson model can be interpreted without any serious difficulties. Even though the measured variable for the Poisson model is defined as volume of exports in absolute amount rather than in logarithms (i.e. which can be interpreted as % change), the coefficients of any explanatory variables denoted in a logarithmic form can nevertheless be interpreted as elasticities, as under OLS (UN ESCAP, 2014).

3.3. Description of dependent and explanatory variables

3.3.1. Dependent variable

The dependent variable that is used in our gravity model is PX_{ij}, which captures exports of services from country *i* to country *j*. Since we are interested in investigating the

determinants of service exports for a single country, namely Lithuania, country *i* will always the same one, the only variation being in the *j* term that denotes the trading partners of Lithuania. Data on exports of services are extracted from Eurostat database, which covers exports of services between Lithuania and the majority of all its trading partners over a 10-year period (2003-2012). Then, the gravity model is estimated several times, with aggregate exports of services, and with exports of services for each service category (transportation; travel; other business services; communication; construction; financial and computer and information services).

However, there are two main issues with the dependent variable that have to be addressed before estimating the gravity equation. The first issue deals with the transformation of nominal trade flows to real values. De Benedictis and Taglioni (2011) argue that trade flows that are used in the gravity equation should be expressed in nominal terms and in a common currency, because the gravity equation is nothing else than an adjusted expenditure equation. Thus, trade flows do not need to be deflated by a price index. Moreover, converting nominal trade flows to real values is likely to result in supplementary sources of biased estimation due to scarce data related to relevant deflators. It is extremely difficult to obtain adequate price indices for bilateral trade flows, even for total amount of exports, not speaking already about disaggregated data such as in our case.

The second issue deals with the impact of inclusion or removal of observations with 0 values from the estimation. As we have already mentioned we will address the issue of zero trade flows with the help of the PPML estimator.

3.3.2. Explanatory variables

The first explanatory variables (*ln_gdp_o and ln_gdp_d)* that are included in the gravity equation, $Y_i$and Y_j, are measures of the economic masses of Lithuania and of its trading partners respectively. In general, a larger size of the markets of the importing country should have a positive impact on the demand for services (provided by the domestic market or imported); while a larger size of the markets of the exporting country should have a positive impact to that country's supplied amount of export services.

The next explanatory variable, D_{ij} (*ldist),* serves as proxy for transportation costs between Lithuania and its trading partners and is measured as the distance between the countries' economic centers (i.e. capitals) retrieved from CEPII database. Even though there is a great amount of controversy concerning the effect of this variable on trade in services in the existing literature, we posit that the effect of distance on trade flows will be negative.

Furthermore, it is important to consider *time differences* and *distance* variables separately; as otherwise, the later variable will incorporate both effects (Culiuc, 2014). The data on time difference between Lithuania and its trading partners measured in hours is retrieved from CEPII database. The impact of time difference (*tdiff)* on trade in services is subject to two opposite effects: time difference can enhance trade if services require continuous production and it can decrease trade volumes if synchronization of office hours is important for service provision (Kimura & Lee, 2006). Thus, either the continuity effect or synchronization effect will prevail in dependence of the service subcategory.

The presence of a common language between the exporting and importing country has been proved to be an important factor influencing goods trade and its impact is likely to be especially strong in services trade. This may be explained by the fact that the existence of a common language is expected to lead to a reduction in search and transaction costs and thus be positively related to the volume of service exports. However, because Lithuania's official language is not shared by any of its trading partners, we use Common Spoken Language (CSL) index from CEPII database, which can take a value between 0 and 1, denoting the % of the population which speaks at least one common language in both exporting and importing country. Overall, it is expected that the coefficient on this index *(csl_index)* to have a positive sign.

The existence of common borders between the exporting and importing country is expected to promote trade between these countries. In order to incorporate this effect, we include a dummy variable *Contig* that equals 1 if the two countries share a common border and 0 otherwise.

Human capital in the exporter and importer countries can also be an important driver of service exports. In our sample human capital in a country (variable hc_k *(k=i,j)*) is proxied by an index of human capital per person, which was constructed based on years of schooling of population (Barro and Lee, 2012) and returns to education (Psacharopoulos, 1994), and was retrieved from the Penn World Table. Further, we compute exporter's relative human capital endowment, which represents a ratio of the exporter's index of human capital per person to the importer's index of human capital per person (*hc_ratio*).

The quality of legal institutions is also a critical determinant of service exports. Thus, we use the time needed for contract enforcement (*time_enforce_cont_d*) as a proxy for institutional quality and efficiency of the judicial system in dispute resolution of the importing country. This indicator, retrieved from the World Bank database, represents time (in number of calendar days) required to enforce a contract from filling a lawsuit in court

until the final decision (World Bank, 2015a). The variable is anticipated to enter the gravity equation with a negative sign since high values for this variable are associated with low institutional quality.

The final dummy that is included in the general gravity equation, *EU membership,* is used to account for the impact of EU membership on export trade flows. So, the *EU* dummy is expected to take a value equal to 1, if both Lithuania and the importing country are members of the EU and 0 otherwise. The dummy variable is expected to enter with a positive sign in the gravity equation since being members of the same union should enhance international transactions between Lithuania and its partner countries.

Last but not least we include a variable that proxies the relative distance of the importing country to the rest of the world (*remoteness$_{jt}$)*. We calculate remoteness of the importer by applying the following formula:

$$REM_{jt} = \ln\left(\frac{1}{\sum_j \frac{GDP_{it}/GDP_{Wt}}{D_{ij}}}\right)$$

where D_{ij} is the distance between country *i* and *j; GDP$_{jt}$* is the GDP of Lithuania in year t; and GDP_{Wt} is the world GDP in year t.

3.3.3. Service subcategories

Further, we estimate the effect of the explanatory variables specified in the gravity equation on different service subcategories. Disaggregation of services exports might reveal different magnitudes of the effects specified in the general equation. We estimate the gravity equation separately for service subcategories and augment the general form of the gravity equation with the relevant explanatory variables for the subcategories considered, which is reflected in modification of the vector in each case. The choice of the categories for the analysis is determined by their share in overall exports of services and by data availability.

Thus, the present study will analyze separately the determinants of the following service categories: transport, travel, other business services, communication, construction, financial services, and computer and information services.

Transport

The present category includes all transportation services, mainly carriage of passengers, freight of goods and other related services (UNCTAD, 2014a). Taking into account the type of provision for transport services, Mode 3, previous research (Shingal,

2009) suggests that additional variables affecting transport services are the quality of infrastructure of the exporting and importing countries.

Transport services are affected to a greater extent by physical infrastructure and the determinants affecting this type of service are expected to be similar to the factors that affect trade in goods (Goswami, Mattoo, & Saez, 2012). Quality of infrastructure (*roaddensity*) variable relates to the road density and is measured by km of road per 100 sq. km of land area. The road network incorporated into the road density measure includes motorways, highways, national and regional roads and urban and rural roads (World Bank, 2015b). The data on the road density indicator is retrieved from the World Bank database.

The EU membership is expected to have a significant effect on transport services as transportation often relates to trade in goods, which is more intensively affected by the elimination of trade barriers (Walsh, 2006). Similarly, we anticipate a positive and significant impact of adjacency in the transport subcategory as contiguity facilitates exports of transport services.

Travel

The travel subcategory of service exports comprises goods and services purchased by non-residents within their period of stay in a country shorter than one year (UNCTAD, 2014b). Travel services are provided under Mode 2 and Mode 3 and could be additionally affected by the quality of infrastructure and real effective exchange rate.

The development of information and communication technologies has decreased the costs of provision of the majority of services categories; thus, the development of electronic infrastructure is expected to positively affect export of services. Internet penetration is widely used in the research on service exports as a proxy for electronic infrastructure development (Goswami, Mattoo, & Saez, 2012). Quality of infrastructure (*int_users*), assessed by the internet penetration, relates to information and communication technologies. The indicator is retrieved from the World Bank database and is measured by internet users per 100 people (World Bank, 2015c). In line with the study of Freund and Weinhold (2002), we expect that the development of the infrastructure abroad will have a positive impact on service provision.

An IMF study on the determinants of international tourism proposes several measurements for *real exchange rate*, among which are bilateral real exchange rate, real effective exchange rates of exporting and importing countries, Penn World Tables' (PWT) PPP factor and PPP factor ratio. Although, the bilateral real exchange rate variable is widely applied in studies of trade flows, it does not incorporate the effect of the third currencies on

the exchange rate. Thus, the real effective exchange rate is preferred to bilateral real exchange rate as it accounts for currency fluctuations relative to third currencies (Culiuc, 2014). The data on CPI-based real effective exchange rate, which measures currency value relative to the basket of country's trade partners' currencies, was taken from the Bruegel database (Bruegel, 2015). The depreciation of trading partners' currency (*ln_reer_d)* is expected to decrease Lithuania's travel exports, as the services would become more expensive to trading partners.

Time differences (*tdiff*) variable is expected to have a negative impact on tourism even after controlling for the distance, which means that time lag affects travel decisions (Culiuc, 2014).

Based on the previous research (Walsh, 2006; Culiuc, 2014) we expect a positive and significant effect of trading partners' GDPs and common language on trade in travel services.

Other business services

Other business services category incorporates trade-related and operational leasing services and supplemental professional, technical and business services, such as advertising, consulting, accounting and legal services (UNCTAD, 2014c). Other business services include cross-border supply, commercial presence and movement of natural persons for service delivery, thus covering Mode 1, Mode 3 and Mode 4 of service provision (Shingal, 2009).

The provision of other business services is mostly affected by the presence of a common language, economic freedom and quality of institutions in the exporting and importing countries (Walsh, 2006; Shingal, 2009).

The corruption index is suggested as a proxy for institutional quality and is expected to have an impact on trade in services due to the intangible nature of services and inability of consumers to assess the service quality before the provision of service (Goswami, Mattoo, & Saez, 2012). Thus, the existence of credible regulators is of vital importance in the service trade as they ensure the quality of services to consumers (Goswami, Mattoo, & Saez, 2012). Lennon (2006) and Grunfeld and Moxnes (2003) augment the gravity equation with the corruption index, in which higher values stand for lower corruption, to control for the institutional quality and find a positive and significant impact on trade in services. Additionally, the corruption measure is found more relevant for international trade in services than for goods trade due to higher personal interaction in service trade (Melnikova & Jong, 2014). Other business services are expected to be highly affected by the corruption index as this category of services is provided under Mode 3 and Mode 4, hence, implying relatively

high personal interaction. The data on countries' corruption index is retrieved from Transparency International database.

Furthermore, we include Economic Freedom of the World Index extracted from the Economic Freedom Network database, which assesses economic freedom in five areas: size of the government; legal system and property rights; access to sound money; freedom to trade internationally and regulation (Kimura & Lee, 2006). We use a summary index of economic freedom, which is computed as the average of five area ratings and takes the values from 0 to 10 (Kimura & Lee, 2006). The Economic Freedom index of the exporting country reflects quality of institutions and is expected to have a positive impact on trade in other business services.

Financial services

Financial services comprise financial auxiliary and intermediation services provided by banks, stock exchanges, credit card enterprises, factoring and other enterprises; excluding services related to life insurance and pension funds, which are captured by insurance services (UNCTAD, 2014e).

When assessing the factors that influence financial services exports, financial sector development should be considered in terms of availability of credit and financial institutions (Sahoo, Dash, Mishra, 2013). Thus, we apply the measure of financial sector development, automated teller machines per 100000 adults, provided by the World Bank. Automated teller machines stand for computerized devices that ensure access to financial transactions in public places for clients of financial institutions (World Bank, 2015d). We anticipate a positive impact of the corresponding variable for exporting and importing countries on trade volumes.

We further incorporate the level R&D expenditure (*rd_d*) of the destination country in the model since the level of technological development is important in service trade as it transformed non-tradable services into tradable (Lennon, 2006). Based on the Lennon study (2006) of the technology impact on commercial service trade we anticipate a positive and significant effect of the R&D expenditure variable on trade in financial services. The data on R&D expenditure of the destination country is retrieved from the World Bank database and covers basic research, applied research and experimental development (World Bank, 2015e).

Market capitalization *(mkt_cap_o)* relates to the size of stock market of the exporting country and reflects financial sector development. The size of the stock market is associated with the ability to diversify risk and mobilize capital. Thus, this variable is expected to have a positive impact on trade in financial services. Data on market capitalization is retrieved from

the World Bank database and is measured as a size of country's stock market as a percentage of GDP (World Bank, 2015f).

Despite various anti-corruption acts and regulations in the financial sector, the issue of corruption still remains crucial for the financial institutions due to the nature and geographic diffusion of business, economic environment of operations and behavior of agents and third parties. According to PWC's Global Economic Crime Survey, 27 % of financial institutions' respondents encounter corruption, placing it the third economic crime after asset misappropriation and accounting fraud (PWC, 2011). We control for the impact of corruption index of the exporting and importing countries on financial service trade and expect a positive impact of the variable since a higher index is associated with lower corruption.

Taking into consideration the findings of preceding research on the determinants of financial services, the variables from initially specified gravity equation, common language and the EU membership, are expected to have a significant impact on trade flows of financial services (Shingal, 2009).

Communication services

The communication services category comprises postal, courier and telecommunication services transactions between residents and non-residents of the country (UNCTAD, 2014f).

We supplement the gravity equation with the quality of infrastructure *(int_users_d*) of the destination market as an additional variable affecting trade in communication services and expect a positive and significant impact on the trade flows.

Unlike in transportation services, contiguity is not expected to have a significant impact on trade in communication services due to the development of ICT.

Computer and information services

Computer and information services are provided under Mode1, Mode3 and Mode 4 and consist of three service categories:

a) computer services that include processing of data and hardware and software related services;

b) new agency services that comprise news, photographs and articles provision;

c) other information services that include services related to data-bases (UNCTAD, 2014g).

The research conducted by Kandillov & Grennes (2010) suggests that computer and information services have the highest magnitude among all service categories with respect to time zone differences, which indicates that time differences do not have a negative impact on computer and information service exports. The present paper will examine the effect of *time differences* on trade in computer and information services with the aim to distinguish whether this category is less sensitive to time differences in comparison with other categories.

The quality of infrastructure (*int_users_d*) of the destination country is expected to influence trade in computer and information services, thus the variable is included in the general gravity equation. Additionally, the level of R&D expenditure (*rd_d*) is incorporated into the model to control for technological development of the destination market. The variable is expected to exert a positive impact on provision of computer and information services.

The percentage of urban population (*pop_d*) in the destination country is an additional determinant for trade in computer and information services. This variable was suggested by Montagnier and Spiezia (2009) and was found to have a positive and statistically significant impact on ICT expenditures. The data on urban population of the importing countries is retrieved from the World Bank database and is measured as a percentage of the urban population relative to the total population (World Bank, 2015g).

The impact of relative human capital endowment is expected to have a positive and significant effect on computer and information technologies exports (Goswami, Mattoo, & Saez, 2012).

Construction services

Construction services imply construction projects conducted by companies outside the country where the companies have been established (UNCTAD, 2014h). Construction services are delivered under the commercial presence in the destination country and the movement of natural persons for service provision, implying Mode 3 and Mode 4 (Shingal, 2009).

The gravity model for construction services is augmented with the corruption index (*cpi*) for the importing and exporting countries. The variable is relevant since the construction sector has the highest rate of bribery and corruption among all industries. The construction sector is less regulated and has a larger share of private ownership than other industries, which can result in high corruption rates. Moreover, procurement of goods and services and the choice of suppliers for the projects are decided by individuals within the company, which

enables corruption and bribery incidents (PWC, 2014). We anticipate positive signs on the coefficients of the corruption index for the exporting and importing countries since higher values of indices reflect lower corruption rates.

3.4. Data

For the analysis we use a data set for Lithuania and its 40 global importers of services across a ten year period, from 2003 until 2012. The data on aggregate trade in services and on trade in service subcategories is available in the Eurostat database. The given period is chosen due to the data availability in the Eurostat database for total service exports and for exports across service subcategories. We confine the sample of trading partners to countries for which the data on service trade volumes is reported for the analyzed period. The list of trading partners is presented in the Appendix 2. Further, we include a group of CIS countries in the list of trading partners, which consists of Belarus, Ukraine and Kazakhstan. The country group (CIS) rather than individual importers is included due to the unavailable disaggregate data for services subcategories for the respective trading partners. The measures for the explanatory variables for CIS countries are constructed accounting for weights of each member country's GDP in the country group GDP.

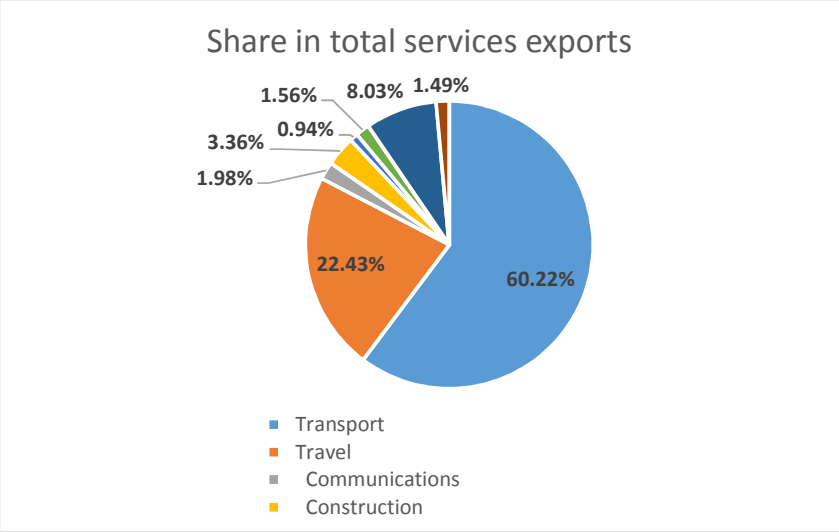
In the first part of the analysis the data on aggregate service trade is applied, whereas in the second part the services data is disaggregated into seven subcategories.

With reference to service exports across the main categories, we see that transport, travel and other business services account for the majority of service exports of Lithuania for the period 2003-2012 (See in Appendix 3). For example, in 2012 transport services accounted for 60. 22% of total exports of services by Lithuania, travel services – 22.43%, then followed by other business services with 8.03% (Figure 1).

Transport services were and remain the dominant category in service exports in the case of Lithuania over the period 2003-2012. However, starting with the year 2005 we see an increase in the volume of service exports in the case of travel services, other business services and construction services. This phenomenon could be partly attributed to Lithuania joining the European Union in 2004, which facilitated the movement of services across borders. Even though other service categories (such as computer and information services, communication and financial services), which we also have decided to investigate in our research, do not constitute a substantial share of the total service exports by Lithuania, they have their own industry characteristics that may lead to different results when analyzing what determinants are the most important for each service category separately.

The dataset analyzed in the present study contains 504 zero observations for disaggregate service exports. Whereas zero observations are dropped in the log-linearized model estimation, the PPML estimation suggested by Santos Silva and Tenreyro (2006) allows including zero trade flows in the analysis (Kandilov & Grennes, 2010).

Figure 1. Exports of services by EBOPS category (% share in 2012)



Data source: created by the authors using data from UNCTAD database

4. Discussion of the results

4.1. Total service exports

The results of the PPML estimation for equation (6) are reported in the second column of Table 1, Appendix 4. First, the log of GDP for the exporting country (i.e. Lithuania) reports a positive coefficient that is statistically significant at 1% significance level. The sign of the coefficient is as expected since a larger country will be able to provide more services both to its citizens and foreigners, and thus will export more services. A similar result seems to hold in the importing country: a larger country tends to consume more services than a smaller one, and as a result a larger country will demand more services to be imported from its trading partners. This is evident in the positive sign of the coefficient on the log of GDP for the importing country. Overall, the results that we obtained on GDP are in line with the findings of Grunfeld and Moxnes (2003), Kimura and Lee (2006), Walsh (2006), etc. Next, we find that distance has the expected effect on export flows using the PPML estimator: the coefficient on distance is negative and statistically significant.

With respect to time-zone differences, we find that the larger the time-zone difference, the lower the exports of services between the exporting and the importing country. Hence, the estimates seem to reflect the fact that the synchronization effect prevails over the continuity effect. The coefficient of 0.232 on the variable *tdiff* in column (2) of Table D.1 appears to indicate that if the time difference increases by one hour then service exports decrease by approximately 23 percent.

As expected, sharing a common border positively affects trade in services between two partners. This finding is consistent with the results obtained by Kimura and Lee (2006) for OECD countries, implying that countries that are located in close proximity trade higher volumes of services with each other. In addition, we find that sharing a similar language has a positive and significant effect on Lithuania's exports of services. This finding is not surprising as person to person communication is extremely important in the process of service delivery and, hence, sharing a similar language may considerably facilitate the communication process. Once again, the result reinforces the positive impact of similar language on trade in services shown in the studies of Head, Mayer, and Ries (2009); Walsh (2006); and Kimura and Lee (2006).

The *EU* dummy enters with a positive sign in the PPML regression, suggesting that being members of the EU promotes trade in services. The coefficient on the *EU* dummy is statistically significant at 1% significance level, reflecting the fact that on average service trade is deeply integrated within the EU. However, it is possible that the impact of being a member of the EU is likely to differ across various service subcategories since not all types of services are fully integrated and liberalized within the EU.

The coefficient on the variable that measures the quality of legal institutions of the importing country is found to be negative and statistically significant at 1%. Therefore, the longer it takes a partner to enforce a contract, the lower are the figures for service exports of Lithuania to that trading partner. The coefficient on Lithuania's relative human capital endowment is negative but statistically insignificant. The effect of exporter's relative human capital endowment on service exports is likely to vary between different types of services due to service heterogeneity.

Finally, as expected, we find the remoteness variable affects positively exports of services. The result reinforces our conjecture that trade will be larger between two partner countries that are situated further from the rest of the world than between two partner countries that are situated closer to the rest of the world.

4.2. Communication services

The results for exports of communication services are shown in Table 1, Appendix 4. Since the results obtained from the gravity model estimated by OLS (column 3) might suffer from heteroskedasticity bias, we mainly focus on the interpretation of the coefficients obtained from the augmented gravity equation estimated by PPML (column 4).

Unlike total service exports, we obtain that exporting country's GDP has a negative but insignificant impact on exports of communication services. The result points to the fact that Lithuania's GDP has little or no relevance for the export of communication services. By contrast, importing country's GDP has a positive and significant on trade in communication services, which is in line with economic theory.

As expected, the coefficient on the distance variable is found to be negative. However, we find that the impact of distance on exports of communication services is not statistically significant, which might mean that distance has little or no effect on this type of service. An alternative explanation for the presence of a statistically insignificant coefficient on distance is that there are two opposing effects of distance on communication services. On

the one hand, distance may have a negative impact on communication service exports because it serves as a proxy for transportation costs, and for cultural, linguistic and legal differences. On the other hand, distance may have a positive effect on communication services because advances in computer and information technologies have made free trade in services possible across borders (Goswami, Gupta, Mattoo & Saez, 2012). In our case, it seems that the two opposing effects are prominent, offsetting each other, and resulting in a statistically insignificant coefficient on the distance variable.

As in the case of total service exports, we find that sharing a similar language affects positively exports of communication services, reflecting the importance of communication in service delivery. The coefficient on the *EU* dummy has a positive sign and it is statistically significant. As expected, the fact that both partners are members of the EU facilitates exports of communication services. In addition, the impact of the quality of legal institutions of the importing countries on Lithuania's exports of communication services is found to be negative but insignificant.

Next, we find that sharing a common border exerts a negative but insignificant effect on trade in communication services. This is not a surprising result since communication services can be provided through information and communication technology tools and, hence, the effect of adjacency is greatly diminished and reversed for this type of service.

The variable that accounts for time-zone differences enters the gravity equation with a positive sign. It seems that for exports of communication services the continuity effect (the ability to operate around the clock) dominates the synchronization effect (the need to coordinate during business hours). Our results are in line with the findings of Kandilov and Grennes (2010), who find a positive effect of time-zone differences on exports of communication services.

With reference to Lithuania's relative human capital endowment, we find that the human capital ratio exerts a negative but insignificant effect on trade in communication services. For the remoteness variable, we find that its coefficient has a negative sign but it is not statistically significant.

Finally, as expected, the additional variable – Internet penetration in the partner country – exerts a positive and significant effect on trade in communication services. We find the better developed the quality of infrastructure of the destination market, the higher Lithuania's exports of communication service. This result is similar to the finding of Shingal (2010), who shows that service exports are highly dependent on the partner's telecommunication density rather than on the reporting country's own network infrastructure.

4.3. Construction services

The results of the estimation of augmented equation for construction services are presented in Table 1 (column 6) of the Appendix 4.

As in the case of total services, we find that exports of construction services are positively affected by GDPs of the exporting (i.e. Lithuania) and the importing country, and negatively affected by the physical distance. In addition, we find that from these three variables only the importing country's GDP exerts a significant effect on trade in construction services.

Time-zone differences between Lithuania and its partners for this type of service are estimated to exert a negative and significant effect. These results are consistent with the need to coordinate work during office hours, reflecting the dominance of the synchronization effect for exports of construction services.

Similar to exports of total services, we find that contiguity influences positively exports of construction services. Intuitively, this would be expected as the delivery of construction services requires the physical movement of persons to the area of consumer (Mode 4).

Sharing a common language does not have a significant impact on exports of construction services. Once again, this result would be expected since the delivery of this type of service does not rely heavily on communication. With respect to the *EU* dummy, we find that the coefficient on this variable has a negative sign and it is statistically significant. This result could be explained by the fact that there is only partial integration for construction services in the context of the European Union. Additionally, the results of the estimated coefficient for the EU dummy could be influenced by the evidence that Norway, which is the largest foreign market for Lithuania's exports of construction services, is not a part of the EU. Moreover, despite Lithuanian membership in the EU, Russia and other CIS countries considered in the analysis remain Lithuania's significant trading partners in the construction services within the analyzed period.

With reference to the quality of legal institutions of the partner, we find that an increase in the number of days it takes to enforce a contract in the partner country leads to a decrease in the amount of exports of construction services on the behalf of Lithuania. This result is not unexpected taking into account that the provision of contract services can only take place after all the necessary contracts had been signed (e.g. workers' contracts, tender contract, contracts for the delivery of building materials, etc.).

Lithuania's relative human capital endowment exerts a negative and significant effect on exports of construction services. This result reflects the fact that Lithuania exports services with lower skill intensity in comparison to services that are produced in the importing country.

Finally, proceeding to the analysis of the corruption indicators, we find, as expected, that the coefficients on the corruption indices for both the exporting and importing country exert a positive effect on exports of construction services. Our results serve as a piece of evidence that, indeed, the construction industry is characterized by high corruption and bribery rates and, as a result, Lithuania will tend to export construction services to countries with lower corruption rates.

4.4. Transport services

Table 1 (column 8) of the Appendix 4 presents the estimated results for Lithuania's exports of transport services. In the case of transport services, after controlling for the effect of quality of infrastructure, the GDP of the exporting country (*ln_gdp_o*) is found positive and statistically significant.

The variable measuring the GDP of the importing country (*ln_gdp_d*) is statistically significant and has a positive impact on the level of exports, which is consistent with model's specification for aggregate export volumes and with the prediction of gravity literature.

The common language (*csl_index*) variable has the expected positive sign and is statistically significant, indicating that a shared language increases exports of transportation services.

Sharing a common border and being members of the same unions (*contig, EU membership*) are found to be statistically significant and exhibit a positive impact on transport services. The impact of a common border and the EU membership is consistent with the results of Walsh (2006) for the corresponding service subcategory. The variables have a positive impact on trade in transportation services due to the similarity of the transport service subcategory with goods trade. Thus, by promoting trade in goods the EU membership leads to increased demand for transportation services (Walsh, 2006).

The coefficient of the variable distance (*ldistance*) is found to have a negative sign, which is in line with the findings of Grunfeld and Moxnes (2003) who demonstrate that there is a significant elasticity of service exports with respect to distance.

Considering the time difference (*tdiff*) variable, estimation results reveal that this variable has a significant and negative impact on transportation services, indicating that the synchronization effect exceeds the continuity effect in case of transportation services.

The quality of legal institutions measured by the time of contract enforcement in destination markets (*time_enforce_cont_d*) has a negative and significant influence on trade in transport services. The impact of the variable is consistent with the expected results and proves the importance of the quality of legal institutions in service trade due to the intangible nature of service provision.

The estimated coefficient on human capital (*hc_ratio*) endowment is negative, which indicates that a lower relative skill endowment of the exporter is associated with higher exports of transportation services.

The estimated coefficient for the variable remoteness (*ln_remote_d*) has the expected positive sign and is statistically significant. The significance of the relative distance is consistent with Kimura and Lee (2006) results for exports of services. Moreover, the findings of Kimura and Lee (2006) suggest that failing to control for remoteness leads to misspecification of gravity equation and biased results.

Complementing the gravity equation with additional variables associated with the quality of physical infrastructure, road density of the exporting and importing countries (*road density_o, road density_d*), we find a statistically significant and positive impact of road density of the importing country on transport services. The relevance of the importing country's infrastructure could result from the mode of provision of transport services, which requires commercial presence in a foreign country. The impact of the quality of infrastructure of the exporting country is not found to be statistically significant.

4.5. Travel services

The results of the gravity model estimated by PPML for travel services are shown in column (10) of Table 2 (Appendix 4) and indicate that the GDP (*ln_gdp_o*) of the exporting country has a positive, yet insignificant effect on travel service trade flows.

The export of travel services is found to be positively affected by GDP of the importing country (*ln_gdp_d*) and common language (*csl_index*), which is in line with the gravity literature and confirms our expected results for the travel subcategory (Walsh, 2006; Culiuc, 2014).

Adjacency (*contig*) has a positive and significant impact on the exports of travel services, which corresponds with the effect of this variable on aggregated exports. A high

magnitude of the coefficient of adjacency (*contig*) for travel services is consistent with Culiuc's (2014) findings, meaning that tourists respond to geographical proximity.

The estimated coefficient for the EU membership (*EU membership*) has a positive sign, yet the variable does not have a significant impact on export of travel services when we control for the real effective exchange rate and the infrastructure development of the importing country.

The results reveal a negative impact of distance (*ldist*) on trade in travel services, however the variable is not found to be statistically significant.

In accordance with Culiuc's (2014) research, gravity estimation reveals a negative and statistically significant effect of time difference (*tdiff*) on exports of travel services.

The time of contract enforcement (*time_enforce_cont_d*) in the importing country is not found to be statistically significant in the case of exports of travel services. The positive impact of time of contract enforcement can reflect the heterogeneity within travel services category; thus, for some types of travel services the quality of legal institutions might play an important role, while for others the role of institutional quality might be negligible (Kandillov & Grennes, 2010).

Human capital endowment of the exporting country (*hc_ratio*) has a negative and significant effect on travel services exports. An increase in exporter's relative secondary school enrollment decreases the exports of travel services, which can be explained by the fact that countries import services that are less skill-intense in comparison with services that are produced domestically (Kandillov & Grennes, 2010).

Relative distance (*ln_remote_d*) enters the gravity equation for travel services with an expected positive sign, indicating that trade flows are expected to be higher between the countries that are far from the rest of the world than between countries closer to their trading partners (Kimura & Lee, 2006).

The additional variable introduced in the gravity equation for travel services category, real effective exchange rate of the importing country (*lreer_d*), is statistically significant and has an expected negative impact on Lithuania's travel services exports. Depreciation of the currency of the importing country would make Lithuania's goods and services relatively more expensive and thus, would have a negative impact on exports of travel services.

The development of electronic infrastructure, measured by internet users of the importing country (*int_users_d*), has an expected positive sign; however, the variable is not statistically significant.

4.6. Other business services

The gravity model estimation for other business services presented in Table 2 (column 12) of the Appendix 4 reveals a positive but insignificant effect of the exporting country's GDP (*ln_gdp_o*) on the exports' level for this type of service. .

GDP of the importing country (*ln_gdp_d*) and sharing a common language (*csl_index*) are found to be statistically significant and the coefficients on those variables have positive signs, which is consistent with Walsh (2006)' results. Sharing a common language (*csl_index*) was expected to have a positive and significant impact on trade in business services, which is related with the modes of provision of business services that rely on personal communication.

Sharing a common border (*contig*) exerts a positive and a statistically significant effect on trade in other business services, which is consistent with aggregate service exports estimation.

The variable on distance (*ldist*) has an expected negative coefficient, yet it is not statistically significant. The insignificant impact of this variable might support the argument of declining role of distance in international trade due to globalization highlighted in the gravity literature (Coe, Subramanian, & Tamirisa, 2007).

The EU membership (*EU membership*) is found to have a negative but insignificant impact on trade in other business services. The negative influence of the union on exports of other business services is supported by findings of Kandillov & Grennes (2010). The negative coefficient on the EU membership could reveal the fact that trade in business services is not fully liberalized within the EU. Additionally, the EU countries are found to express a home country bias in international trade, meaning that national borders maintain its significance in the EU (Nitsch, 2000).

The time difference (*tdiff)* has a significant negative impact on trade in other business services, indicating the dominance of the synchronization effect in the respective service subcategory.

The coefficient on time of contract enforcement in the importing country (*time_enforce_cont_d*) has an expected negative sign, meaning that a higher number of days necessary to enforce a contract in the destination market is associated with lower exports of business services. However, this variable is not statistically significant.

The variable measuring relative human capital endowment (*hc_ratio*) is statistically significant for exports of other business services and its positive coefficient indicates that

higher relative secondary school enrolment of the exporting country enhances trade in other business services. The results reveal relative skill-intensity of other business services exports.

Remoteness of the destination country (*ln_remote_d*) in the estimated gravity model for other business services is not found to be significant.

Further, the results reveal that the corruption index of the importing country *(cpi_d*) exerts a positive and significant effect on trade in other business services, whereas the corruption index of the exporting country is not found statistically significant. The significance of the corruption index confirms that the institutional quality of the destination country matters in provision of other business services due to their intangible nature and reliance on interpersonal interaction.

The ultimate variable of the augmented form of the gravity equation, economic freedom of the exporting country (*free_o*), has a positive but insignificant influence on trade in other business services.

4.7. Financial services

In the estimated gravity equation for the financial services (Appendix 4, Table 2, column 14) GDPs of the exporting and importing countries (*ln_gdp_o, ln_gdp_d*) are positively affecting export volumes, whereas only GDP of the importing country is found to be statistically significant.

The Common Spoken Language index (*csl_index*) reveals a positive and statistically significant effect on trade in financial services, which confirms the results of preceding research. A relatively large value of the coefficient on *csl_index* denotes the importance of a common language in interpersonal communication implied by financial services provision.

The coefficient on the contiguity variable (*contig*) is statistically significant and has a positive sign, which is attested in the gravity literature for the aggregate service exports and supported by Walsh (2006)' findings for the commercial services subcategory.

Distance (*ldist*) and remoteness (*ln_remote_d*) have insignificant impact on trade in financial services, which can be attributed to the decreasing role of distance in financial services trade due to globalization and development of ICT.

The EU membership (*EU membership*) has an expected positive effect on exports of services, which implies that being members of the same union enhances international trade in financial services between Lithuania and its partners.

The time difference (*tdiff*) between Lithuania and its partner countries has a negative and significant impact on exports of financial services, emphasizing the importance of synchronization effect for financial services.

The quality of legal institutions measured by time of contract enforcement (*time_enforce_cont_d*) is found to have a significant impact on trade in financial services. The coefficient of the variable has an expected negative sign, suggesting that financial services trade flows are sensitive to the quality of legal institutions in the destination market.

Human capital endowment (*hc_ratio*) variable has a positive coefficient, which denotes financial services' reliance on highly skilled labor. Thus, higher relative secondary school enrollment of the exporting country promotes exports of financial services.

Incorporated into the gravity equation, the corruption index (*cpi*) is found to be significant only for the destination market, meaning that lower corruption in the importing country enhances Lithuania's exports of financial services.

The measure of financial sector development, automated teller machines (*ATM*), enters with a positive sign in the gravity equation for both the exporting and importing countries, which is consistent with the proposition that a higher number of automated teller machines is associated with a more developed financial sector and therefore, increases trade in financial services. However, the variable is not found statistically significant neither for the exporting nor for the destination countries.

The level of R&D expenditure (*rd_d*) of the importing country has a positive and significant effect on the trade volumes of financial services. Lennon's (2006) findings support the obtained results suggesting that countries' technological development has a considerable impact on trade in commercial services.

The stock market capitalization of the exporting country (*mkt_cap_o*) exerts a positive and significant effect on the exports of financial services, highlighting the responsiveness of financial services trade volumes to the size of the stock market of the exporting country.

4.8. Computer and information services

The estimation of the gravity equation for computer and information services (Appendix 4, Table 2, column 16) reveals that exporter's GDP (*ln_gdp_o*) is positively related to the trade volumes, although the variable is not statistically significant.

The GDP of the importing country (*ln_gdp_d*) and the Common Spoken Language index (csl_index) variables are found to be statistically significant in the gravity specification

for computer and information services. The positive signs of the coefficients are consistent with our conjecture and with the results for aggregate services exports.

A common border (*contig*) has a negative but insignificant impact on trade in computer and information services. The estimated results for this variable (*contig*) differ from the results for aggregate services due to the Mode 1 of delivery of computer and information services in which only services cross the border. Such mode of delivery implies a significant role of development of ICT rather than countries' contiguity.

The coefficient of the variable measuring distance (*ldist*) has an expected negative sign for computer and information services exports, which is consistent with the results for aggregate trade flows. However, similar to exports of financial services, distance is found insignificant for computer and information category supporting the argument of the decreasing role of distance in services exports.

Similar to aggregate services, computer and information services are positively affected by the EU membership (*EU membership*), which reflects enhancement of international trade between the members of the same union.

The variable measuring time zone differences (*tdiff*) is positively affecting computer and information services exports, yet is not found statistically significant in the augmented gravity equation for the corresponding subcategory. The magnitude of the coefficient of this variable is the highest for computer and information services in comparison with other services subcategories, which is consistent with Kandillov & Grennes (2010)' findings.

The amount of time required for contract enforcement in the destination country (*time_enforce_cont_d*) has an expected negative and significant impact on service trade. This implies that a higher number of days required to enforce a contract is associated with less efficient legal institutions in the importing country and thus impedes trade in computer and information services.

Relative human capital endowment (*hc_ratio*) was not found statistically significant in the gravity model specification for computer and information services, but the coefficient of the variable has an expected positive sign, which is supported by the argument that higher relative secondary school enrollment of the country contributes to its exports of computer and information services (Nyahoho, 2010).

Remoteness (*ln_remote_d*) was found insignificant in the gravity equation for computer and information services. Nonetheless, the coefficient of the variable has a positive sign which is in line with the proposition that a higher relative distance increases trade between countries.

The variables for the augmented gravity equation, the number of internet users and the level of R&D expenditure in the importing country (*int_users_d*, *rd_d*) have an expected positive and significant effect on computer and information services exports. Thus, higher quality of infrastructure and technological development of the destination country promotes exports of IT related services.

The percentage of urban population (*pop_d*) in the importing country is found to be a relevant determinant for computer and information services exports. Higher levels of urban population result in larger trade volumes in computer and information services.

5. Robustness check

In this part of the paper, we present results of three different tests (i.e. Park test, Gauss-Newton regression test, and RESET test) that point to the fact that the PPML estimator is more appropriate than the Ordinary Least Squares (OLS) estimators for estimating our gravity equation for exports. Overall, the results support our conjecture that the PPML estimator is a better estimating technique than the OLS.

5.1. Park and Gauss-Newton regression tests

First, we perform Park test and Gauss-Newton regression test to justify the application of a nonparametric estimator of the variance and to assess whether the heteroskedasticity pattern assumed by the model is relevant. According to Manning and Mullahy (2001), if

$$V[y_i|x] = \lambda_0 E[y_i|x]^{\lambda_1} \qquad (7)$$

holds and $E[y_i|x]$ can be consistently estimated, then estimates of λ_1 can be obtained by running a Park-type auxiliary regression. Park (1966) auxiliary model takes the following form:

$$\ln(y_i - \breve{y}_i)^2 = \ln \lambda_0 + \lambda_1 \ln \breve{y}_i + v_i \qquad (8)$$

where $\breve{y}_i$ designates estimated value of $E[y_i|x]$ (Santos Silva & Tenreyro, 2006). Park-type test allows studying the hypothesis that constant elasticity model can be estimated in the log linear form. Therefore, if one finds that the constant elasticity model can be estimated in the log linear form then the OLS estimator is a more appropriate method for estimating the gravity equation than the PPML estimator.

Gauss-Newton regression (GNR) tests the hypothesis that $V[y_i|x]$ is proportional to $E[y_i|x]$, which can be rejected if the confidence interval for λ_1 from the equation (9) does not include 1 (Silva and Tenreyro, 2006).

$$(y_i - \breve{y}_i)^2 = \lambda_0 \breve{y}_i^{\lambda_1} + \varepsilon_i \qquad (9)$$

Thus, if $\lambda_1 = 1$ and $\breve{y}_i = \exp(x_i\tilde{\beta})$ the equation (9) could be expanded to

$$(y_i - \breve{y}_i)^2 = \lambda_0 \breve{y}_i + \lambda_0(\lambda_1 - 1)(\ln y_i)\breve{y}_i + \varepsilon_i \qquad (10)$$

The hypothesis that $V[y_i|x]$ is proportional to $E[y_i|x]$ is tested by verifying if the parameter $\lambda_0(\lambda_1 - 1)$ is statistically significant. Due to the possible heteroskedasticity of the error term in the equation (10), Gauss-Newton regression is estimated by Weighted Least Squares method, weighting the equation (10) by $\exp(-x_i\tilde{\beta})$ (Santos Silva & Tenreyro, 2006). Therefore, the GNR test could be conducted by estimating the equation (11) by OLS and concluding on significance of $\lambda_0(\lambda_1 - 1)$.

$$(y_i - \breve{y}_i)^2/\sqrt{\breve{y}_i} = \lambda_0\sqrt{\breve{y}_i} + \lambda_0(\lambda_1 - 1)\,(\ln \breve{y}_i)\sqrt{\breve{y}_i} + \varepsilon^*{}_i \qquad (11)$$

Obtaining an insignificant coefficient on $(\ln \breve{y}_i)\sqrt{\breve{y}_i}$ implies that PPML assumption $V[y_i|x] = \lambda_0\, E[y_i|x]$ (i.e. that $V[y_i|x]$ is proportional to $E[y_i|x]$) cannot be rejected, thus justifying the use of the PPML estimator.

The results of the Park test that analyzes the appropriateness of OLS estimation of the log linear model are presented in Table 3. Test results indicate that log linear specification of the model in the present research is rejected in the case of total service exports and in five of seven analyzed subcategories. Construction and travel services are the only subcategories for which the appropriateness of log linear model could not be rejected at 5% significance level.

GNR test results (Table 4) reveal that PPML assumption $V[y_i|x] = \lambda_0\, E[y_i|x]$ cannot be rejected in neither model specification for total services exports nor for the export subcategories analyzed since the coefficient $\lambda_0(\lambda_1\text{-}1)$ is insignificant. Thus, considering the results of Park and GNR tests, the use of PPML estimator is justified.

Table 3. Park test results

	(1) Total services	(2) Communic.	(3) Constr.	(4) Transp.	(5) Travel	(6) Other bus.	(7) Financ.	(8) Comp. and inf.
λ_1	-2.087***	-0.627***	-0.196	-1.084***	-0.288	-0.735***	-0.317**	0.522**
	(0.000)	(0.000)	(0.340)	(0.000)	(0.163)	(0.000)	(0.024)	(0.035)

p-values in parentheses
*p< 0.10, **p< 0.05, ***p< 0.01

Table 4. GNR test results

	(1) Total services	(2) Communic.	(3) Constr.	(4) Transp.	(5) Travel	(6) Other bus.	(7) Financ.	(8) Comp. and inf.
$\lambda_0(\lambda_1\text{-}1)$	7.993	2.218	-0.514	6.631	0.149	12.04	0.822*	2.620*
	(0.165)	(0.138)	(0.476)	(0.183)	(0.953)	(0.123)	(0.072)	(0.052)

p-values in parentheses
*p< 0.10, **p< 0.05, ***p< 0.01

5.2. RESET test

The final test that we employ with the purpose of robustness check is a Regression Equation Specification Error Test (RESET) (Ramsey, 1969). The RESET test allows us to verify whether the functional form of the estimated equations is defined correctly. More specifically, if the functional relationship between the explanatory variables and the dependent variable is nonlinear, then the model is considered to be mis-specified. Therefore, by testing the statistical significance of an additional explanatory variable constructed

as $(x'b)^2$, where b represents the vector of predicted coefficients, we can verify the appropriateness of the estimated equations (Silva & Tenreyro, 2006). The p-values of the RESET test are shown in the tables 5 and 6. When the regression equation was estimated with the help of the Ordinary Least Squares (OLS) method, the null hypothesis of no misspecification was rejected for total service exports and for each type of service, except for construction services (Table 5). These results suggest that estimating the regression equation with the help of logarithmic specification is not valid. We obtain opposite results when the regression equation is estimated with the help of the Poisson regression, and thus the RESET test confirms the appropriateness of the PPML estimates. The p-values from Table 6 show that the null hypothesis of no misspecification (i.e. that the parameter on the test variable is equal to 0) is not rejected for total service exports and each type of service, excluding communication and financial services.

To sum up, we provide strong evidence that the PPML estimator does not suffer from strong misspecification errors based on RESET test, and thus we conclude that the estimated results based on the Poisson regression are reliable.

Table 5. Reset test p-values for OLS

	(1) Total	(2) Communic.	(3) Constr.	(4) Transport	(5) Travel	(6) Other business	(7) Financ.	(8) Comp. and inf.
p-value	0.0000***	0.0002***	0.8238	0.0005***	0.0304**	0.0000***	0.0076*	0.0003***

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

Tables 6. Reset test p-values for Poisson

	(1) Total	(2) Communic.	(3) Construct.	(4) Transport	(5) Travel	(6) Other business	(7) Financ.	(8) Comp. and inf.
p-value	0.2663	0.0541*	0.6043	0.2446	0.8226	0.6594	0.0026***	0.9004

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

6. Conclusion

In the paper we employ disaggregated service export data from Eurostat to analyze Lithuania's exports to its forty global trading partners. The gravity equation is estimated separately for seven service subcategories to distinguish the significance of service trade determinants across service categories. For the analysis, we apply the PPML estimation

proposed by Santos Silva and Tenreyro (2006), which allows to incorporate zero trade observations and to avoid biases that results from estimation of the model with OLS. The results of Park, GNR and RESET tests presented in the research justify the use of Poisson regression.

The gravity framework for service trade suggests that the GDP of the destination country has a positive and significant impact on trade across seven subcategories considered. Similarly, the CSL index was found positive and significant in all model specifications except construction services, indicating the importance of communication in service delivery. In contrast, time zone difference, the EU membership and human capital ratio reveal heterogeneous effect across service subcategories. Contrary to the estimation for total services, time zone difference has an explicit positive effect on trade in communication services, which reflects the importance of round the clock provision of communication services. In line with Kandilov and Grennes (2010)' findings for exports from Central and Eastern European countries, the time zone difference has the strongest negative impact on trade in construction services due to the necessity to coordinate working hours. The EU membership was found to have an expected positive impact on trade in all the service categories except construction, travel and other business services, which indicates that membership in the European Union facilitates trade in some service categories to a larger extent than in others. In addition, the negative and significant coefficient of the EU dummy for construction services may suggest the fact that there is only partial integration for construction services in the context of the European Union or reflect the fact that the majority of construction services are exported to countries which are not members of the EU, such as Norway, Russia and other CIS countries. The impact of human capital endowment also varies across service subcategories having the lowest magnitude for construction services (-7.88) and the highest for financial services (2.358), which reflects the fact that exports of construction services require lower skill intensity than the services produced by Lithuania's trading partners, whereas exports of financial, computer and information and other business services demand higher exporter's skill intensity.

From the augmented specification of the gravity equation for services subcategories, internet penetration in partner countries was found to have a positive and significant impact for communication and computer and information services. Institutional quality in destination countries measured by the corruption index proved to be a significant determinant of trade in construction, financial and other business services. Road density, which reflects the development of physical infrastructure in Lithuania's trading partners, exerts a positive and

significant impact on transport services exports. The real effective exchange rate of the destination country, Lithuania's market capitalization and the percentage of urban population in the importing country are identified as significant determinants of travel, financial and computer and information services respectively. Lastly, the results suggest that the importer's technological development assessed by the level of R&D expenditure significantly affects exports of financial, and computer and information services.

Overall, the results of this paper indicate that there is limited value in analyzing aggregate service flows. Different types of services have distinct roles in the global economy, are characterized by different market structures, and have different modes of supply. Therefore, an inference that can be drawn from our results for examination of policy reforms is that sector-specific characteristics have to be considered. In this way, further research could focus on the impact of the modes of supply on trade in services. This will allow policy makers to understand which laws hamper trade in services, and which laws may be unnecessary; and will enable to determine the adequate order, design and principles of liberalization policy.

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Appendix 1. Modes of supply

GATS distinguishes four modes of supply of international trade in services:

Mode 1, *cross-border supply*, is the provision of service in which only service crosses the border, while the provider and consumer of the service do not change their location. The delivery of service in this mode occurs via information and communication technology tools.

Mode 2, *consumption abroad*, refers to consumption of service outside of the domestic country.

Mode 3, *commercial presence*, occurs when service supplier constitutes branches or subsidiaries in another country, thus creating commercial presence in foreign country.

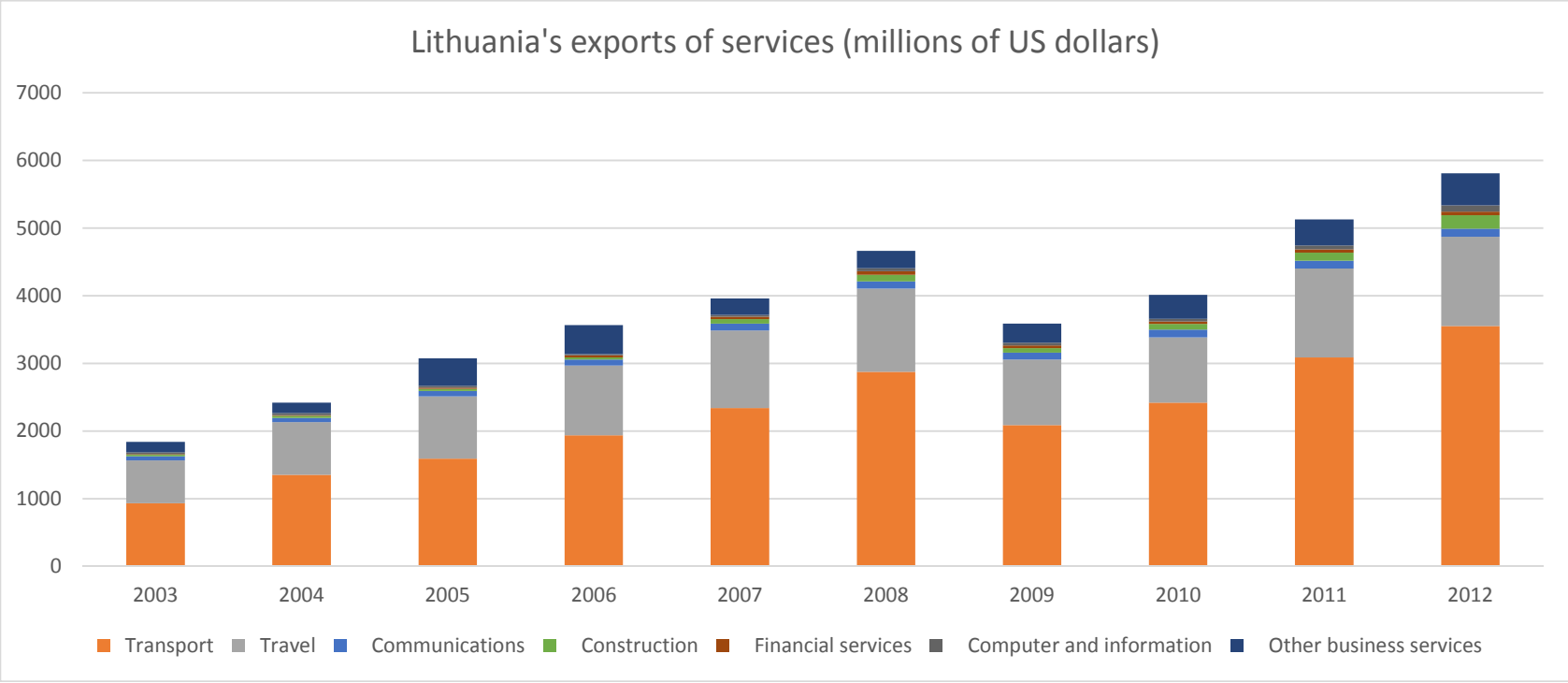
Mode 4, *presence of natural persons*, takes place when the supplier of service moves to the area of consumer with the purpose of service provision (WTO, 2010).

Appendix 2. Trading partners of Lithuania

AUS	AUT
BEL	CIS
CAN	CHN
HRV	CYP
CZE	DNK
EST	FIN
FRA	DEU
GRC	HKG
HUN	ISL
IND	IRL
ISR	ITA
JPN	KOR
LVA	LUX
MLT	NLD
NOR	POL
PRT	ROU
RUS	SVK
ESP	SWE
CHE	TUR
GBR	USA

Appendix 3. Lithuania's exports of services

Table1. Exports of services for Lithuania



Source: created by the authors using data from UNCAD database

Appendix 4. Regression tables for total exports and exports subcategories

Table 1. The determinants of service exports (total services, communication, construction and transport services)

	OLS (1) Total serv.	PPML (2) Total serv.	OLS (3) Communic. services	PPML (4) Commun. services	OLS (5) Construct. services	PPML (6) Construct. services	OLS (7) Transp. services	PPML (8) Transp. services
ln_gdp_o	2.879***	1.666***	3.404**	-1.095	3.846	4.653	2.454	1.779**
	(0.001)	(0.000)	(0.025)	(0.233)	(0.414)	(0.225)	(0.301)	(0.021)
ln_gdp_d	0.805***	0.641***	0.700***	0.401***	0.348***	0.385***	0.985***	0.727***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
ldist	-2.525***	-1.505***	-4.166***	-0.219	-1.461	-3.012	-2.019	-1.313**
	(0.007)	(0.000)	(0.008)	(0.817)	(0.752)	(0.417)	(0.287)	(0.026)
csl_index	6.156***	3.922***	5.957***	3.834***	0.976	-0.619	7.855***	5.013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.346)	(0.435)	(0.000)	(0.000)
contig	0.421**	0.601***	-0.490	-0.133	2.992***	3.470***	0.227	0.273*
	(0.027)	(0.000)	(0.188)	(0.570)	(0.000)	(0.000)	(0.480)	(0.052)
EU member.	0.799***	0.321***	0.682***	0.693**	-0.676	-0.542**	0.898***	0.307***
	(0.000)	(0.000)	(0.005)	(0.038)	(0.236)	(0.032)	(0.000)	(0.003)
tdiff	-0.334***	-0.232***	0.0960	0.154***	-0.264**	-0.397***	-0.499***	-0.234***
	(0.000)	(0.000)	(0.159)	(0.005)	(0.033)	(0.000)	(0.000)	(0.000)
time_enforce_cont_d	-0.000732***	-0.000554***	-0.0000561	-0.000130	-0.00111	-0.00365***	-0.00133***	-0.000570**
	(0.002)	(0.000)	(0.876)	(0.670)	(0.110)	(0.000)	(0.000)	(0.010)
hc_ratio	-0.904*	-0.763	0.572	-0.368	-6.676***	-7.880***	-1.646**	-0.472
	(0.087)	(0.104)	(0.475)	(0.677)	(0.007)	(0.000)	(0.023)	(0.252)
ln_remote_d	2.620***	1.362***	3.151**	-0.407	1.179	2.713	2.392	1.289**
	(0.005)	(0.000)	(0.042)	(0.658)	(0.795)	(0.462)	(0.202)	(0.029)
Int_users_d			0.0164***	0.0205***				
			(0.001)	(0.000)				
CPI_o					1.016	0.377		
					(0.406)	(0.684)		
CPI_d					0.345***	0.310***		
					(0.000)	(0.000)		
Road_dens_o							0.0944	-0.00233
							(0.337)	(0.941)
Road_dens_d							0.000953*	0.00139***
							(0.099)	(0.000)

Constant	-54.23***	-30.24***	-61.42**	10.96	-48.24	-63.65	-64.57**	-33.92***
	(0.001)	(0.000)	(0.020)	(0.488)	(0.522)	(0.300)	(0.025)	(0.000)
Observ.	399	399	316	362	171	365	396	397
R^2	0.756	0.939	0.596	0.643	0.522	0.649	0.647	0.929

p-values in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2. The determinants of service exports (travel services, other business services, financial services and computer and information services)

	OLS (9) Travel services	PPML (10) Travel services	OLS (11) Other business	PPML(12) Other business	OLS (13) Financial serv.	PPML (14) Financial serv.	OLS (15) Comp. & inf. serv.	PPML (16) Comp. & inf. serv.
ln_gdp_o	-1.753**	0.391	8.088**	3.669	4.704	1.055	3.117	2.332
	(0.049)	(0.614)	(0.044)	(0.295)	(0.175)	(0.802)	(0.118)	(0.202)
ln_gdp_d	0.868***	0.705***	0.892***	0.372***	0.249***	0.217***	0.729***	0.355***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.000)	(0.000)
ldist	-0.214	-0.462	-7.524**	-3.691	-2.070	1.013	-4.411**	-3.072
	(0.813)	(0.565)	(0.043)	(0.249)	(0.554)	(0.809)	(0.026)	(0.114)
csl_index	6.014***	4.041***	5.410***	2.731***	6.903***	4.557***	5.853***	4.410***
	(0.000)	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)
contig	0.911***	1.425***	0.734*	1.114***	0.400	1.708***	-1.706**	-0.599
	(0.001)	(0.000)	(0.059)	(0.000)	(0.331)	(0.001)	(0.010)	(0.434)
EU member.	0.622***	0.213	0.568**	-0.366	0.674***	0.743**	0.161	1.098**
	(0.000)	(0.117)	(0.025)	(0.137)	(0.009)	(0.031)	(0.608)	(0.016)
tdiff	-0.299***	-0.393***	-0.372***	-0.263***	-0.141**	-0.341***	0.00912	0.256
	(0.000)	(0.000)	(0.000)	(0.001)	(0.044)	(0.000)	(0.946)	(0.182)
time_enforce_cont_d	0.000281	0.0000445	-0.000890*	-0.000807	-0.000695**	-0.00376***	-0.00212***	-0.00177*
	(0.197)	(0.897)	(0.081)	(0.252)	(0.023)	(0.000)	(0.005)	(0.054)
hc_ratio	-0.714*	-2.313***	-0.194	1.982*	1.623*	2.358	1.352	2.222
	(0.092)	(0.000)	(0.861)	(0.092)	(0.079)	(0.223)	(0.390)	(0.282)
ln_remote_d	-0.257	0.221	7.191*	3.851	2.218	-0.552	3.279*	2.457
	(0.775)	(0.790)	(0.054)	(0.231)	(0.525)	(0.893)	(0.092)	(0.153)
Int_users_d	0.00416	0.00203					0.0210**	0.0225***
	(0.117)	(0.431)					(0.012)	(0.007)
lreer	-0.718	-1.082**						
	(0.242)	(0.028)						
CPI_o			-0.273	-0.272	-0.540	-0.212		
			(0.756)	(0.712)	(0.549)	(0.842)		
CPI_d			0.148**	0.147*	0.273***	0.289***		
			(0.019)	(0.092)	(0.000)	(0.000)		

Free_o			-1.609	1.247				
			(0.267)	(0.393)				
ATM_o					0.00834	0.0213		
					(0.685)	(0.275)		
ATM_d					-0.00529**	0.00205		
					(0.023)	(0.365)		
Rd_d					0.231*	0.551***	0.118	0.432**
					(0.053)	(0.000)	(0.409)	(0.014)
Mkt_cap_o					0.00859***	0.00659***		
					(0.003)	(0.001)		
Pop_d							0.0280*	0.0334**
							(0.079)	(0.012)
Constant	17.76	-4.421	-129.0**	-80.45	-71.97	-19.94	-61.83*	-51.37*
	(0.262)	(0.752)	(0.029)	(0.100)	(0.205)	(0.762)	(0.068)	(0.095)
Observ.	385	391	341	361	261	316	207	331
R^2	0.824	0.872	0.601	0.469	0.598	0.524	0.597	0.417

p-values in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 5. The definitions and sources of the dependent and independent variables

Variable name	Definition	Source
$GDP_{exporter}$, $GDP_{importer}$	Total value of goods and services produced less the value of goods and services used for intermediate consumption in their production recorded at current prices in million euro (Eurostat, 2015).	Eurostat
Distance	The variable is valid for pairs of countries and represents the distance between countries' capitals in kilometers.	CEPII database
Common Spoken Language Index (CSL)	The construction of the variable requires that the language is spoken by at least 4% of the population in two countries. The CSL Index takes the values from 0 to 1 and reflects probability that a pair of people at random in two countries understand one another in some language (Melitz&Toubal, 2012).	CEPII database
Common border	A dummy variable *Contig* equals to 1 if the two countries (Lithuania and its trading partner) share a common border and 0 otherwise.	Constructed by the authors
Human capital endowment (human capital ratio)	The variable human capital represents index of human capital per person based on years of schooling and returns to education (Barro& Lee, 2012; Psacharopoulos, 1994). Further,exporter's relative human capital endowment is computed representing a ratio of the exporter's index of human capital per person to the importer's index of human capital per person (*hc_ratio*).	Penn World Table
Quality of legal institutions (time to enforce a contract in the destination country)	The variable is measured by thenumber of calendar days required to enforce a contract from the filing of the lawsuit in court until the final decision.	World Bank database
EU membership	A dummy variable which takes a value 1 if both, Lithuania and its trading partner are members of the EU and a value 0 otherwise.	Constructed by the authors
Time differences	The variable represents time zone difference between Lithuania and its trading partners measured in hours.	CEPII database
Remoteness of the importing country	Economic remoteness represents GDP-weighted average of the distance to all countries:	Constructed by the authors using data

	$REM_{jt} = \ln(\frac{1}{\sum_j \frac{GDP_{it}/GDP_{Wt}}{D_{ij}}})$.	from Eurostat, CEPII database
Road density	Road density is measured by km of road per 100 sq. km of land area.	World Bank database
Internet users	The indicator is measured by internet users per 100 people in the destination country.	World Bank database
Corruption index	The variable indicates the perceived level of country's public sector corruption on a scale of 0-100, where 0 denotes high level of corruption.	Transparency International database
Economic freedom of the exporting country	The index measures the degree to which country's policies and institutions encourage economic freedom. The degree of economic freedom is measured in five areas: size of government;legal structure and security of property rights; access to sound money; freedom to trade internationally; regulation of credit, labor, and business. Within the five areas there are 24 components of the index scaled from 0 to 10. Further, the components' ratings are averaged to identify the ratings of five areas and countries' ratings (Gwartney, Lawson & Hall, 2014).	Economic Freedom of the World dataset
R&D expenditure of the destination country (% of GDP)	R&D expenditures represent current and capital systematic expenditures aimed at increasing knowledge. R&D comprises basic research, applied research, and experimental development.	World Bank database
Urban population (% of total)	The variable reflects the people living in urban areas and is calculated using World Bank population estimates and United Nations World Urbanization Prospects urban ratios.	World Bank database
ATM in the exporting and importing countries	The indicator of financial sector development, automated teller machines, is measured as ATM per100000 adults.	World Bank database
Market capitalization of the exporting country (% of GDP)	Market capitalization of listed companies represents the share price multiplied by the number of shares outstanding.	World Bank database
Real effective exchange rate of the destination country	REER measures the real value of country's currency against the basket of trading partners of a country. REER is calculated from nominal effective exchange rate and a measure of relative prices or costs of the studied country and its trading partners. CPI is used as a measure of price and cost applied for REER calculations.	Bruegel database