ARTICLE IN PRESS
ECMODE-03866; No of Pages 8
Economic Modelling xxx (2015) xxx–xxx
Contents lists available at ScienceDirect
Economic Modelling
journal homepage: www.elsevier.com/locate/ecmod

International trade and tourism flows: An extension of the gravity model☆

María Santana-Gallego [a,1], Francisco J. Ledesma-Rodríguez [b,2], Jorge V. Pérez-Rodríguez [c,*]

[a] Departamento de Economía Aplicada, Facultad de Ciencias Económicas y Empresariales, Universitat de les Illes Balears, 07122, Palma de Mallorca, Spain
[b] Departamento de Análisis Económico, Facultad de Ciencias Económicas y Empresariales, Universidad de La Laguna, 38071, Santa Cruz De Tenerife, Spain
[c] Dpto. de Métodos Cuantitativos en Economía y Gestión, Facultad de Ciencias Económicas y Empresariales, Universidad de Las Palmas de Gran Canaria, 35017, Las Palmas, Spain

ARTICLE INFO

Article history:
Accepted 28 October 2015
Available online xxxx

Keywords:
International trade
Tourism
Gravity equation
Intensive and extensive margin

ABSTRACT

The empirical relationship between trade and tourism has been explored during recent years finding that international tourism promotes international trade between countries. However, the impact of tourism on trade flows has been neglected within standard international trade models such as the gravity equation. The main aim of this paper is to provide empirical and theoretical evidence that tourism matters for international trade. To that end, the framework proposed by Helpman, Melitz and Rubinstein (2008) is used by recognising that tourism flows could reduce fixed and variable costs of exporting. Moreover, once the model is estimated, the empirical evidence suggests that tourism increases both the probability of two countries trading with each other and the volume of international trade between them.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

In recent years, there has been a growing interest in analysing the relationship between international trade and tourism. Empirical papers have tested the relationship between trade and tourism by using cointegration and causality techniques (Kulendran and Wilson, 2000; Shan and Wilson, 2001; Lin and Lee, 2002; Khan et al. 2005 or more recently Santana-Gallego et al., 2010a). A main conclusion is that this empirical nexus seems to exist and it mainly happens in the sense that tourism promotes trade. Indeed tourism may stimulate closer trade relations between countries. However, in spite of this evidence, the impact of tourism on trade has been traditionally neglected within standard international trade models such as the gravity equation.

Tourism, like migration, involves movement of people from the home country to the host one. The empirical evidence of the relationship between trade and migration is well established concluding that larger bilateral migration movements are associated with larger trade flows. For instance, Gould (1994) for the United States, Head and Ries (1998) for Canada, Girma and Yu (2002) for the United Kingdom or Blanes (2005) for Spain find evidence of an empirical link between immigration and bilateral trade using trade gravity models. Literature proposes at least three basic channels for this empirical relationship. First, immigrants bring with them a preference for home-country products (preference channel). Second, immigrants can reduce transaction costs of bilateral trade with their home countries (transaction cost channel).[3] Third, international trade theory states that immigration increases market size promoting not only domestic transactions but also international trade.

Regarding the effect of tourism on trade, similar channels have been suggested but not introduced in a standard international trade model. First, the preference channel is pointed out by Marrocu and Paci (2011) presenting that tourism flows may represent an important and costless information source on external demand preferences, which can help local firms to produce new goods for these international markets. Brau and Pinna (2013) held that travelling involves an exchange of information with a dual content: on local products and on foreign tastes. In this sense, Quinn (2009) analyses how the exposure to foreign products and culture through media and tourist visits affects consumers' preferences for foreign products. Second, the transaction costs channel is found by Kulendran and Wilson (2000) indicating that successful business trips directly promote a flow of exports and/or imports in

☆ We thank the Spanish Ministry of Economy and Competitiveness for financial support (ECO2011-23189). We are grateful to four anonymous referees and the editor for comments and suggestions and to the United Nations World Tourism Organization for kindly providing tourism data.
* Corresponding author. Tel.: +34 928 458 222; fax: +34 928 458 225.
E-mail addresses: maria.santana@uib.es (M. Santana-Gallego), fledesma@ull.es (F.J. Ledesma-Rodríguez), jvperez@dmc.ulpgc.es (J.V. Pérez-Rodríguez).
[1] Tel.: +34 971 17 13 83.
[2] Tel.: +34 922317119.

[3] This reduction of trade costs can be explained through immigrant's business connections or personal contacts with his home country (networks) and because of the additional knowledge brought by immigrants about foreign markets and different social institutions which facilitates business dealings (Rauch, 1999; Rauch and Trindade, 2002).

http://dx.doi.org/10.1016/j.econmod.2015.10.043
0264-9993/© 2015 Elsevier B.V. All rights reserved.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

subsequent periods. Moreover, leisure visitors may identify business opportunities that could lead to further international transactions.[4] Third, the channel of the increased market size is also present in the case of tourism. Khan et al. (2005) stated that tourism might encourage international trade since tourists purchase food, souvenirs, transportation and so on in the foreign country, many of which have to be imported.

The main aim of this paper is to analyse the tourism-link effect on trade in a standard gravity model, focusing on the transaction costs channel. Moreover, a step further is taken by investigating whether tourism affect both intensive and extensive margins of trade. To that respect, Chaney (2008) states that a decrease in the fixed bilateral costs of trade (e.g., start-up costs) would affect the extensive margin (number of firms) while a decrease in the variable trade cost (e.g., ad valorem transport costs) would increase both the extensive and intensive margin, i.e. number of firms and volume of exports, respectively.[5]

After being introduced by Tinbergen (1962), the gravity equation has become one of the most used empirical models of international trade. One of the main traditional critiques to the gravity model is the lack of theoretical underpinnings of the estimated equations. Nevertheless, nowadays international economists recognise that the gravity specification can be supported by Heckscher–Ohlin models, models based in differences in technology across countries, and the models that introduce increasing returns and product differentiation (Deardorff, 1998). One of the most referenced papers on this area is Anderson and Van Wincoop (2003) where the authors developed a well-founded gravity model that provides consistent and efficient estimates by considering both multilateral and bilateral trade resistances. Helpman, Melitz and Rubistein (2008) model, HMR thereafter, generalises the Anderson and Van Wincoop's framework by describing the probability conditions enabling a firm to be an exporter.

The HMR approach presents a theoretical framework to study bilateral trade flows across countries. The main advantage of their approach is that it can explain two regularities in trade data not traditionally considered in empirical trade models: the asymmetry in bilateral trade between country pairs and the high prevalence of zeroes. In this way, their method avoids these two causes of biased estimation of empirical trade models.

In the present paper, tourism is introduced into the HMR model by recognising that it could reduce both fixed and variable costs of exporting, promoting international trade. Moreover, following the estimate procedure proposed by HMR, an empirical exercise is carried out to quantify the importance of tourism on the intensive and extensive margin. To that end, the modified HMR model is estimated for a cross-section that comprises 195 countries in year 2012.

The paper is organised as follows. In Section 2 the links between tourism and trade costs are presented. Section 3 introduces tourism in the HMR framework with the incorporation of a tourism variable. Section 4 presents the empirical analysis where the augmented trade gravity model by including tourism is estimated. Finally, Section 5 draws some conclusions.

2. Tourism and trade costs

A simple way to introduce tourism in the HMR framework is by recognising that tourist arrivals can reduce both fixed and variable trade costs. Following Melitz (2003), variable trade costs can be explained by tariffs and transport costs while fixed trade costs are due to several factors such as research of foreign regulatory environment and foreign standards, set up distribution channels in the foreign country, and conform to shipping rules specified by foreign custom agencies.

With respect to fixed trade costs, tourism could reduce cultural distance between countries and, as a consequence, costs associated with the research of foreign standards. Following Deardorff (2014), Tadesse and White (2010) argue that observed transaction costs do not fully explain variation in cross-border trade flows and show that cultural dissimilarity between nations inhibits international trade. Transaction costs that are related to cultural differences between trading partners may not be fully represented by geographic distance or by variables that represent prior colonial relationships. Their results suggest that cultural distance, as a proxy for differences in the norms and values between trading partners, affects negatively to trade flows. In that sense, international tourism may help to mitigate and overcome trade costs since (i) it improves the knowledge about foreign culture and, as a consequence, about business habits and practices in other countries and (ii) facilitates and stimulates to learn other languages, making bilateral trade easier.

Tourism may also reduce fixed trade costs due to gaps of information. According to Sinclair (1998), tourism could help to mitigate market failures related to information deficiencies regarding favourable productions and contracts. Similarly, Arandhyula and Tronstad (2003) find evidence that international tourist arrivals could help to overcome information gaps about market opportunities facilitating new business ventures. Marrocu and Paci (2011) held that tourists transmit relevant information to the local firms which can be exploited to generate a positive impact on the efficiency level of the local economy. On that point, being in contact with tourists suppose an important and costless information source on external demand preferences, which can help local firms to produce new goods for these international markets. Brau and Pinna (2013) argue that the direct contact between tourists and local market could represent a cheap way to promote the domestic supply of particular goods in the international markets than simply activating international marketing activities. Moreover, tourism can facilitate better consumer knowledge and may change consumers' attitudes about foreign cultures, inducing new demand for foreign products.

With respect to variable trade costs, tourism sector requires good basic facilities, services, and infrastructure such as transportation and communication systems that are also necessary for trade. Khadaroo and Seetanah (2008) recognise that good transport infrastructures, i.e. air services, land transport system and routes and water transport infrastructures, are a precondition for the development of tourism and also a determinant of the attractiveness of a tourist destination. Thus, as shown for instance by Khan and Kalirajan (2011), the provision (connectivity) and improvement of transport infrastructures likely leads to reduced transport costs, i.e., lower variable trade costs.

For that reason, we argue that tourism could reduce trade costs and, as a consequence, the minimum productivity making international sales profitable. This last could create new trade links between countries. Also the reduction of trade costs could intensify existing trade links, i.e., could increase international trade between trading partners. Summarising we conjecture that tourism could increase both the extensive and the intensive margins of trade.

3. Econometric modelling

HMR model presents a theoretical framework to study bilateral trade flows across countries. This model extends the classical gravity equation of trade to correct for the large number of zeros in the world

[4] In a similar way, tourism could help to mitigate market failures related to information deficiencies regarding favourable productions and contracts (Sinclair, 1998). Also Aradhyula and Tronstad (2003) held that tourism facilitates commercial relations under information failures since it could help to mitigate information deficiencies. These authors find evidence that tourism promotes cross-border trade and highlight the role of governments in promoting international tourism in order to overcome imperfect information related to trade opportunities.

[5] Peri and Requena-Silvente (2010) found that immigrants significantly increase Spanish exports mainly because of the reduction of bilateral fixed costs that increases trade extensive margin. Segura-Cayuela and Vilarrubia (2008) analyse the role of foreign-service (embassies and consulates) on trade flows obtaining that the presence of a foreign service officer in a given country increases the probability of trading with that partner, but there is no effect on the volume of trade with already existing trading partners. The role of tourism on fixed and variable trade cost has not been explored yet.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

trade matrix (export selection) and for the unobservable fraction of exporting firms (extensive margin). Then, these aspects are incorporated to analyse the volume of exports between country pairs (intensive margin). This model presents three features that make it suitable to describe empirical patterns of bilateral trade flows. First, the model can yield asymmetric trade flows between country pairs depending on the direction of export flows (from i to j versus from j to i). Second, it can predict zero trade flows between countries. Third, a well-founded empirical framework for estimating the gravity equation for positive trade flows is developed. Therefore, the HMR model has the potential to explain these prevalent regularities in trade data.

The HMR approach generalises the Anderson and Van Wincoop (2003) model in two ways. First, it accounts for firm heterogeneity and fixed trade costs and second, it deals with asymmetries in the volume of exports between two countries. The HMR model proposes a two-stage estimation procedure. In the first stage, a probit equation is estimated for the probability that country j exports to country i while in the second stage, predicted components from the probit are used to consistently estimate the gravity equation for positive exports flows.

In the HMR model, a utility function *à la* Dixit-Stiglitz (1977) is assumed to allow for product differentiation. Producers face variable and fixed costs of exporting to each destination country by recognising that profitability of exports to a particular destination depends on both a genuine transport cost and a fixed cost of serving that particular country. These trade costs are critical for the decisions of a firm about exporting and the quantity to be exported. The monopolistic competition equilibrium yields a gravity equation as well as a firm selection equation.[6]

A probit equation for trading partners is estimated in the first stage of the procedure. This selection equation captures zeros and explains why bilateral trade occurs at all. Therefore, the probability that country j exports to country i (p_{ij}) can be expressed as follows:

$$p_{ij} = \Pr(E_{ij} = 1|\text{observed variables}) = \Phi\left(\gamma_0 + \xi_j + \zeta_i - \ln f_{ij} + (1-\varepsilon)\ln\tau_{ij}\right) \quad (1)$$

where $E_{ij} = 1$ if country j exports to country i, $\Phi(.)$ is the accumulative standard normal distribution function, f_{ij} is a fixed trade cost for the pair of countries, γ_0 is a constant term, ε is a demand parameter expressing the elasticity of substitution across products, ξ_j and ζ_i are exporter and importer fixed effect while τ_{ij} measures trade variable costs for the pair of countries. So, the probit equation for trading partners depends on barriers that affect variable trade costs, such as distance between countries in the pair (d_{ij}), and fixed trade costs (f_{ij}).

In the second stage, the outcome equation, based on the gravity equation, characterises the volume of trade conditioned on trade taking place. The outcome equation can be expressed as

$$m_{ij} = \beta_0 + \lambda_j + \chi_i + (1-\varepsilon)\ln\tau_{ij} + w_{ij} \quad (2)$$

where m_{ij} denotes the log of country i's imports from j.[7] β_0 is the constant term, λ_j and χ_i are idiosyncratic effects of exporter and importer countries, respectively, and w_{ij} is an additional variable depending on the profitability of serving country i from country j, i.e. the selection of firms into export markets. As can be observed, the volume of trade depends on the distance and other barriers affecting variable trade costs (τ_{ij}).

The question posed in our analysis is whether tourism helps to create new trade links between non-trading partners (extensive margin) and/or if tourism intensifies the existing ones (intensive margin).[8] As discussed above, intensive and extensive margins of trade can be affected by tourism flows since the trade creation effect of tourism can be a consequence of the reduction of both, fixed and variable trade costs. In the present research, the equations for variable (τ_{ij}) and fixed trade costs (f_{ij}) of serving a particular market are rewritten, with respect to the original HMR approach, by adding tourism to both equations. Therefore, variable and fixed costs of exporting are respectively defined as

$$\tau_{ij} = \left[D_{ij}^{\gamma} T_{ij}^{-\psi} \exp(-u_{ij})\right]^{1/_{\varepsilon-1}} \quad (3)$$

$$f_{ij} = T_{ij}^{-\beta} \exp\left(\phi_{ex,j} + \phi_{im,i} + \kappa\phi_{ij} - \nu_{ij}\right). \quad (4)$$

T_{ij} represents tourist arrivals to country j from country i; D_{ij} is the distance between country pairs; $\phi_{ex,j}$, $\phi_{im,i}$ and ϕ_{ij} measure the exporter, importer and country-pair specific trade fixed costs, respectively, exp donates exponential function while u_{ij} and v_{ij} are unmeasured trade frictions. Parameters β and ψ are expected to be positive. Therefore, tourist arrivals are easily introduced in the HMR framework by recognising that they can reduce both fixed and variable trade costs.

By applying logarithm to Eqs. (3) and (4) and substituting these two expressions in the probit equation (Eq. (1)) and the gravity equation (Eq. (2)), they are respectively rewritten as

$$p_{ij} = \Pr(E_{ij} = 1|\text{observed variables}) = \Phi(\gamma_0 + \phi_i + \varsigma_j + (\beta+\psi)t_{ij} - \gamma d_{ij} - \kappa\phi_{ij} \quad [5]$$

$$m_{ij} = \beta_0 + \lambda_j + \chi_i - \gamma d_{ij} + \psi t_{ij} + w_{ij} + u_{ij}. \quad (6)$$

In Eq. (5), country fixed effects ς_j and φ_i now include exporter $\varphi_{ex,j}$ and importer $\varphi_{im,i}$ specific trade costs. The country pair specific trade cost (ϕ_{ij}) measures a set of bilateral fixed trade facilitating and impeding factors such as sharing a geographical common border, a common spoken language, sharing a common colonial background or the number of islands and landlocked countries in the pair, among others. Variables t_{ij} and d_{ij} are the natural logarithm of tourist arrivals (T_{ij}) and distance (D_{ij}), respectively. Furthermore, the error term associated to the latent variable used for the probit is assumed to be correlated with the error term u_{ij}. Now, in Eqs. (5) and (6) tourism appears to potentially promote both, the probability that j exports to i and the volume of this export, via a reduction of variable and fixed trade costs.

As mentioned above, the HMR approach follows a two-stage estimation procedure. In the first stage, the probit equation (Eq. (5)) for the probability of exporting to a particular country is estimated by maximum likelihood and two controls are generated. In the second stage, the gravity equation (Eq. (6)) for the volume of exports is consistently estimated by adding two control variables saved from the first stage. Therefore, Eq. (6) can be estimated using the following transformation[9]

$$m_{ij} = \beta_0 + \lambda_j + \chi_i - \gamma d_{ij} + \psi t_{ij} + \vartheta\hat{\bar{\eta}}_{ij} + \ln\left(\exp\left[\delta\left(\hat{z}_{ij} + \hat{\bar{\eta}}_{ij}\right)\right] - 1\right) + \theta X'_{ij} + u_{ij} \quad (6')$$

where X'_{ij} is a row vector containing dummy variables used as controls in the standard gravity equation, such as sharing a land border, a common language, a common major religion, colonial ties, a common membership to a free trade agreement, sharing a common currency and the number of islands and landlocked countries in the pair,

[6] A detailed presentation of HMR theoretical framework may be found in Santana-Gallego et al. (2010b).

[7] It can also be interpreted as exports from country j to country i.

[8] The definitions of extensive and intensive margins in HMR model are different from those used by Lawless (2010) and Coughlin (2012). On the basis of disaggregated data, they decompose total exports into number of firms and average export sales per firm.

[9] The details of the two-stage estimation of the trade equation may be found in Section VI of Helpman et al. (2008).

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

ARTICLE IN PRESS

θ is a vector of unknown parameters and $\hat{z}_{ij}$ and $\widehat{\overline{\eta}}_{ij}$ are the controls saved from the first stage. In particular, the first control is for country selection into trading captured by the fitted value of the inverse Mills ratio ($\widehat{\overline{\eta}}_{ij}$). The second control is the endogenous number of exporters defined by $\ln(\exp[\delta(\hat{z}_{ij}+\widehat{\overline{\eta}}_{ij})]-1)$ where $\hat{z}_{ij}=\Phi^{-1}(\hat{p}_{ij})$ is the predicted value of the latent variable. [10] Since Eq. (6′) is non-linear in δ, it is estimated by using maximum likelihood (ML). In this stage, we consider the normality assumption of the error term and we will estimate both the parameter in the conditional mean equation defined by Eq. (6′) and the parameter corresponding with the variance of residuals σ_u^2.

The HMR theoretical model suggests that trade barriers that affect fixed trade costs but do not affect variable trade costs should only be used as explanatory variables in the selection equation. Econometrically, this provides the needed exclusion restriction for identification of the second stage outcome equation. Similarly to HMR, we use data on costs of forming new firms, which provides a more direct measure of the fixed costs of trade. In particular, we define two bilateral entry cost: the logarithm of the product of the number of legal procedures needed to operate a new business and the sum of the entry cost as percentage of GDP in the exporter and importer country.

4. Empirical analysis

4.1. Data

In this study we use a dataset of 195 countries with tourism data availability for the year 2012, i.e. 25,387 observations. The variables included for the estimation of Eqs. (5) and (6′) are the following:

- m_{ij} denotes the log of exports from country j and country i,
- t_{ij} is the log of the number of tourist arrivals to country j from country i,
- d_{ij} is the log of great-circle distance between capital cities of countries i and j,
- $Border_{ij}$ is a binary variable which is unity if i and j share a common land border and zero otherwise,
- $Colony_{ij}$ is a binary variable which is unity if one country ever colonised the other or vice versa and zero otherwise,
- $Col45_{ij}$ is a binary variable which is unity if countries have had a colonial relationship after 1945 and zero otherwise,
- $ComCol_{ij}$ is a binary variable which is unity if countries in the pair have ever had a common coloniser and zero otherwise,
- $Lang_{ij}$ is a binary variable which is unity if i and j have a common language and zero otherwise,
- $Landl_{ij}$ is the number of landlocked countries in the pair,
- $Relig_{ij}$ is a binary variable which is unity if i and j have a common first religion (with a share over 60%) and zero otherwise,
- FTA_{ij} is a binary variable which is unity if i and j are common members of a regional free-trade agreement,[11]
- $Island_{ij}$ is the number of islands in the pair,
- CU_{ij} is a binary variable which is unity if i and j belong to the same currency union,
- $EntryProcedure_{ij}$ is the log of the product of the number of legal procedures needed to operate a new business in i and j,
- $EntryCost_{ij}$ is the sum of the entry cost as percentage of GDP in i and j.

Specifically, we consider data of export flows from country j to country i from the *Direction of Trade Statistics* dataset, published by the *International Monetary Fund* (M_{ij}). Tourism variable (T_{ij}) is obtained from the *United Nations World Tourism Organisation*. The distance variable (D_{ij}), common border ($Border_{ij}$), if countries have ever had a colonial link ($Colony_{ij}$), if countries have had a colonial relationship after 1945 ($Col45_{ij}$), if countries have ever had a common coloniser ($ComCol_{ij}$), dummy variable for common language ($Lang_{ij}$) and the number of landlocked countries in the pair ($Landl_{ij}$) are collected from the *Centre d'Etudes Prospectives et d'Informations Internationales-GeoDist* dataset; dummy variable for sharing a common major religion ($Relig_{ij}$) is obtained from the *World Factbook* by the *Central Intelligence Agency*; belonging to the same free trade agreement (FTA_{ij}) is collected from *Regional Trade Agreements Information System* by the *World Trade Organization*. Finally, the number of islands in the pair ($Island_{ij}$) and belonging to a currency union (CU_{ij}) are obtained from Andrew K. Rose's website.[12] Finally, we use the country-level data on regulation costs of firm-entry provided by the World Bank publication Doing Business to generate the exclusion restrictions ($EntryProcedure_{ij}$ and $EntryCost_{ij}$).

The descriptive statistics are presented in Table 1. Note that the means of binary variables, i.e., colony variables, common language, common religion, free trade agreement and common currency represent shares over the total observations. For example, the mean of ($Lang_{ij}$) indicates that 14.4% of bilateral flows are happening between countries sharing a common spoken language.

Linear correlations are displayed in Table 2, where the correlations between trade and each of the explanatory variables are significant at 5%, with the exception of common currencies, common coloniser and tourism. As can be observed, the highest correlation for trade happens with respect to tourism (51%). For its part, the highest negative correlation for trade is with respect to distance and entry costs (−25%).

4.2. Estimation results

The explanatory variables for trade are introduced in the model since they are common controls of gravity equations affecting trade costs and, as a consequence, international trade flows. Taking into account previous literature on trade gravity equations and linear correlations, distance, the number of landlocked countries and the number of islands in the pair are expected to reduce international trade as they may increase trade costs. Sharing a common border, language and currency, having colonial and religious links, belonging to the same free trade agreement are expected to promote international trade given that they may reduce trade costs. Finally, as proposed in Section 2, tourism could increase both, the probability to trade and the volume of trade between countries via a reduction in fixed and variable trade costs.

As presented in Section 3, our extension of the gravity model by Helpman et al. (2008) is modified to introduce tourism flows. In Eq. (5), tourism is introduced as a determinant of the probability of exporting to a particular country because it might reduce both, fixed and variable trade costs. If the coefficient of tourism variable is statistically significant and positive, it would imply that tourism increases the probability of exporting to a particular destination, and so it affects the extensive margin of trade. In the gravity equation (Eq. (6′)), tourism also appears as an explanatory variable of the volume of exports. In that case, if the coefficient of the tourism variable is statistically significant and positive, it means that tourist arrivals and exports are complement. Conversely, if it is statistically significant but negative, it means that they are substitutes.

[10] Following HMR (2008), there are country pairs whose characteristics are such that their probability of trade is indistinguishable from 1. Therefore, the same $\hat{z}_{ij}$ is assigned to country pairs with an estimated $\rho_{ij} > 0.9999999$.

[11] See, for instance, Geldi (2012) for a disaggregated analysis of the effect of different regional agreements trade.

[12] In Rose and Spiegel's (2011) dataset the euro is not considered. This last is discussed by Frankel (2008) in the analysis of the discrepancy between the magnitude of the euro effect on trade and the impact of other monetary unions among smaller countries.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

ARTICLE IN PRESS

Table 1
Descriptive statistics.

Variable	Obs	Mean	Std. dev.	Min	Max
M_{ij}	25387	651.0	6490.0	0.0	353000.0
T_{ij}	25387	43337	716293	1	78700000
D_{ij}	25387	7756	4491	10	19951
$Border_{ij}$	25387	0.018	0.135	0	1
$Colony_{ij}$	25387	0.013	0.114	0	1
$Col45_{ij}$	25387	0.008	0.090	0	1
$ComCol_{ij}$	25387	0.099	0.298	0	1
$Relig_{ij}$	25387	0.493	0.500	0	1
$Lang_{ij}$	25387	0.144	0.351	0	1
$Landl_{ij}$	25387	0.356	0.540	0	2
$Island_{ij}$	25387	0.452	0.593	0	2
FTA_{ij}	25387	0.167	0.373	0	1
CU_{ij}	25387	0.008	0.087	0	1
$EntryProc_{ij}$	25387	51.487	35.991	1	476
$EntryCost_{ij}$	25387	0.616	0.705	0.002	5.713

Exports are presented in millions of US$.

It is important to note the potential endogeneity of tourism. That is, tourism flows between two countries might also be affected by the international trade between them. Indeed, previous papers that apply cointegration and causality techniques (see for instance Kulendran and Wilson, 2000; Shan and Wilson, 2001; Lin and Lee, 2002; Khan et al., 2005 or Santana-Gallego et al., 2010a) find evidence of a bidirectional relationship between trade and tourism flows. Given that interpretation of the marginal effects of that variable requires that the regressors are exogenous, we need to address endogeneity and attempt to correct it in both equations. Trying to overcome this problem, we have used the Segura-Cayuela and Vilarrubia (2008) approach to lead with endogeneity in the context of the HMR model. These authors explore the impact that embassies and consulates have on the intensive and extensive margin of trade. Following the paper by Rose (2007), these authors account for reverse causality between exports and embassies/consulates. They proxy the probability of setting up a foreign mission using instrumental variables, and then they introduce this predicted variable in the HMR estimation procedure.

Following Segura-Cayuela and Vilarrubia (2008), we proxy the tourism arrivals on a set of variables that attempt to capture the general attractiveness of a country for tourists but they might not affect trade flows. Our set of instruments includes lagged tourist arrivals such as tourism flows in 2011, the number of World Heritage Sites (WHS) declared by UNESCO per destination country and annual average temperatures in the origin and destination country. Empirical literature on tourism has shown that climate variables are important determinants on the tourist destination decision process. Hamilton et al. (2005a, b), Hamilton and Tol (2007) or Roselló and Santana-Gallego (2014) obtained that temperature at the origin and destination country affect international tourism movements. In particular, people from colder countries travel more and they prefer to visit warmer destinations. Culiuc (2014) and Patuelli et al. (2013) obtain that the cultural heritage and attractions of a country are important determinants of tourism demand. Finally, the use of tourism flows in the previous period avoids reverse causality and also control for repeated tourism and the word-of-mouth effect. Firstly, we estimate tourism flows in 2012 against the sets of instruments defined above. Secondly, we include this predicted tourist arrivals ($\hat{t}_{ij}$) as a regressor on Eqs. (5) and (6′) instead of tourist arrivals (t_{ij}).

Since the main objective of our research is to analyse whether tourism matters for trade gravity equations, three different models are estimated: Model A does not include tourism, Model B includes tourist arrivals (t_{ij}) while Model C addresses endogeneity by including predicted tourist arrivals ($\hat{t}_{ij}$). Models with tourism are considered the general model, while the model without tourism is the restricted model. HMR

Table 2
Linear correlations.

	M_{ij}	T_{ij}	D_{ij}	$Border_{ij}$	$Colony_{ij}$	$Col45_{ij}$	$ComCol_{ij}$	$Relig_{ij}$	$Lang_{ij}$	$Landl_{ij}$	$Island_{ij}$	FTA_{ij}	CU_{ij}	$EntryProc_{ij}$	$EntryCost_{ij}$
M_{ij}	1														
T_{ij}	0.5141*	1													
D_{ij}	−0.2498*	−0.3468*	1												
$Border_{ij}$	0.1275*	0.1228*	−0.0652*	1											
$Colony_{ij}$	0.1712*	0.2349*	−0.3602*	0.0967*	1										
$Col45_{ij}$	0.0905*	0.0815*	−0.0277*	0.7817*	0.0364*	1									
$ComCol_{ij}$	−0.0653*	−0.0194*	−0.0488*	−0.0384*	0.0528*	−0.0300*	1								
$Relig_{ij}$	−0.0191*	0.0513*	−0.1198*	0.0391*	0.0645*	0.0104	−0.0744*	1							
$Lang_{ij}$	−0.0029	0.0927*	−0.1060*	0.1456*	0.1065*	0.1412*	0.3885*	0.1021*	1						
$Landl_{ij}$	−0.1390*	−0.0960*	−0.1251*	−0.0325*	0.0479*	−0.0282*	−0.0267*	0.0138*	−0.0439*	1					
$Island_{ij}$	−0.1993*	−0.1301*	0.1912*	0.0388*	−0.0921*	0.0602*	0.1483*	0.0931*	0.1774*	−0.2649*	1				
FTA_{ij}	0.2281*	0.2913*	−0.4464*	0.0774*	0.1965*	0.0500*	0.0160*	0.2208*	0.0807*	−0.0374*	0.0107	1			
CU_{ij}	−0.0047	0.0036	−0.1149*	0.0096	0.0855*	0.0172*	0.1120*	0.0229*	0.1740*	0.0343*	−0.0097	0.0542*	1		
$EntryProc_{ij}$	−0.0264*	−0.0573*	0.0558*	−0.008	0.0300*	−0.0224*	0.0422*	−0.0065	0.0372*	−0.0410*	−0.1065*	−0.0979*	−0.0046	1	
$EntryCost_{ij}$	−0.2540*	−0.2171*	0.0116	−0.0438*	0.0124*	−0.0252*	0.0764*	−0.0517*	0.0989*	0.0689*	−0.0976*	−0.1596*	0.1409*	0.2828*	1

Note: *) indicates that correlation is statistically significant at 5% level.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

ARTICLE IN PRESS

Table 3
HMR two-stage estimation.

	Selection equation (extensive margin)			Outcome equation (intensive margin)		
Variables	Model A	Model B	Model C	Model A	Model B	Model C
d_{ij}	−0.107***	−0.0867***	−0.0853***	−1.376***	−1.181***	−1.190***
	(0.00410)	(0.00417)	(0.00417)	(0.0304)	(0.0326)	(0.0326)
$Border_{ij}$	−0.0618	−0.110**	−0.108**	0.677***	0.529***	0.509***
	(0.0380)	(0.0461)	(0.0466)	(0.112)	(0.107)	(0.107)
$Colony_{ij}$	0.0879***	0.0782***	0.0766***	0.0267	−0.0229	−0.0211
	(0.00351)	(0.00329)	(0.00328)	(0.133)	(0.138)	(0.137)
$Col45_{ij}$	−0.923***	−0.932***	−0.933***	1.649***	1.566***	1.582***
	(0.00321)	(0.00302)	(0.00302)	(0.190)	(0.191)	(0.194)
$ComCol_{ij}$	0.0142**	0.00850	0.00918	0.957***	0.894***	0.913***
	(0.00635)	(0.00609)	(0.00602)	(0.0772)	(0.0763)	(0.0767)
$Relig_{ij}$	0.00795*	0.00377	0.00408	0.170***	0.0928**	0.0922**
	(0.00464)	(0.00429)	(0.00429)	(0.0444)	(0.0441)	(0.0442)
$Lang_{ij}$	0.0580***	0.0488***	0.0479***	0.380***	0.268***	0.265***
	(0.00433)	(0.00418)	(0.00416)	(0.0570)	(0.0559)	(0.0561)
$Landl_{ij}$	−0.0836***	−0.0907***	−0.0810***	−1.287***	−1.289***	−1.266***
	(0.0303)	(0.0277)	(0.0271)	(0.339)	(0.334)	(0.338)
$Island_{ij}$	−0.177***	−0.113**	−0.149***	−2.497***	−2.361***	−2.348***
	(0.0508)	(0.0475)	(0.0451)	(0.407)	(0.415)	(0.423)
FTA_{ij}	0.0415***	0.0309***	0.0316***	0.438***	0.324***	0.315***
	(0.00560)	(0.00540)	(0.00529)	(0.0510)	(0.0505)	(0.0507)
CU_{ij}	0.0503***	0.0455***	0.0450***	1.382***	1.283***	1.278***
	(0.00988)	(0.00886)	(0.00873)	(0.221)	(0.219)	(0.219)
$EntryProc_{ij}$	−0.0202	−0.0282	−0.0154			
	(0.0189)	(0.0173)	(0.0167)			
$EntryCost_{ij}$	−0.0396**	−0.0155	−0.0338**			
	(0.0189)	(0.0181)	(0.0167)			
t_{ij}		0.0125***			0.0910***	
		(0.00120)			(0.00654)	
$\hat{t}_{ij}$			0.0129***			0.0902***
			(0.00122)			(0.00664)
$\widehat{\overline{\eta}}_{ij}$				0.847***	0.617***	0.637***
				(0.0842)	(0.0827)	(0.0836)
$(\hat{z}_{ij}+\widehat{\overline{\eta}}_{ij})$				0.291***	0.299***	0.300***
				(0.0351)	(0.0329)	(0.0330)
σ_u^2				2.948***	2.922***	2.914***
				(0.0215)	(0.0214)	(0.0215)
Constant				25.10***	23.44***	23.46***
				(0.656)	(0.653)	(0.659)
Pseudo-R2	0.4839	0.489	0.491			
Log L	7139.775	7069.503	6941.778	32397.257	32314.227	31975.428
LR test		140.546	395.996		166.060	843.658
		0.00	0.00		0.00	0.00
Observations	23,620	23,620	23,334	18,951	18,951	18,768

Note: * significant at 10%, ** significant at 5% and *** significant at 1% level. In the first stage; (a) marginal effects evaluated at the mean value are reported, (b) Marginal effects for discrete change of dummy variable are from 0 to 1. Robust standard errors are computed to calculate t-statistic for the null hypothesis where the underlying parameter is zero. P-values appear between brackets. Exporting and importing effects are not reported.

procedure is used to estimate the three different specification and results are presented in Table 3.

In Table 3 we present the marginal effects evaluated at the mean of variables for the selection equation (Eq. (5)), the estimated parameters in the outcome equation (Eq. (6′)) and p-values for both models. Moreover, Table 3 shows the number of observations employed, the chi-square test for the null hypothesis of joint parameters are equal to zero (chi^2 and its p-value), and the pseudo R-squared (pseudo R^2) for probit models. Finally we report the maximum value of the logarithm of likelihood function (Log L), the likelihood ratio (LR) test for comparing the restricted model against the general model which is distributed as a chi-square with one degree of freedom. Since the first stage of the HMR model involves the estimate of a probit model for the probability that country j exports to country i, a dataset containing enough zero trade flows between country pairs is necessary. A dataset of 195 countries for 2012 is used, where non-zero exports suppose 80.23% of the sample.[13]

The three first columns in Table 3 present the estimate for the selection equation (extensive margin of trade) for the three different models. As can be observed sign and significant are the same for the three models considered. Variables commonly included in gravity equation for the volume of trade also affect the probability that two countries trade with each other. Particularly, closer countries are more likely to trade with each other, although sharing a common land border also reduce the probability of exporting. Moreover, sharing a common coloniser or have ever had a colonial relationship, speaking a common language, belonging to the same free trade agreement or sharing a common currency increase the probability to trade while the number of landlocked countries and islands reduce this probability. As expected, both exclusion restrictions, namely entry regulations and entry cost, are significantly negative. So, higher regulation costs for new firms negatively affect the country selection into trading partners.

Regarding the variable of interest, coefficient for tourism variable is positive and significant which implies that tourist arrivals may increase the probability of trading between countries since tourism flows reduce fixed and variable trade costs. However, in spite of this, the magnitude of coefficient shows a small economic significance. In particular, a 1% increases in tourist arrivals from country i to country j increase the probability of exporting (from j to i) by a 1.25%. Moreover, it is noteworthy that the model that includes tourism presents smaller coefficients

[13] Missing values also exists for a number of country pairs.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

than the model without tourism variable. To state that coefficients of the model vary when the tourism variable is introduced, we carry out a LR test for comparing the general model including tourism against restricted model which does not include tourism. Results indicate that we can not reject that tourism is a relevant variable to explain the probability to trade. Consequently, these results indicate the existence of a link between tourism and probability to trade and a significant variation between the coefficients estimated.

Results for the second stage of the HMR model (intensive margin) are presented in the last three columns of Table 3. As expected, sharing a common border, a colonial relationship, speaking a common language, and belonging to the same FTA or currency union affect positively the volume of exports while the number of landlocked countries and islands in the pair reduce trade. Also results indicate that exports decrease in distance implying that distance increases variable trade costs.

When tourism is included as a regressor in the outcome equation (Eq. (6′)), it is significantly positive. Particularly, a 1% increase in tourist arrivals to the exporting country, increase exports to the home country of tourist by a 9%. When endogeneity is controlled in Model C by introducing predicted tourism flows, the estimate coefficients are very similar to the ones in Model B.[14] Furthermore, as can be checked in Table 3, the estimates for all determinants are reduced with the introduction of tourism. In fact, the LR test for comparing the model with tourism against the model which does not include tourism indicates that we cannot reject that tourism is a relevant variable to explain the volume of trade. Again, this result suggests that omitting tourism in trade gravity equations, leads to biased estimates. Precisely the estimation for tourism shows a nexus between tourist arrivals and intensive margin of international trade, since tourism might reduce trade costs.

5. Conclusions

The main contribution of this paper is to fill the gap left by empirical and theoretical research on the relevance of tourism for international trade from a gravity model. Indeed from literature on trade costs it may be concluded that tourism could reduce fixed and variable trade costs through several ways: (i) new information about markets provided by visits, (ii) improved infrastructure for tourism also facilitating trade, (iii) reduced cultural distance between countries. Thus in this paper tourism is introduced in the HMR model by recognising that this flow could reduce costs of exporting. In this modified framework, tourism variable appears in both, the selection for the probability of exporting and in the gravity equation for the volume of exports.

The HMR model including tourism is estimated for cross-section of 195 countries in 2012. Tourism is found to be a relevant variable affecting both, the extensive and intensive margin of trade. Particularly, a 1% increase in tourist arrivals increase the probability of exporting by a 1.25% and raise the volume of exports by a 9%. These results are robust to the potential endogeneity arising from the bidirectional relationship between trade and tourism flows. Moreover, the introduction of tourism seems to indicate that the influence of other significant variables on trade may be overvalued.

This research presents some limitations: (i) despite being statistically significance in the explanation of international trade, the economic significance of international tourism seems to be small, (ii) the potential collinearity between regressors in gravity models could imply stability problems of the estimated model, and (iii) the HMR framework leads to a cross-sectional analysis and it does not exploit the time-series link between trade and the regressors.

In addition to the mentioned limitations, future research is needed to confirm the findings focusing on the treatment of endogeneity by applying instrumental variables techniques. Also more effort to theoretically show the influence of international tourism in international trade would be valuable.

Still this paper displays that it could be a case of omitted variable in gravity equations since tourism matters for international trade. Results suggest that there is some but small scope for policies promoting international tourism and that tourism may bring countries closer for international trade.

[14] We also have applied instrumental variables techniques to estimate equations (Eqs. (5) and (6′)). Tourist arrivals the 3 years before (2009, 2010 and 2011) are used as instruments and the Hansen's J test confirms the validity of the instruments. However, the use of GMM approach to estimate the non-linear equation (Eq. (6′)) was not computationally possible to estimate the original model that includes exporter and importer fixed effects due to convergence problems. So, although the coefficients for tourism are similar to the ones presented in the paper, estimates from this model cannot be compared to the one proposed by HMR.

References

Anderson, J.E., Van Wincoop, E., 2003. Gravity with gravitas: a solution to the border puzzle. Am. Econ. Rev. 93, 170–192.
Aradhyula, S., Tronstad, R., 2003. Does tourism promote cross-border trade? Am. J. Agric. Econ. 85 (3), 569–579.
Blanes, J., 2005. Does immigration help to explain intra-industry trade? Evidence for Spain. Weltwirtschaftliches Archiv. Rev. World Econ. 141, 244–270.
Brau, R., Pinna, A.M., 2013. Movements of people for movements of goods? World Econ. 36 (10), 1318–1332.
Chaney, T., 2008. Distorted gravity—heterogeneous firms, market structure and the geography of international trade. Am. Econ. Rev. 98, 1707–1721.
Coughlin, C.C., 2012. Extensive and intensive trade margins: a state-by-state view. Federal Reserve Bank of St. Louis Working Paper 2012–002A.
Culiuc, A., 2014. Determinants of International Tourism. IMF working papers (14/82).
Deardorff, A.V., 1998. Determinants of bilateral trade: does gravity work in a neoclassical world? In: Frankel, J. (Ed.), The Regionalization of the World Economy. University of Chicago Press, pp. 7–22
Deardorff, A.V., 2014. Local comparative advantage: trade costs and the pattern of trade. Int. J. Econ. Theory 10 (1), 9–35.
Dixit, A.K., 1977. Monopolistic competition and optimum product diversity. Am. Econ. Rev. 67 (3), 297–308.
Frankel, J.A., 2008. The estimated effects of the euro on trade: why are they below historical effects of monetary unions among smaller countries? NBER Working Paper Series 14542
Geldi, H.K., 2012. Trade effects of regional integration: a panel cointegration analysis. Econ. Model. 29, 1566–1570.
Girma, S., Yu, Z., 2002. The link between immigration and trade. Evidence from UK. Weltwirtschaftliches Archiv. Rev. World Econ. 138, 116–130.
Gould, D., 1994. Immigrant links to the home country: empirical implications for U.S. bilateral trade flows. Rev. Econ. Stat. 76 (2), 302–316.
Hamilton, J., Tol, R., 2007. The impact of climate change on tourism in Germany, the UK and Ireland: a simulation study. Reg. Environ. Chang. 7, 161–172.
Hamilton, J., Maddison, D., Tol, R., 2005a. The effects on climate change on international tourism. Clim. Res. 29, 245–254.
Hamilton, J., Maddison, D., Tol, R., 2005b. Climate change and international tourism: a simulation study. Glob. Environ. Chang. 15, 253–266.
Head, K., Ries, J., 1998. Immigration and trade creation: econometric evidence from Canada. Can. J. Econ. 31, 47–62.
Helpman, E., Melitz, M., Rubinstein, Y., 2008. Estimating trade flows: trading partners and trading volumes. Q. J. Econ. 123, 441–487.
Khadaroo, J., Seetanah, B., 2008. The role of transport infrastructure in international tourism development: a gravity model approach. Tour. Manag. 29, 831–840.
Khan, I.U., Kalirajan, K., 2011. The impact of trade costs on exports: an empirical modelling. Econ. Model. 28, 1341–1347.
Khan, H., Toh, R.S., Chua, L., 2005. Tourism and trade: cointegration and granger causality tests. J. Travel Res. 44, 171–176.
Kulendran, N., Wilson, K., 2000. Is there a relationship between international trade and international travel? Appl. Econ. 32 (8), 1001–1009.
Lawless, M., 2010. Deconstructing gravity: trade costs and extensive and intensive margins. Can. J. Econ. 43 (4), 1149–1172.
Lin, K.S., Lee, H.Y., 2002. The political economy of exchange rate regimes: evidence from Hong Kong and Taiwan. Asian Econ. J. 16, 1–15.
Marrocu, E., Paci, R., 2011. They arrive with new information: tourism flows and production efficiency in the European regions. Tour. Manag. 32 (4), 750–758.
Melitz, M.J., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71, 1695–1725.
Patuelli, R., Mussoni, M., Candela, G., 2013. The effects of world heritage sites on domestic tourism: a spatial interaction model for Italy. J. Geogr. Syst. 15, 369–402.
Peri, G., Requena-Silvente, F., 2010. The trade creation effect of immigrants: evidence from the remarkable case of Spain. Can. J. Econ. 43 (4), 1433–1459.
Quinn, M., 2009. Movies and the mystery of the missing trade: is hollywood good for U.S. exporters? Int. Trade J. 23 (2), 231–254.
Rauch, J.R., 1999. Networks versus markets in international trade. J. Int. Econ. 48 (1), 7–35.
Rauch, J.R., Trindade, V., 2002. Ethnic Chinese networks in international trade. Rev. Econ. Stat. 84, 116–130.

Please cite this article as: Santana-Gallego, M., et al., International trade and tourism flows: An extension of the gravity model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.10.043

Rose, A.K., 2007. The foreign service and foreign trade: embassies as export promotion. World Econ. 30 (1), 22–38.
Rose, A.K., Spiegel, M.M., 2011. The olympic effect. Econ. J. 121 (553), 652–677.
Roselló, J., Santana-Gallego, M., 2014. Recent trends in international tourist climate preferences: a revised picture for climatic change scenarios. Clim. Chang. 124, 119–132.
Santana-Gallego, M., Ledesma-Rodríguez, F., Pérez-Rodríguez, J., 2010a. Does a common currency promote countries' growth via trade and tourism. World Econ. 33 (12), 1639–1972.
Santana-Gallego, M., Ledesma-Rodríguez, F., Pérez-Rodriguez, J., 2010b. Revisiting Rose's common currency debate. Asociación Española de Economía y Finanzas Internacionales Working Papers n°10-02.
Segura-Cayuela, R., Vilarrubia, J.M., 2008. The effect of foreign service on trade volumes and trade partners. Previously circulated as Banco de España Working paper no. 0808. Moneda y Crédito 226, pp. 99–136.
Shan, J., Wilson, K., 2001. Causality between trade and tourism: empirical evidence from China. Appl. Econ. Lett. 8, 279–283.
Sinclair, M.T., 1998. Tourism and Economic development: a survey. J. Dev. Stud. 34 (5), 1–51.
Tadesse, B., White, R., 2010. Does cultural distance hinder trade in goods? A comparative study of nine OECD member nations. Open Econ. Rev. 21 (2), 237–261.
Tinbergen, J., 1962. Les données fondamentales d'un plan régional. Rev. Tiers Monde 3, 329–336.