

Social networks and trade of services: modeling interregional
tourism flows with spatial and network autocorrelation effects

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Abstract

Recent literature on border effect fostered research on informal barriers to trade and the role of networks promoting it. In relation to social networks, it has been shown that the intensity of trade of goods is positively correlated with the migration flows between any pair of countries/regions. In this article we investigate if such relation also holds for inter-regional trade of services, focusing on the case of the Spanish intra and inter-regional monetary flows generated by the domestic tourist sector. With this aim, we develop a gravity model rooted in the Dixit-Stiglitz-Krugman theoretical frameworks, and we consider recent techniques developed in the field of spatial econometrics in order to capture spatial and network autocorrelation effects affecting the regions of origin and destination. These two former effects are measured separately and simultaneously, measuring to what extent the impedance of distance between origins and destinations is affected by ‘demographic’ linkages between regions. Network autocorrelation are measured by means of Census data, regarding the stock of people from each region living in the others. According to the results obtained, the intensity of the flows depends positively on the gross value added of the Tourist sector, the population and income levels in the importing regions and the actual traveling distance. Moreover, network direct effects are highly significant and also the indirect spatial and network autocorrelation effects.

KEYWORDS: social networks, gravity models, trade of services, internal tourism, Bayesian spatial autoregressive regression model, spatial connectivity of origin-destination flows.

1 Introduction

In spite of a permanent decrease in transportation costs, recent literature on border effect shows how countries still trade more with themselves than with any other country (McCallum, 1995; Helliwell, 1996; Wolf, 2000; Evans, 2003; Chen, 2004; Okubo, 2004). Thus, several authors are trying to find alternative explanations to this main trade puzzle. Among them, research has increasingly focused on informal barriers to trade as an explanation for high trade costs. As it has been highlighted by Rauch and Casella (2003), since lack of information about international trade and investment opportunities could act as an informal barrier (Portes and Rey, 1999), networks are seen as a way to overcome such barriers and increase the volume of international trade. Such evidence has been found for business groups operating across national borders (Belderbos and Sleuwaegen, 1998), immigrants (Gould, 1994), and long-settled ethnic minorities that maintain co-ethnic business societies.

Regarding this literature, there are two main mechanisms that could induce a positive relation between the bilateral trade and the immigration between any two countries or regions. The first mechanism is related to the 'idiosyncratic' preferences for the immigrants ('taste effect'): the positive impact of immigrant on the intensity of trade reflects the taste for goods from their countries of origin. The second mechanism is the reduction of transaction costs ('information effect'): immigration can reduce transaction costs because people who migrate know the needs and preferences, the social institutions, the language and the legislation of both countries, what makes communication easier. Moreover, this communication flows fluently through social and business networks that connect immigrants with their home countries, fostering the intensity of bilateral trade.

Based on this literature centered in the relation between immigration and the trade of goods, we are interested in investigating whether similar results are to be found in the context of trade of services. In order to avoid conceptual and statistical problems related to the nature of 'trade of services', we focus in the special case of inter-regional trade flows of the tourist sector, where trade usually implies a cross-border movement of people, and it could therefore be analyzed in the same way than the commodity flows. Before doing that, it is obliged to remark the scarcity of literature in the topic. First, due to the lack of information on bilateral trade of services, it is difficult to find empirical work on the quantification of the border effect for services. Therefore,

the relation of distance with this kind of trade, and the presence of informal barriers for trading services like in the case of goods, seems to be still an open question.

In this context of limited antecedents, some authors have used the gravity model to analyze the bilateral trade flows of services. In the field of international trade, Ceglowsky (2006), developed a gravity model using panel data from the OCDE international trade of services data base for the period 1999-2000, finding a larger negative elasticity of trade with distance compared to the one usually obtained for goods. Furthermore, Kimura and Read (2006), using the same OCDE database, found that apart from the strong negative elasticity of distance, ‘language and cultural proximity between producer and consumer’ plays an important role in determining the intensity of international trade of services. This result is in line with the ‘information effect’ described above for the relation between social networks and the international trade of goods.

In contrast with this results for aggregated flows of services, there is a dispersed literature discussing the unequal effect of distance on some specific types of services like education or tourism. In a recent review on the topic for education, Sá, Florax and Rietveld (2004) aim towards an inverse relation between the trade of education and the distance between the place of origin and destination. However, the discussion about this relation in the case of tourism flows is less conclusive ¹. To this regard, it is important to take into account that while in most part of goods and services, proximity between producers and consumers reduce the transaction costs (shorter travel times, lower transportation cost, more homogenous cultural, historical and institutional schemes...) and increase the intensity of trade, in the case of tourism there is a trade-off between at least two opposite forces: on the one hand, transaction cost push toward more intense flows with closer destinations; on the other, tourists may look for the most different and exotic destinations at hand, given an specific budgetary constrain. In this sense, although the transportation cost and the cultural proximity may justify the presence of a certain distance decade in the cumulative distribution of trade of tourism for an specific origin, it is also expected to find a minor influence of the distance as an impediment for the interaction with remote destinations.

On the top of that, in parallel with the positive relation between networks and the trade of goods, it is reasonable to expect that social and business networks would also affect the trade of

¹See Witt and Witt, 1995 for a classic review on the use of econometric models for tourism; see also Sien Imm Ng’s (2007) and Khadaroo and Seetanah (2008) for a quantification on the impact of cultural differences and the transportation linkages on the destination choice in international flows

services in general, and the tourism flows in particular. Regarding business networks, tourism flows would be more intensive between countries/regions that share common infrastructures and intermediaries (transportation networks, common tour-operators...). Moreover, regarding social networks -approached by the stock of immigrants- there are several mechanisms that could induce positive correlation between trade and the intensity of the social linkages. As we will describe later on, we find at least 2 direct and 4 indirect channels throughout immigration could affect the destination choices of tourists. These channels could be synthesized around what we have named 'the home-land-attraction' and the 'the host-country-attraction' direct and indirect effects.

From an empirical viewpoint, and focusing in the international trade of the Tourist sector (inter-national tourism flows versus inter-national migration stocks), one may expect to find small network effects, mainly because of the restricted number of foreign immigrants in a country, the third-world composition of the immigration structure, and the high cost of traveling regularly back home. However, when the analysis focuses on the internal flows (inter-regional tourism flows versus inter-regional migration stocks), magnitudes could be not so negligible. In order to emphasize the magnitude of the phenomenon, one may consider the **????** millions of inter-state travels occurring in a year in the US, and the **????** percentage of the people living in the US that were born in another State different to his current residence. As another reference, we choose Spain, which is a much smaller country but with a strong tourist tradition (Spain is 2nd in the World ranking of tourists inflows). In this case, there was 552 million overnight trips of Spanish citizens within Spain in 2001 (note that there is just 42 million citizens in Spain), and the 16% of the current population was born in a region different to their current region of residence. Furthermore, when the focus is on inter-regional movements of people, one have to consider that, apart from the potential savings on 'transaction costs' induced by the 'social networks', travelers could face additional decreases in the housing cost in destination, due to the ownership of 'second residences' or the tendency to 'share' house with relatives and friends.

Finally, although the possibility of finding significant relations between tourist trade flows and immigration stocks is larger with inter-regional flows than with the inter-national ones, the lack of information have restricted the possibility to measured them until know. In fact, to the best of our knowledge there is no previous attempt to measure this relation for internal flows

both in Spain and worldwide ².

Based on these hypothesis, in this paper we study the relation between inter-regional trade flows of services linked to the tourist sector with the distance and the social networks produced by the stock of inter-regional migration in each region. From the theoretical viewpoint, we follow Combes et al. (2005) and Treyz and Bumgardner (1996), embedding the inter-regional trade flows on the well known Dixit-Stiglitz-Krugman framework, including the role of social networks and considering the aggregate flows. Based on this theoretical paradigm, we develop a gravity model enriched with spatial econometric elements that allows for a parsimonious treatment of the spatial and network effects by means of two alternative weight matrices. Additionally, another virtue of our approach leads on the use of efficient Bayesian econometric approaches based on the MCMC estimation methods. Finally, taking advantage of a recent estimate of the intra and inter-regional trade flows of tourism between the Spanish regions for the year 2001 (Llano and de la Mata, 2009a, 2009b), we obtain some interesting results confirming the positive relation between the intensity of trade and the social networks through the direct and indirect effects considered. First, by means of a simple gravity model, we find a strong ‘border effect’ and a low negative elasticity between distance and trade services in the tourism sector. Then, when the strong intra-regional trade are controlled, and the network effects are introduced one by one, the negative effect of distance disappear and become positive and significative. These results are interpreted as a sign of some kind of systematic behavior in the intra-national distribution of trade of services in the tourist sector, which reflect a preference toward consuming intra-regional services, inter-regional services from contiguous regions and inter-regional services from regions with strong linkages in terms inter-regional migration. Moreover, the spatial econometric techniques used also allow to verify the multilateral resistance of every flows connecting the trading regions with their neighbors, considering that ‘neighborhood’ could be defined both in terms of spatial contiguity and common migration composition.

The paper is organized as follows. Section 2 describe the theoretical model and discuss the origin and nature of the network effects on the trade flows of services. In section 3 we show the empirical gravity model, describing different specifications for controlling for spatial and network autocorrelation effects. The next section (4 describe the results obtained when

²Although there are some studies analyzing internal tourism flows, they use input-output models (Eriksen and Ahmt, 2008) or time series approaches (Athanasopoulos and Hyndman, 2008), but not a theoretical-based gravity model with cross-section data with an special attention on network effects

applying the previous model to the intra and inter-regional trade flows of tourism in Spain. A final section concludes.

2 Trade and networks: definitions, concepts and the theoretical model

In this section we carried out a brief review of the main concepts used in the paper regarding inter-regional trade of tourism and networks. Then, we describe the theoretical underpinnings of the empirical model described in section 3.

2.1 Social networks, immigration and trade of services

Economic network has been defined as *'a group of agents that pursue repeated, enduring, exchange relations with one another (Podolny and Page, 1998)'*. Departing from this idea, several authors have analyzed the impact on bilateral trade of immigrants. As Rauch (2001) pointed out in an exhaustive review, an immediate concern is that any positive impact of immigration on trade might simply reflect immigrant taste for goods from their countries of origin or the correlation of immigration with country characteristics that promote trade, such as proximity. However, different authors have demonstrated that apart from these 'taste effect', there is a 'network effect' induced by the social linkages that immigrants keeps with their countries of origin, which may induce important reductions in transaction cost and, therefore, further promotions of bilateral trade.

Regarding this former mechanism, some authors have tried to quantify the relevance of social and business networks on the international trade of goods in a country. For example, Gould (1994), in a pioneer article, analyzed US trade with other 47 countries (1970-86), showing how immigration reduces the information costs and the border-effect. He also founded that immigration affects more to exports than to imports and more to differentiated manufactures than to intermediate goods, which are more homogeneous. Then, Head and Ries (1998), repeated a similar analysis with the Canadian bilateral trade with 136 countries in the period (1980-92). Dunlevy and Hutchinson (1999, 2001) study the imports and exports for US (1870-1910), finding that immigration affects both the imports (where the 'taste effect' is larger than the 'information effect') and the exports (where the 'information effect' is larger, due to the knowledge of trade

opportunities between both countries). From a dynamic perspective, they also point out that the first immigration waves promotes international trade of commodities in a simultaneous way, while the positive effect on trade tend to dissipate with time. Similarly, Wagner et al. (2002) estimated the effects of immigration on the international trade of Canadian provinces. Rauch and Trindade (2002) study how the presence of Chinese ethnics affects bilateral trade. In the countries where the presence of Chinese ethnics represent a percentage of the population big enough and that have a lot of border connections, as in the Asian southeast, the effects on the bilateral trade are greater because of the information effect and the effect on differentiated products is bigger.

Digging deeper on the historical causes of the social networks induced by immigration stocks, Girma and Yu (2002) carried out a similar analysis using data for the United Kingdom data on immigration and trade where they distinguish between migration from countries with an historical relation with the Commonwealth and countries without it. Considering that the reduction on transaction costs can act in two different ways (first, because of presence of contacts between the countries of origin, and second, because of immigrants knowledge of both markets and social institutions), they found that the more similar the origins and destinations are, the smaller the reduction of the border effect is. Based on this finding, they confirm that the role of networks ('information effect') is larger when immigration connects 'heterogenous' countries, which is the case where 'information cost' is larger and play a critical role as an impediment to trade. Then, with an special focus on culture, White and Tadesse (2008) measured the effect of immigration on trade, making the difference between cultural and non cultural products. By means of a Tobit specification of the gravity equation, they include a cultural distance indicator and the interaction between stock of immigration and cultural distance, using data at state level of US and other 75 countries. By this procedure, they are able to confirm that immigrants tend to counteract the negative effect on trade of the cultural distance. However, their results shows that the influence of the immigrants on trade was not big enough to surpass the resistance to trade derived from the information costs induced by the cultural distance.

Paradoxically, although immigration and trade flows are always more intense within the country than between countries, the literature about the relation between these two phenomena at the interregional level is very scarce. Among the exceptions, Helliwell (1999) analyzed the inter-regional and international trade of Canada and the US, founding that the role of inter-

regional migration plays a minor role compared to the international migration, since the ‘taste and information effects’ are smaller between regions than between countries. More recently, Combes et al (2005) quantified the impact of social and business networks on the intensity of inter-regional trade between 94 French regions (departments). In this paper, by means of different gravity models, embedded in a Dixit-Stiglitz-Krugman theoretical framework, the authors verify that, despite of the traditional impediments to trade (distance and boundaries), networks facilitate bilateral trade, founding larger effects for business than for social networks.

Furthermore, as it was pointed out before, most of these analysis focus on international trade of goods, without considering similar relations between the inter-regional trade of services and the inter-regional migration flows, which are indeed much larger than the priors in all the OCDE countries ³.

Focussing on the tourist sector, there are several channels that may lead to positive relations between the intensity of trade and the presence of business and social networks. Regarding business networks, tourist flows would be more intensive between countries that share good transportation networks (airlines, highways and railways) or are linked by common tour-operators. What is more interesting for us in this paper, also social networks -approached by the stock of immigrants- could induce positive correlation between trade and the intensity of the social linkages. For the shake of clearness, we classified these channels in two groups, making the difference between relations affecting the trading countries/regions (direct effects) or relations affecting one of the trading countries/regions with their neighbors (indirect effects).

First, lets think in the tourist decisions of everyone who was born in different country/region where he lives (generally speaking, we use the term ‘immigrants’ for them)⁴. For this group, we could describe the following direct effects:

1. The destination choice of immigrants is conditioned by the familiar ties with their countries/regions of origin. Since tourists take advantage of vacations to visit their country/region of origin, where they usually keep houses and properties, it is expected to find larger tourism exports from the host country/region to the country/region of origin (i.e.

³For example, according to the Spanish National Accounts, more than 60% of the Spanish GDP is produced by services, and more than 70% of the total output is consumed within the country

⁴For the sake of a more generalist approach to the topic, in this section we describe concepts that stands for inter-national and inter-regional trade and migration. Therefore, we independently refer to ‘countries’ and ‘regions’, and we describe examples where ‘countries’ and ‘regions’ are mixed. We expect that this approach could be more attractive for an international audience

moroccans living in France tend to travel back to Morocco on their vacations. Therefore, Morocco would account for larger tourist exports to France than what would be expected from the moroccan tourist ‘characteristics’). We name this as ‘the Direct-Home-Land-Attraction’ (DHLA) effect;

2. Conversely, relatives and friends living in the country/region of origin, may tend to visit the immigrant’s in the host country/region, finding better information and prior access to cheap dwelling options than in any other destination (i.e. German tourists may choose Spain as destination since they could share information and housing with other Germans already set in Spain). Consequently, we name this as ‘the Direct-Host-Country-Attraction’ (DHCA) effect.

Apart from these two direct effects, for the case of tourism flows, there are new channels throughout social networks could have additional indirect effects on the bilateral trade flows of the tourist sector. These channels are considered indirect because the relation is not between the trading regions and their bilateral immigration flows in the past. However, these new mechanisms arise when considering other flows connecting the neighbors of the origins and the destinations under consideration. As we will see in the next sections, these indirect effects are connected with the concept of ‘multilateral resistance’ in the gravity model (Behrens et al, 2007), as well as the discussion about ‘spatial and network’ autocorrelation effects affecting the estimation of spatial interaction models (Bolduc et al, 1992; LeSage and Pace, 2008). In sum, the basic idea behind these effects is that the bilateral flows between two country/regions i and j is not independent from the flows between them and their corresponding neighbors. Moreover, the concept of ‘neighborhood’ could be defined from the double perspective of the ‘spatial contiguity’ or the similarity of the ‘social networks’ affecting the trade flows. Consequently, the indirect effects could be stocked in two groups, that we label ‘indirect spatial effects’ and ‘indirect network effects’.

For the case of the ‘indirect spatial effects’ we can define two sub-groups of effects:

1. Linked to the ‘DHLA’ effect, immigrants living in a country/region may also look for destinations that are closer to their country/region of origin. This effect could be named as ‘the Home-Land-Neighbors-Attraction effect (HLNA), and could be justify by at least two complementary mechanisms:

- (a) Due to the ‘taste effect’, immigrants from an specific country/region of origin may chose as destination a country/region that is a spatial neighbor of his home-land, since the probability to find similar ‘characteristics’ in these neighbors countries/regions is larger than for others (i.e. immigrants from Cuba living in Chicago may prefer Florida for vacations, which is the closest ‘spatial and cultural neighbor’ to Cuba within the US).
 - (b) Additionally, since -previously- gravity had affected the immigration flows, the probability to find co-nationals (and therefore family and friendship ties) in the neighbors countries/regions of one’s country/region of origin is larger than anywhere else (i.e. since immigrants from Cuba tend to concentrate in Florida, any Cuban living in Chicago may prefer Florida for vacations, since he could take advantage of his social networks with other co-nationals in order to find better prices or even flat mates for their stay).
2. Conversely, from the perspective of the ‘DHCA’ effect, the relatives of the immigrants, who are still in the country/region of origin, may also look for destinations that are closer to the immigrant’s host country/region instead of the host country/region itself. The mechanism causing this indirect effects are equivalent to the ones described for the HLNA, but forces act in the inverse direction. Therefore, this effect could be named as ‘the Host-Country-Neighbors-Attraction effect (HCNA).

Similarly, for the case of the ‘indirect network effects’ two sub-groups of effects could also be identified:

1. When considering the history of emigration in a country/region, if emigrants have concentrated in a group of host countries/regions, then ‘network effects’ are more likely to appear between these countries/regions and the country/region of origin. However, ‘network effects’ could also appear between these ‘host countries’ themselves, throughout the presence of strong communities of co-nationals. In fact, a concept of ‘social neighbors’ could be easily defined depending on the similarity of the immigration structure of a group of host country/regions. This cross relation would introduce competing effects for the direct positive relation between the tourist trade flows from region i to j and the stock of immigrants from j in i (DHLA effect). This new indirect effect could be named

as ‘the Home-Land-Social-Neighbors-Attraction effect (HLSNA), and can be explained by different mechanisms. For example, following with our example with Cubans, if the proportion of immigrants from Cuba in the US and Spain is similar, it is likely to find cross ties between Cubans living in both host-countries, and therefore, US and Spain could be considered as ‘social neighbors’ regarding to Cuban emigrants. Thus, the ‘network effect’ affecting the bilateral trade flows of tourism between US and Cuba would compete somehow with a parallel ‘network effect’ between US and Spain. As we pointed out before, since immigration was previously affected by gravity, ‘social neighbors’ could coincide with ‘spatial neighbors’. However, alternative situations could also be true (i.e. just think in the last Jew’s diaspora after the IIWW and the strong communities set in countries like Israel, US or Argentina, which are further away one from the other).

2. Conversely, the same kind of ‘network interference’ could affect the ‘DHCA’ effect, since the relatives of the immigrants who are still in the country/region of origin could decide to visit ‘the social neighbors’ of the host-country instead of the host-country itself. The mechanism causing this indirect effects are equivalent to the ones described for the HLSNA, but forces act in the inverse direction. Consequently, this effect could be named as ‘the Host-Country-Social-Neighbors-Attraction effect (HCSNA).

Finally, we think now in tourist decisions of non-immigrants, that is, people who lives in their country/region of origin. For this group, it is important to highlight that immigrants could also affect the ‘destination decisions’ of other non immigrants living in the host country/region. Moreover, the relatives and friends of the immigrants who are still living in the origin country (but could interact regularly with them), could also spread their travel experiences and tastes among their co-nationals in the home-land.⁵ Although the diffusion of information and preferences would preferably take place within each country/region (the home-land and the host country/region), it could also be progressively spread among their neighbor country/regions. In Combes et al. (2005), this effect was the main force driving the relation between the ‘information effect’ and the ‘border effect’ in the case of inter-regional trade of goods. In our case, this

⁵If we think in the large number of immigrants who marry a national, we could easily find strong mechanism throughout the immigrant tastes and networks ties could also affect the destination decisions of non-immigrants when they are planning a trip. In the case of a ‘mixed couple’ (immigrant and non-immigrant) with two kids, the decision of visiting a relative in the home-land of 1 immigrant is conditioning the travel decision of three ‘non-immigrants’

force is mixed and strengthened by the 2 direct and the 4 indirect effects described above.

In sum, we have identified 2 direct effects that potentially could induce positive relations between bilateral trade of services in the tourist sector and the bilateral immigration stocks between any pair of regions i and j . Additionally, we have described 4 indirect forces affecting tourist decisions, which could lead to positive correlation between the trade flows of tourism between an origin and a destination with the trade flows from the same origin/destination with their corresponding ‘spatial’ (contiguous country/region) and ‘social neighbors’ (countries/regions with similar immigration composition). Furthermore, it could be assumed that all these effects could affect both immigrants (mainly) and non-immigrant tourist decisions. As we will see in the next section, the omission of the indirect effects could lead to inconsistent and biased estimates of the gravity models.

2.2 The theoretical model

This section is based on Combes et al. (2005), who developed a model of monopolistic competition à la Dixit-Stiglitz-Krugman (DSK; Dixit and Stiglitz, 1977; Krugman, 1980), which accounts for home bias in consumers preferences and transaction costs. Additionally, the theoretical model takes into consideration the work of Treyz and Bumgardner (1996), who also developed a monopolistic competition model for estimating inter-regional trade flows in services. In our view, the DSK framework offers several advantages compared to others available in the literature of international trade: first, as it has been shown by different authors (Anderson and Van Wincoop, 2003; Feenstra, 2004), this model offers a robust theoretical base for deducing the gravity model, and therefore, for the empirical analysis of the intensity of flows between dyads of countries or regions; second, we believe that the monopolistic competition model is based on some theoretical assumptions that fit especially well with the tourist sector, such as, the presence of a large market with free-entry conditions and a number of companies offering a large variety of services (hotels and restaurants with different qualities, cultural and environmental characteristics,...), with some capacity to fix prices and benefit from a certain monopolistic situation, mainly when the tourist has arrived to the destination and any variation in the tourist plan is costly.

Following Combes et al., (2005), the consumers utility in region i depends upon the con-

sumption c_{ijh} of all varieties h of tourist services produced in any region j .⁶ Varieties are differentiated with a constant elasticity of substitution (CES). Each variety imported by region j is weighted by a coefficient a_{ij} , which describes the preferences of i consumers with respect to j varieties. Let n_j denote the number of varieties produced in region j and N the total number of regions. Thus the corresponding utility function is

$$U_i = \left(\sum_{j=1}^N \sum_{h=1}^{n_j} (a_{ij} c_{ijh})^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (1)$$

where $\sigma > 1$ is the elasticity of substitution, p_{ij} is the price of the service in the region i offered to tourist from region j . The transaction costs are represented in the price differences between locations, $p_{ij} = (1 + \tau_{ij})p_j$, where τ_{ij} is the iceberg-type cost of traveling from regions j to i and p_j the mill price in region j . Thus, the demand function of services offered by region i to tourist from region j is described by

$$c_{ij} = c_{ij} P_i^\sigma n_j p_j^{\sigma-1} (1 + \tau_{ij})^{-\sigma} \quad (2)$$

where $c_i = \sum \sum c_{ijh}$ is total consumption (in quantities, i.e. number of nights in hotels, meals in restaurants,...) in region i of differentiated varieties of tourism services imported from all possible regions (including i) and where P_i is the price index in region i , $P_i \equiv (\sum_j a_{ij}^{\sigma-1} n_j p_{ij}^{\sigma-1})^{1/(1-\sigma)}$.

2.3 Transaction costs and preferences

Treyz and Bumgardner (1996), consider that transportation costs in service industries include non-monetary transactions costs of distance such as disparities in access to information and the time cost of travel. More clearly, we follow Combes et al (2005), assuming that transaction costs include two different elements: on the one hand, physical transport costs, T_{ij} and on the other, the information costs I_{ij} . Therefore, transportation cost are modeled as follows:

$$1 + \tau_{ij} = T_{ij} I_{ij} \quad (3)$$

⁶For the case of tourism it is important to remember that monetary trade flows always travel in the opposite direction than the people. Thus, an export of tourism (Euros) from region i to region j is originated by a person (tourist) that travels from region j to region i . In order to simplify notation, we use the standard notation used for goods without considering this twist between i and j for people and monetary flows.

Assuming that transport cost have the following expression:

$$T_{ij} = (1 + t_{ij})^\delta \exp(-\theta t_{ij}^2) \quad (4)$$

Where t_{ij} is a measure of transport cost between i and j . Parameters δ and θ are expected to be positive. Treyz and Bumgardner (1996), focussing on trade off services in general, consider that various modes of interaction such as telecommunications, parcel post and face-to-face discussion may be employed to transport the output of services from the supplier to the consumer. For simplicity, they assume that all these transportation costs increase linearly with distance and are paid by the consumer. In our case, since the tourism flows implies the displacement of the client to the place where the supplier is located (hotel, apartment, restaurant,...) we can easily accept that the consumer assume all the expenses related to the trip, and this is well approached by the distance.⁷ In our case, following Combes et al. (2005), we assume that the quadratic cost function embodies increasing returns in transport activities, where the marginal cost of traveling to another region is positive but it decreases with distance.

As we will see in the next section, here our approach slightly diverge from Combes et al. (2005). For the information cost we assume

$$I_{ij} = (1 + mig_{ij})^{-\alpha_I} (1 + mig_{ji})^{-\beta_I} \exp(\varphi_I A_{ij} - \psi_I C_{ij}) \quad (5)$$

Where A_{ij} is a dummy variable set to 1 when $i \neq j$ and C_{ij} is another dummy set to 1 when i and j are contiguous regions⁸. With Combes et al. (2005) we assume that $\varphi_I > 0$ and $\psi_I > 0$, that is, the informational transaction cost is lower inside a region than between two regions, but higher between two neighbors regions than between neighbor ones⁹. The direct impact of social networks on information costs is captured by two variables, mig_{ij} and mig_{ji} ,

⁷For the case of tourism the best option would be to consider also the relation between the distance and the transport mode used for the displacement. In the case of inter-national or inter-regional flows in a large country, the mode choice may break the linear relation between distance and transport cost. However, this assumption is more plausible for the inter-regional flows in a small country like Spain, with a prevalence of land transportation and a less disperse transport costs for those modes competing for short distance trips.

⁸Note that this theoretical configuration which includes the ‘border effect’ dummy variable would not hold for the specifications where intra-regional flows are modeled separately and flows to contiguous regions are captured by the spatial autocorrelation effect.

⁹For the shake of clearness, we prefer not to use the concept ‘contiguous’ like Combes et al. (2005) but the concept of ‘neighbor’. From the spatial econometrics perspective, contiguity is a concept related to regions with common borders, while neighbors could be define in a more broad way, where the neighbors condition is defined on ‘spatial’, ‘cultural’ or any other nature of association.

corresponding to migrant networks. As it has been described above, and in line with Combes et al. (2005), we consider that social networks could influence inter-regional flows of services through 2 direct effects: on the one hand, the monetary tourist flows going from i to j (tourists moving from j to i), could be positively correlated with the number of people born in region i living in region j (therefore, mig_{ij} captures the ‘DHLA’ effect). Reciprocally, the monetary tourist flows going from i to j (tourists moving from j to i), could be positively correlated with the number of people born in region j living in region i (therefore, mig_{ji} captures the ‘DHCA’ effect).

In contrast to Combes et al. (2005), we do not consider business networks, first because of the lack of data about multi-regional tour-operators and tourist companies, and second, because, the importance of this intermediaries in the internal tourist sector is weak.

Since inter-regional migration are assumed to reduce transaction costs of inter-regional trade of tourism, parameters α_I and β_I are expected to be positive. Consumers are assumed to have both deterministic and stochastic elements in their preferences a_{ij} . For the deterministic part it is assumed that tourist are more fond of consuming local services (intra-regional trade), tourist services from contiguous regions and tourism services from their home-land region. This assumption is in line with Combes et al., (2005), the intuition of finding strong ‘border effects for services’ and the 2 direct effects described for networks. However, the identification of 4 additional indirect effects that may interfere with the positive direct network effects considered in the consumer preferences, obliged us to introduce new elements in line with the multilateral resistance term (Behrens et al, 2007; Anderson and van Wincoop, 2003)

2.4 The multilateral resistance term

For the case of international trade of goods, Behrens et al. (2007), considered that any bilateral flow X_{ij} between region i and j could be defined as a system of implicit equations describing the interdependence of all trade flows towards region j .

$$X_{ij} = Y_j^\sigma \left[\sum_k \frac{L_k}{L_i} \left(\frac{\tau_{kj}}{\tau_{ij}} \frac{Y_k}{Y_i} \right)^{1/\sigma-1} X_{kj}^{1-1/\sigma} \right]^{-\sigma} \quad \forall i, j \quad (6)$$

Through this strategy, they suggest a way to introduce the multilateral resistance term defined by Anderson and van Wincoop (2003), overcoming the drawbacks of other procedures based on

the use of region-specific importer-exporter fixed effects (Feenstra, 2002; Rose and van Wincoop, 2001). As it is explained by Behrens et al. (2007), although the use of such fixed effects procedure yields consistent estimates within the gravity model, it is unable to control for a significant amount of the spatial interdependence. Therefore, they propose a novel method for estimating the gravity equation using spatial econometric techniques (LeSage and Pace, 2008).

Based on these experience, our model consider the presence of 4 indirect effects that may compete with the 2 direct network effects assumed in the consumer preferences, and could generate spatial and network autocorrelation effects. for simplicity, these 4 indirect effects will be grouped in 2 weight matrices, which will account separately for the ‘spatial’ and the ‘network’ indirect effects.

3 The empirical model

Based on the previous theoretical model, in this section we discuss the concept of spatial and network autocorrelation effect defined in the field of the spatial econometrics. Then, following Behrens et al. (2007), LeSage and Pace (2008), LeSage and Fischer (2008) and Autant-Bernard and LeSage (2008), we define the empirical model that would be used in the application.

3.1 Spatial and network autocorrelation effects affecting gravity model estimates

Black (1992) suggested that network and spatial autocorrelation may bias the classical estimation procedures of typical spatial interaction models. He suggested that “autocorrelation may (...) exist among random variables associated with the links of a network”. Then, Berglund and Karlstrm (1999) developed a G_{ij} statistic to measure the presence of spatial autocorrelation in interregional migration flows, taking into account spatial and network autocorrelation of bilateral migration flows. Bolduc et al. (1992) suggested that “*a given observation of the N_{ij} , S_i , S_j variables usually refers only to the corresponding ij market, that is network variables such as travel time or generalized cost for the competing market ‘is’ (same origin, different destination) or r_j (same destination, different origin) do not appear in*” the classical gravity model. *The same is true for socio-economic and network variables adjacent to market ij should also be incorporated in the relationship explaining y_{ij} (the flow), but do this in a proper way could*

well lead to an intractable model. The omission of those variables and the frequent lack of data describing the geographic structure of the region gives raise to some spatial autocorrelation in the regression errors. Sources of spatial autocorrelation among errors are model misspecification and omission of explanatory variables capturing effects related to the physical and economic structure (distances between zones, size of zones, length of frontiers between adjacent zones, etc) of the region. For these reasons, the error term of the gravity model will reflect this situation. Cliff and Ord (1981) suggested that this inter-relationship is caused by the dependent nature of the zones belonging to a region.”

More recently, LeSage and Pace (2008) point to the implausible nature of the assumption that origin and destination (OD) flows in the classical gravity model contained in the dependent variable vector X_{ij} exhibit no spatial dependence. They note that the gravity model makes an attempt at modeling spatial dependence between observations using the distance vector alone, but if each region exerts an influence on its neighbors this might be inadequate. For most part of socio-economic spatial interactions (migration, trade, commuting, etc.), there are several explanations for this effects. For example, neighboring origins and destinations may exhibit estimation errors of similar magnitude if underlying latent or unobserved forces are at work or missing covariates exert a similar impact on neighboring observations. That agents located at origins nearby in space may experience similar transport costs and profit opportunities when evaluating alternative destinations. This similar positive/negative influence among neighbors could also be explained in terms of common factor endowments or complementary/competitive sectoral structures. For example, if natural factor endowments are key variables explaining trade specialization, neighbor regions with similar factor endowments may be affected in a similar way by demand and supply shocks. Since a large number of factor endowments are conditioned by space (land, natural resources, climate, log-lat coordinates, common transport infrastructures...), it would be easy to find spatial autocorrelation in the sector specialization of production and trade of regions, when the spatial scale is fine enough.

Furthermore, as we have seen in previous sections, bilateral trade flows of service for the tourist sector could be also affected by at least 4 indirect effects. Based on this idea, our purpose for the next section is to offer a extended gravity model that accounts for spatial and network autocorrelation effects for the inter-regional trade flows of tourism.

3.2 Introducing spatial and network effects in the gravity model

The first specification defined by equation (7) corresponds to the most basic gravity model, where the size of the regions of origin is approached by the gross value added of the tourist sector in region i (gva_i), while the size of the destination region j is approached by the population (pop_j) and the income (inc_j). The model also includes the bilateral distance between i and j , and a dummy variable $border$ that takes value 1 when trade is intra-regional, and 0 otherwise.

$$X_{ij} = \alpha_N + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + border\beta_4 + \gamma d_{ij} + \varepsilon \quad (7)$$

The second specification defined by equation (8) introduces some refinements regarding the treatment of intra and inter-regional flows. Following LeSage and Pace (2008) we create a separate model for intra-regional flows from the main diagonal of the flow matrix. This can be accomplished by setting all regressors corresponding to the intra-regional flows to zero. This prevents the large magnitudes associated with these observations from entering the inter-regional flow model by forcing the non-zero observations in the explanatory variable matrices gva_i, pop_j, inc_j to explain variation in the interregional flows.

The separate intra-regional model is constructed using an additional matrix of explanatory variables that we label X_I . Only observations associated with the intra-regional flows from the vector X_{ii} contain non-zero values in the matrix X_I . Use of the separate model for intra-regional commodity flows should down-weight the impact of the large values on the main diagonal of the flow matrix, preventing them from exerting undue impact on the resulting estimates for β_1 , β_2 and β_3 . We interpret these parameters as reflecting the relationship of characteristics of the origin and destination regions on variation in flows, whereas the estimates for β_I represent the relationship between regional characteristics and intra-regional flows.

One point to note is that there are only n non-zero observations in the matrix X_I , which might limit the number of explanatory variables that can be used for samples involving a small number of regions n . Plausible variables that should explain the magnitude of intra-regional flows would be the population (pop_I) and the income (inc_I) of the region. Therefore, we expect that the richer and more populated a region is, the bigger the daily expenditure in the tourist sector (restoration mainly) should be.

Note that since inter-regional and intra-regional trade flows are now modeled separately, the

border dummy is meaningless and drops out from the equation. Note also that ‘distance’ (d_{ij}) affects both intra and inter-regional flows.

$$X_{ij} = \alpha\iota_N + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + X_I\beta_I + \gamma d_{ij} + \varepsilon \quad (8)$$

Next, we want to introduce progressively new variables that capture each of the 6 effects that immigration could induce in the tourist flows. First, we will start with the 2 direct effects and then with the 4 indirect ones.

Regarding the direct effects, equation (9) include the ‘DHLA’ effect by means of the variable m_{ij} that capture the stock of immigrants from region i that are living in region j .

$$X_{ij} = \alpha\iota_N + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + m_{ij}\beta_4 + X_I\beta_I + \gamma d_{ij} + \varepsilon \quad (9)$$

In a similar fashion, equation (10) include the ‘DHCA’ effect by means of the variable m_{ji} , that capture the stock of immigrants from region j that are living in region i . Next, both direct migration effects are mixed in equation (11).

$$X_{ij} = \alpha\iota_N + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + m_{ji}\beta_4 + X_I\beta_I + \gamma d_{ij} + \varepsilon \quad (10)$$

$$X_{ij} = \alpha\iota_N + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + m_{ij}\beta_4 + m_{ji}\beta_5 + X_I\beta_I + \gamma d_{ij} + \varepsilon \quad (11)$$

Next specifications cover all possible specifications that combine the three previous direct effects with the 4 indirect effects packed in two alternative weight matrices. For simplicity, we will focus on three alternative specifications for the indirect effects, that could be combined with each of the three previous models capturing the direct effects.

Thus, equation (12) extends the gravity model to a spatial lag model that control for the ‘spatial autocorrelation effects’ that capture the aggregation of the ‘HLNA’ and the ‘HCNA’ effects.

$$X_{ij} = \alpha\iota_N + \rho_1 W^{spa} X_{ij} + gva_i\beta_1 + pop_j\beta_2 + inc_j\beta_3 + X_I\beta_I + \gamma d_{ij} + \varepsilon \quad (12)$$

In this specification, the spatial weighted matrix W^{spa} corresponds to a row-standardized

next neighbor matrix. In a typical cross-sectional model with n regions where each region represents an observation, spatial regression models rely on an n by n non-negative weight matrix that describes the connectivity structure between the n regions. For example, $W_{ij} > 0$ if region i is contiguous to region j . Besides contiguity, various measures of proximity such as cardinal or ordinal distance have been used to specify non-zero elements of the matrix W . By convention, $W_{ii} = 0$ to prevent an observation from being defined as a neighbor to itself, and the matrix W is typically standardized to have row sums of unity.

In the case of OD flows, where we are working with $N = n^2$ observations, a key issue is how to construct a meaningful spatial weight matrix that describes connectivity between regions treated as origins and destinations. LeSage and Pace (2008) provide a solution by noting that $W_d = I_n \otimes W$, represents an N by N row-standardized spatial weight matrix that captures connectivity between regions viewed as destinations, and $W_o = W \otimes I_n$ produces another N by N row-standardized spatial weight matrix that captures connectivity between origin regions.¹⁰ For our model of commodity flows we rely on the matrix $W^{spa} = W_d^{spa} + W_o^{spa}$, to form a *spatial lag* of the dependent variable.

This additional explanatory variable captures both ‘destination’ and ‘origin’ based spatial dependence relations using an average of flows from neighbors to each origin and destination region, that is the aggregation of the ‘HLNA’ and the ‘HCNA’ effects. Intuitively, forces leading to flows from any origin to a particular destination region may create similar flows from neighbors to this origin to the same destination, a situation labeled origin-based dependence by LeSage and Pace (2008). This formally captures the point of (Griffith and Jones, 1980) that flows from an origin are ‘enhanced or diminished in accordance with the propensity of emissiveness of its neighboring origin locations’. The spatial lag vector $W^{spa}X$ also captures destination-based dependence reflecting the intuition that forces leading to tourism flows from a particular origin region to a destination region may create similar flows to nearby or neighboring destinations. This is the notion of Griffith and Jones (1980) that flows associated with a destination are ‘enhanced or diminished in accordance with the propensity of attractiveness of its neighboring destination locations’.

Following this idea, equation (13) assumes a similar format than the previous but using an alternative weight matrix W^{net} , which capture the network autocorrelation effects, where the

¹⁰We use the symbol \otimes to denote a kronecker product.

‘HLSNA’ indirect effects are included. Like in the previous case, the W^{net} is a row-standardized weight matrix obtained by the aggregation of two weight matrix capturing the ‘social neighbors’ of the origin i and of the destination region j ($W^{net} = W_d^{net} + W_o^{net}$). Note that for the case of ‘network autocorrelation’ the ‘tastes and information’ could flow in two different directions. Consequently, in the same way than for the direct network effects two vectors m_{ij} , m_{ji} where defined, also a rotated network weight matrix could also be defined as $W'^{net} = W_d'^{net} + W_o'^{net}$, for capturing the and ‘HCSNA’ indirect effects are included. In both cases, for W^{net} and W'^{net} , equation (13) could be used.

$$X_{ij} = \alpha \iota_N + \rho_2 W^{net} X_{ij} + gva_i \beta_1 + pop_j \beta_2 + inc_j \beta_3 + X_I \beta_I + \gamma d_{ij} + \varepsilon \quad (13)$$

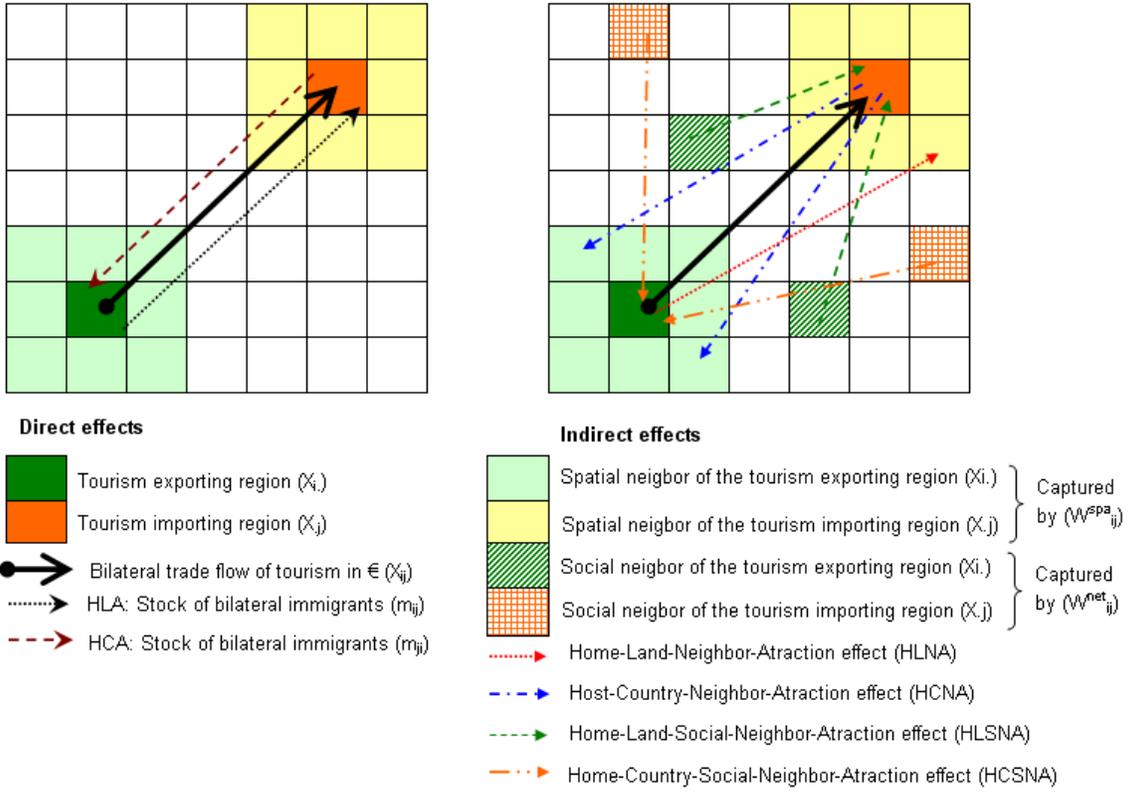
Finally, equation ((14)) measures simultaneously the presence of spatial and network autocorrelation effects for origins and destinations, combining a W^{spa} and a W^{net} matrices together with the rest of the variables. Following LeSage and Fischer (2008) and Autant-Bernard and LeSage (2008), when two different weight matrices are combined in the same Spatial Autocorrelation (SAR) model it is convenient to modify the matrices so that both sum up the unity along the rows. With this purpose, both matrices are multiply by 1/2.

$$X_{ij}^i = \alpha \iota_N + \rho_1 W^{spa} y_{ij} + \rho_2 W^{net} y_{ij} + gva_i \beta_1 + pop_j \beta_2 + inc_j \beta_3 + X_I \beta_I + \gamma d_{ij} + \varepsilon \quad (14)$$

We note that any of the spatial lag models subsume the non-spatial model as a special case when the scalar parameter ρ takes on a value of zero. This allows us to test for the presence of significant spatial and network dependence in the bilateral trade flows. If there is spatial or network dependence, it has been shown that least-squares estimates are biased and inconsistent, which suggests that ignoring such sources of dependence should result in less accurate forecasts.

In order to facilitate the interpretation of the theoretical and the empirical model, the direct and indirect effects as well as the variables capturing them are summarized in the Figure 1.

Figure 1: Scheme summarizing the spatial and network effects on tourism trade



4 An application to the Spanish internal trade of the Tourist sector

4.1 The Data

On the outset, like in most of the countries, there is no official data on the inter-regional trade flows of the Tourist sector in Spain. Our application take advantage of a recent estimate of the intra and inter-regional trade of tourism between the Spanish regions done for the year 2001 (Llano and de la Mata, 2009a, 2009b) in the context of a larger research project (www.c-intereg.es). Schematically, the methodology used can be summarized in three steps: 1) The estimation of the output of the Tourist sector in each region that would be consumed by Spanish citizens, that's to say, that wont be exported internationally; 2) The estimation, for each region, of the share of this national absorbtion that would be consumed within the region (intra-regional trade) and the aggregate that would be consumed by Spanish citizens living in other regions (total inter-regional trade); 3) Then, the aggregate inter-regional trade for each region would be split in bilateral flows. This last step is based on the existing information regarding daily expenses of travelers in the destination region (Familitur and Egatur surveys from the Spanish Institute of Tourist Studies www.iet.es; Familitur (2001) and Egatur (2004)) and different origin and destination matrices (Familitur and Movilia surveys; Ministerio de Fomento (2001); Familitur (2001)) that captures all the overnight displacements of the Spanish residents, depending on the type of their dwelling option in destination. To this regard, the estimation was able to use different daily expenses for hotels, apartments and own second residence, covering all possible motives (leisure, work, culture, study,...). Conversely, the definition of the output and consumption of the Tourist sector considered is restricted to the following three activities: hotels, apartments, restaurants, bars and travel agencies. Therefore, our data does not include expenses related to transportation, shopping or any other good or service bought during their stay. This fact avoids problems of endogeneity between the inter-regional trade flows of the Tourist services and the transport cost linked to the bilateral distance. In summary, the estimates used the most accurate statistical sources available in Spain, obtaining figures that are constrained by the regional and national output of the sector (National Institute of Statistics), the Balance of Payment (Bank of Spain) and the widest sample of surveys on people movements within the

country available in the country (Familitur, 2001; Ministerio de Fomento, 2001).

Regarding the rest of the variables, we use the gross value added of the Tourist sector, the population and the income level obtained from the Spanish Regional Accounts (Spanish National Institute of Statistics). Similarly, the inter-regional migration matrices are obtained based on the 2001 Census (Spanish National Institute of Statistics), which offer information on the stock of people living in a region that was born in the others. The direct effects captured by the m_{ij} and the m_{ji} terms enter as two independent column vectors. The spatial weight matrices are built taking into account the first order contiguity relation, that is, considering as contiguous any region that shares a border with another. The social weight matrices are built using the row standardized OD matrix of immigrants born in one region who are living in another ¹¹.

Finally, the distance used in this paper is obtained from the Movilia survey 2001 (Ministerio de Fomento, 2001), which offer the average distance traveled by the Spanish residents in their displacements, both within their regions and to other regions. One of the most interesting features of this measure is that it include not just inter-regional distance but also the intra-regional one. To this regards, we are able to scape from the theoretical hypothesis assumed in most of the papers in the field (McCallum, 1995; Combes et al., 2005; Behrens et al., 2007), where the internal distance is obtained by different a priori conventions that truly make an influence in the results (Head and Mayer, 2002). Moreover, the distance used in this paper is an average of the real distance traveled by each of the more than 500 million displacements estimated by the Movilia survey in 2001. We want to emphasize that this displacements cover all motives, so that the distance reported by each of them is not constrained by the distance between capitals, which could be predominant for work trips, but also, the distance between tourist spots (beaches, mountains and countryside) located in the periphery.

In order to help the interpretation of the internal tourist flows used in this paper, Figure 2 shows the most intense inter-regional monetary flows accounted in 2001, together with the distribution of the Spanish population and the location coefficient for the Tourist sector ($LC_{Region_i} = \frac{Regional_Tourist_GVA/National_Tourist_GVA}{Regional_GDP/National_GDP}$). For a right interpretation, grey arrows with origin in the coast regions (Andalusia) and destination in a inner region (Madrid) capture

¹¹Alternative specifications of the W^{net} matrix have also been defined, both, as percentage of the destination region population, or transformed into a dichotomic matrix when this percentage overpass a threshold (i.e. 5% of the population in the destination region). Finally, since our trade flows are measured in levels (not in percentage) we choose the current specification. This option shows stronger results and avoids subjective decisions regarding the threshold level for the dichotomic matrix.

Table 1: Description and source of the X variables

Variable	Description	Source
Income	Income by regions NUTS2 in 2001.	INE
Population	Population by regions NUTS2 in 2001.	INE
GVA	Gross Value Added of Tourism sector. 2001.	INE
OD migration matrix	Spanish Census. 2001.	INE
Distance	Average distance in Km between regions. 2001.	Movilia

an export (in current euros) of the tourist sector from Andalusia to Madrid, caused by a large number of people from Madrid traveling to Andalusia. In sum, it is easy to see that the main exporting regions remain along the coast and the main importers are the most populated and rich regions. Note also that many important inter-regional flows connect distant regions that in some cases keeps important social networks through the history of bilateral immigration between them (i.e. Andalusia to Catalonia).

4.2 Estimation results

In the next section we analyze the main results obtained for 21 alternative specifications. For the shake of robustness the models are estimated using different classical and Bayesian econometric procedures: classical Ordinary Least squares (OLS), Bayesian heteroscedastic model (BH) and Bayesian spatial autoregressive model (BSAR). For the case of equations (12) and (13), we use a spatial autoregressive model to accommodate spatial and network dependence in Tourism flows. For equation (14), we estimate a spatial autoregressive Bayesian model based on LeSage and Fischer (2008) and Autant-Bernard and LeSage (2008). The specifications have been estimated for 17 Spanish regions, that is the 18 NUTS 2 with the exception of Ceuta and Melilla. Consequently, vector X_{ij} and all the explanatory variables have 289 observations (17×17), with 17 intra-regional flows and 272 inter-regional ones. All the variables were used in \log form and were referred to 2001.

In Table 2 we show the main results obtaining with the OLS estimates using different specifications. In the first column, $T1$ shows the estimation for the simplest gravity model. The goal is to measure the aggregate level of bilateral Tourist flows in current Euros X_{ij} with Gva_i , Pop_j , Inc_j and the distance d_{ij} . The results shows that these 4 variables alone are able to explain the 36% of the flows. All the variables are highly significative, and their coefficients

Figure 2: Main flows (Euros) of the Spanish Tourist Sector in 2001 (Llano and De la Mata, 2009b).

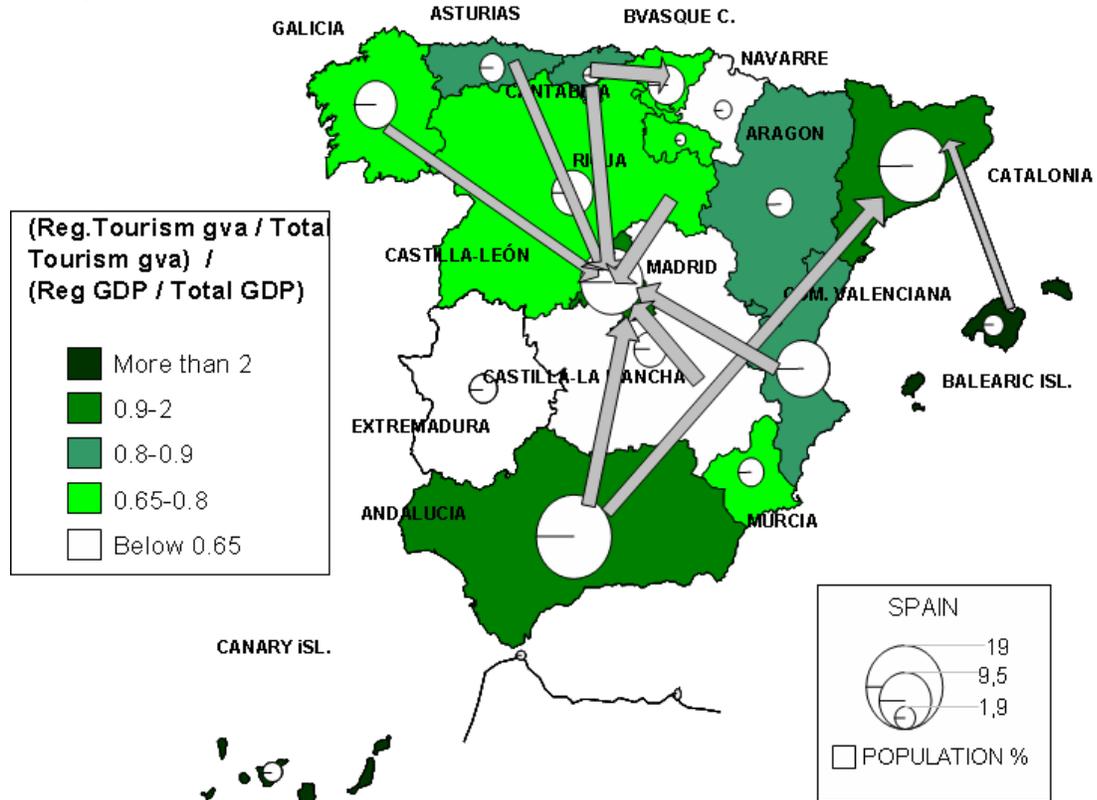


Table 2: Ordinary Least Squares

	T1	T2	T3	T4	T5	T6
R-squared	0.375	0.598	0.604	0.657	0.699	0.705
Rbar-squared	0.366	0.591	0.596	0.649	0.692	0.697
σ^2	3.649	2.353	2.328	2.023	1.774	1.745
Durbin-Watson	1.518	1.494	1.522	1.491	1.496	1.520
Variable	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
pvalue						
Constant	-37.23	-39.37	-40.40	-27.59	-40.02	-35.01
	0.00	0.00	0.00	0.00	0.00	0.00
Gva_i	1.06	0.93	0.97	0.74	0.32	0.33
	0.00	0.00	0.00	0.00	0.00	0.00
Pop_j	0.98	0.92	0.96	0.47	0.37	0.27
	0.00	0.00	0.00	0.00	0.00	0.02
Inc_j	2.14	2.32	2.30	1.50	3.31	2.83
	0.00	0.00	0.00	0.00	0.00	0.00
m_{ij}				0.46		0.18
				0.00		0.01
m_{ji}					0.70	0.59
					0.00	0.00
d_{ij}	-0.56	-0.06	-0.07	0.08	0.25	0.26
	0.00	0.48	0.41	0.37	0.00	0.00
Border		5.31				
		0.00				
Pop_I			1.27	1.11	1.18	1.14
			0.00	0.00	0.00	0.00
Inc_I			3.91	2.71	3.86	3.39
			0.00	0.00	0.00	0.00

show the expected signs: positive values with the economic size of origins and destinations for this specific sector, and negative values with the distance between them. The income elasticity of the tourism flows is greater than 1, which -accordingly to the specialized literature in the sector- confirm that Tourism is a ‘luxury good’. In sum, it could be said that in general, intra and inter-regional tourism flows could be reasonably be explained by a basic gravity equation. However, in brief we will show that intra and inter-regional flows are different in nature, and the importance of distance could be eroded when including some of the effects described above.

Being aware of the importance of intra-regional flows, $T2$ includes the border effect dummy. If we compared the coefficient obtained (5.31) with the one obtained by Combes et al (2005) for inter-regional commodity flows before considering networks (2.0, in the most similar specification), we can assert that trade of the Tourist sector as a whole is affected by an strong border effect. Considering other reference for the case of industry specific inter-regional trade flows for Spain (Llano and Requena, 2008; Ghemawhat et al, 2009) this strong border effect for tourist trade is in line with others obtained by sectors like ‘Non-metallic minerals’ or ‘Food and beverages’. As it has been explained (Llano and De la Mata, 2009b), the strong border effect for the tourist sector seems to be induced by the importance of restaurants within the Tourist sector (more than the 50% of the output), and its tendency toward intra-regional trade (at the end of the year, people expend locally a larger share of income in restaurants and bars than what they expend in other regions in hotels, tour agencies and restaurants). Another interesting consequence of introducing the border dummy is that the distance variable become non significant. This result announce the importance of splitting between short and long distance trips (i.e. short distance trips to ‘second residences’ in the surrounding regions during the weekends versus long distant trips to the coast on vacations).

In order to control for the different nature of the intra-regional flows, all the next specifications will deal separately with intra and inter-regional flows. At this point, it is important to highlight that the distance variable will be non significant or positive. Apart, we want to make notice that the two variables explaining the intra-regional flows are very significant and to comment that the results for the rest of the variables are very similar to the ones obtained for $T2$. This means that including the border dummy or controlling for the intra regional flows have a similar impact. Maybe for this reason, the coefficient obtained for the border 5.31 would be approximately the sum of the coefficients of the X_I variables explaining the intra-regional

flows along in the next specifications.

Moreover, $T5$, $T6$ and $T7$ include alternately the two direct effects ('DHLA' and 'DHCA'), finding that the intensity of tourist flows for the inter-regional trade flows have a positive relation with the bilateral immigration stocks. Like in Combes et al, 2005, this result is a sign of the presence of 'taste and information effects' affecting the flows in both directions. What is also interesting in the last two specifications is that distance (d_{ij}) registers a positive and significative value when such direct effects are controlled for. This result empower our first intuition about the heterogenous impact of distance in the tourist sector. With this results, a person from an specific region that is not visiting a relative or his home-land, could tend to choose distant destinations (in the context of a small country like Spain) able to offer a more heterogeneous 'characteristic' to the ones offered by its regions of origin or their surrounding regions. In a nutshell, when trips are not conditioned by social networks, tourist want 'something as different as possible' to what they have 'at home'. This example is very clear when considering the tendency of people living in rich-populated-inner regions like Madrid to travel to the coast on vacations. Apart from the high significative levels found for all the variables, the control of within-region flows and the inclusion of the direct network effects leads to higher R^2 than previous specifications (the model now is able to explain the 69% of the flows).

Next 4 models are included for comparing the results obtained with OLS and Bayesian Heteroscedastic Linear Model using similar specifications. The similar results obtained suggest that they are robust to the estimation method used.

The following models introduce autoregressive elements to control for the spatial and social network autocorrelation effects. In Table 3 we show the results obtained when the W matrices are introduced, one for capturing the spatial association of origins and destinations with their contiguous regions (W^{spa}) and another for the network association affecting also origins and destinations (W^{net}).

In $T11$ we have a similar model to $T7$, but introducing spatial autoregressive effects in terms of 'HCNA' effect. We obtain similar but slightly lower value for coefficients for most part of the variables, and negative but not-significative coefficients for distance d_{ij} . In $T12$ the 'DHLA' effect (m_{ij}), is included as a vector in the same way than in $T4$ and $T8$, but now also the indirect spatial effects are included. In this case, we obtain a positive and non-significative coefficients for distance, like in $T4$ when OLS was used. The rest of the coefficients are similar to the results

Table 3: Bayesian Heteroscedastic Linear Model Gibbs

	T7	T8	T9	T10
R-squared	0.569	0.629	0.627	0.681
Rbar-squared	0.560	0.620	0.664	0.672
σ^2	0.698	0.611	0.496	0.484
Variable	Coef.	Coef.	Coef.	Coef.
pvalue				
Constant	-29.62	-23.40	-31.51	-28.61
	0.00	0.00	0.00	0.00
Gva_i	0.81	0.65	0.25	0.26
	0.00	0.00	0.00	0.00
Pop_j	0.95	0.60	0.50	0.42
	0.00	0.00	0.00	0.00
Inc_j	1.62	1.27	2.56	2.28
	0.00	0.00	0.00	0.00
m_{ij}		0.31		0.12
		0.00		0.00
m_{ji}			0.54	0.47
			0.00	0.00
d_{ij}	-0.34	-0.08	0.13	0.16
	0.00	0.14	0.05	0.01
Pop_I	1.24	1.12	1.13	1.09
	0.00	0.00	0.00	0.00
Inc_I	2.92	2.32	3.08	2.81
	0.00	0.00	0.00	0.00

in $T4$, and $\rho1$ is significant and positive. Then, the $T13$ specification is similar to $T9$, since it include the ‘DHCA’ effect (m_{ji}) and the indirect spatial effects. The results are similar than those obtain for $T9$, obtaining a positive and significative coefficient for the distance and the $\rho1$. Then, in $T14$ the two direct effects are included simultaneously (like in $T10$), but now they are mixed with the spatial autocorrelation effects. The results are significative for all variables, including the two direct and the indirect effects, as well as the distance, which -like in the $T6$ and $T10$ - register a positive coefficient. Another interesting result arise when analyzing the impact of the indirect spatial effects on the direct network effects: in all the cases considered, when we control for the multilateral resistance regarding the contiguous regions to the origins and destinations, the coefficients of the direct network effects (m_{ij} and m_{ji}) decrease. This effect could be interpreted in the line of our previous comments regarding the natural tendency to find stronger network effects with the spatial neighbors, since before tourism flows, immigration was previously affected by gravity.

The two last specifications $T15$ and $T16$ in Table 3 show the results when network autocorrelation effects are considered alone, without the direct effects and the spatial autocorrelation effects. In the case of $T15$, the network weight matrix is included $W^{net} = W_d^{net} + W_o^{net}$, capturing the autocorrelation effects flowing in the same direction than the DHLA effect (m_{ij}). Conversely, in $T15$ we include the rotated matrix $W'^{net} = W_d'^{net} + W_o'^{net}$, what capture the indirect network effects flowing in the opposite direction (m_{ji})¹². The results obtained for both specifications confirms that both types of effects are positive and significative, without affecting the coefficients and signs for the rest of the variables. The only remarkable result is that for $T15$ and $T16$, distance become negative and significant in contrast to $T11$, which did not include the ‘indirect network effects’ but the ‘indirect spatial effects’.

As a final check, Table 5 shows the results obtained for 5 final Bayesian specifications that, following LeSage and Fischer (2008) and Autant-Bernard and LeSage (2008), are able to simultaneously incorporate the spatial and network autocorrelation effects when each direct effect are included one by one. In the first 4 specifications, the network autocorrelation effects are included as W^{net} , while in $T21$ the matrix is included in its rotated version (W'^{net}). With these new specifications, the results for most of the variables are significative, obtaining the expected signs.

¹²Note that the spatial weight matrix does not need for this dual definition: two spatial contiguous regions are always contiguous. However, when considering ‘social neighbor’, the taste and information effects could interact in the two directions.

Table 4: Bayesian Spatial Autoregressive Heteroscedastic Model

	T11	T12	T13	T14	T15	T16
R-squared	0.590	0.632	0.674	0.680	0.578	0.600
Rbar-squared	0.582	0.623	0.666	0.671	0.569	0.592
sige-epe/(n-k)	2.409	2.172	1.922	1.894	2.483	2.351
Variable	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
pvalue						
Constant	-29.73	-24.42	-31.18	-28.21	-29.83	-29.81
	0.00	0.00	0.00	0.00	0.00	0.00
Gva_i	0.68	0.58	0.27	0.29	0.65	0.57
	0.00	0.00	0.00	0.00	0.00	0.00
Pop_j	0.81	0.56	0.49	0.42	0.79	0.70
	0.00	0.00	0.00	0.00	0.00	0.00
Inc_j	1.57	1.27	2.38	2.09	1.75	1.82
	0.00	0.00	0.00	0.00	0.00	0.00
m_{ij}		0.25		0.12		
		0.00		0.00		
m_{ji}			0.46	0.39		
			0.00	0.00		
d_{ij}	-0.09	0.04	0.18	0.21	-0.26	-0.18
	0.11	0.27	0.01	0.00	0.00	0.00
Pop_I	0.95	0.92	0.99	0.96	0.92	0.84
	0.00	0.00	0.00	0.00	0.00	0.00
Inc_I	2.93	2.42	3.07	2.80	3.03	2.99
	0.00	0.00	0.00	0.00	0.00	0.00
ρ_1	0.32	0.25	0.15	0.15		
	0.00	0.00	0.00	0.00		
ρ_2					0.34	0.45
					0.00	0.00

Table 5: Spatial Autoregressive Model

	T17	T18	T19	T20	T21
Rsquared	0.616	0.618	0.629	0.629	0.740
Rbarsquared	0.608	0.608	0.619	0.618	0.732
σ^2	2.201	2.192	2.130	2.128	1.493
loglikelihood	-971.255	-970.808	-966.892	-966.758	-876.374
Variable	Coef.	Coef.	Coef.	Coef.	Coef.
pvalue					
Constant	-37.33	-35.28	-37.52	-38.72	-33.74
	0.00	0.00	0.00	0.00	0.00
Gva_i	0.20	0.16	-0.01	-0.02	0.30
	0.02	0.07	0.86	0.84	0.00
Pop_j	0.35	0.27	0.15	0.18	0.26
	0.00	0.03	0.18	0.15	0.01
Inc_j	2.53	2.41	2.92	3.04	2.54
	0.00	0.00	0.00	0.00	0.00
m_{ij}		0.08		-0.04	0.15
		0.25		0.60	0.03
m_{ji}			0.24	0.27	0.40
			0.00	0.00	0.00
d_{ij}	0.10	0.11	0.19	0.19	0.27
	0.26	0.21	0.03	0.04	0.00
Pop_I	-0.14	-0.14	-0.13	-0.12	0.73
	0.70	0.69	0.70	0.73	0.01
Inc_I	4.15	3.94	4.14	4.25	3.44
	0.00	0.00	0.00	0.00	0.00
ρ_1	0.13	0.11	0.11	0.11	0.08
	0.00	0.00	0.00	0.00	0.00
ρ_2	0.62	0.63	0.63	0.63	0.13
	0.00	0.00	0.00	0.00	0.00

For the case of $T17$, $T18$, $T19$ and $T20$ some strange results are obtained for the intra-regional variable Pop_I , which become negative and non significant for all cases. Surprisingly, in $T19$ and $T20$ the variable Gva_i become also negative and non-significative. These strange results seems to indicate some kind of interference between the variables when both weight matrices are included in these two specifications, which requires further research. Conversely, the results obtained for $T20$ are the best ones of the 21 specifications, since the overall level of explanation reach the 73% and all the variables show high levels of significance and the correct signs. Like in previous specifications, for the case of $T19$, $T20$ and $T21$, the coefficient for distance is positive and significant, which clearly confirm one of our most novel hypothesis regarding the heterogeneous effect of distance in the inter-regional flows of the tourist sector.

5 Conclusions

In this paper we study the relation between inter-regional trade flows of services the distance and the social networks produced by the stock of inter-regional migration in each region. From the theoretical viewpoint, we embed the inter-regional trade flows on the well known Dixit-Stiglitz-Krugman framework, including the role of social networks throughout the transaction costs. Then we develop a gravity model with spatial and network autocorrelation effects that allows for a parsimonious consideration of the different kinds of direct and indirect effects by means of two alternative weight matrices. The application focus on the internal flows of the Tourist sector in Spain, taking advantage of a recent estimate of the intra and inter-regional monetary tourist flows between 17 Spanish regions for the year 2001 (Llano and de la Mata, 2008a, 2008b).

According to the results obtained, the intensity of the flows depends positively on the gross value added of the Tourist sector in the exporting region, the population and income levels in the importing regions and the destination between them. First, our results accounts for a strong ‘border effect’ and a low negative elasticity between distance and trade services in the tourism sector. Then, our results confirms the positive relation between the intensity of trade and the social networks through 2 direct and 4 indirect effects considered. Additionally, when the strong intra-regional trade are controlled, and the network effects are introduced one by one, the negative effect of distance disappear and become positive and significative. This result is interpreted as a sign of a systematic preference towards consuming intra-regional services, services offered by contiguous regions and services from regions with strong linkages in terms of internal migration in both directions. Furthermore, the spatial econometric techniques used allow to verify the multilateral resistance of every flows as regards to the flows connecting the trading regions with their neighbors, considering that ‘neighborhood’ could be defined in terms of spatial contiguity and common migration composition.

Based on this novel results, we expect to offer further results extending the database for a longer period, which may allow for the use of panel data techniques. We would also want to extend the analysis for other inter-regional and inter-national flows for goods and service, considering larger countries, lower spatial scales (Nuts 3 instead of Nuts 2) and alternative source of spatial and network effects like those generated by business or transportation linkages.

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