Spatial pattern and domestic tourism: An econometric analysis using inter-regional monetary flows by type of journey[1]

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Abstract

In this article, we develop an econometric analysis of the intra- and interregional trade flows of the accommodation, restaurant industry, and travel- agency sectors in Spain by means of several specifications of the gravity model and three alternative databases containing the monetary flows for 2001 and 2007. The results obtained show the existence of an important border effect in favor of the intraregional trade of tourism, and verify a minor elasticity of the trade flows in some tourism characteristic tourism sectors in relation to distance. Finally, the two main typologies of flows— – tourist establishments and second homes— – are modeled separately, identifying specific factors for explaining each category.

Key words: Interregional trade, Domestic tourism, Gravity models, border effect, Spain.

JEL Classification:

C21 – Cross-Country Running Sectional Models; Spatial Models; Treatment Effect Models; Quantile Regressions
R12 – Size and Spatial Distributions of Regional Economic Activity; Interregional Trade
L8 – Industry Studies: Services
L83 – Sports; Gambling; Recreation; Tourism

[1] **Acknowledgements:** This paper is developed in the context of two research projects: the C-intereg Project (www.c-intereg.es), funded by 10 Spanish regional governments, and the TransporTrade Program S2007/HUM/497, funded by the Education Department from the Comunidad Autónoma de Madrid www.uam.es/transportrade. We also want to thank the financial support received from the Spanish Ministry of Science and Innovation (ECO2010-21643).

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1 Introduction

The gravity equation has been extensively used for modeling all kinds of interactions in spaces that can potentially be explained by attraction and repulsion forces. There are multiple applications in the research areas of trade, transportation, and immigration (Sen and Smith, 1995; Roy and Thill, 2004). The gravity model has also been used in the field of tourism with the aim of analyzing the causes that determine the intensity and direction of flows (Long, 1970; Gordon and Edwards, 1973; Malamud, 1973; Durden and Silberman, 1975; Witt and Witt, 1995; Imm Ng et al., 2007; Khadaroo and Seetanah, 2008).

In their comprehensive review, Witt and Witt (1995) discussed the main methods used to forecast tourist demand, with a particular emphasis on empirical comparisons of the accuracy of tourism forecasts generated by different techniques. Among these, they examine the most appropriate explanatory variables and discuss the use of a gravity-model approach for modeling tourist flows. Following Wilson (1967), they suggest that the simplest gravity model can only be valid when a homogeneous purpose category is considered; if this is not the case, a different treatment or model with explanatory variables that control the heterogeneity of the flows should be used. In this respect, Imm Ng et al. (2007) examine, by means of a gravity model, the influence of cultural distance on tourists' destination choices. They noted that, although culture influences people's decision-making processes, cultural differences have been largely ignored as a potential predictor of tourists' destination choice. Thus, they investigated five cultural-distance measures to examine their consistency and observe which ones were most strongly related to people's destination intentions. In the same line, the gravity model is used by Khadaroo and Seetanah (2008) to analyze the importance of transportation infrastructure in determining the tourism attractiveness of destinations. Khadaroo and Seetanah found that transportation infrastructure is a significant determinant of tourism inflows into a destination, although the sensitiveness of tourism flows to transportation infrastructure can vary by origin and destination.

All these studies concentrated primarily on the analysis of international travel, paying little attention to domestic travel. In most of them, the dependent variable was the displacement of tourists instead of monetary flows. It is very difficult indeed to find any study that analyzes domestic interregional monetary flows generated by the tourist sector and also takes also into account intraregional trade flows.

In the case of Spain, a smaller number of authors have estimated and analyzed the domestic tourist trade (Tall Jimenez, 1976; Ravine, 2002; Millán Escriche, 2004). This number, however, further decreases, dramatically, when we look for multi-regional studies adopting a bilateral approach (Usach Domingo, 1998; Cañada, 2002). As with the international sphere, most of these studies focus their analysis on travel rather than monetary flows. In fact, if we want to find any information about the economic flows induced by the tourist sector at a regional level, we have to direct our attention to studies employing Regional Input/Output Tables and to occasional attempts to estimate the Regional Balances of Payments (Parellada, 1997, Mella and Sanz, 2001, 2003). Most of these works, once again, do not take into account the tourist trade taking place inside each region.

In our view, without neglecting the relevance of analysis of travel decisions and movements of tourists, it is essential to emphasize the importance of monetary flows, both at the international and interregional levels.[1] First, we want to stress the idea that, in many countries and definitely in Spain, a major concern of policy makers is not just the number of visitors and the length of their stays, but also the amount and type of their spending. The socioeconomic breakdown of the visitors and the types of establishment at which they stay may severely alter the effective economic impact of tourism, both in the origin and destination country or region. For example, in Spain, there is an open debate about the impact on tourist expenses of an observed trend of substituting stays in hotels with stays in co-ownership apartments and second homes. Without looking at the controversial aspects of this trend, a better understanding of this factor might be useful, considering that tourism accounts for a large share of the service sector. The majority of the literature on international and interregional trade of goods focuses on monetary flows rather than freight movement in tons. The importance of this perspective is connected with the well-known link between trade balance (in monetary units, namely euros [€]) and the level of national net saving in an economy. By contrast, most of the analysis connected to the tourist sector tends to consider the movement of tourists rather than that of the monetary flows generated by them. Therefore, the chance to infer the macroeconomic consequences of the trips is missed.

[1] In line with our claim, during the First International Conference on the Measurement and Economic Analysis of Regional Tourism organized by the World Tourism Organization (WTO) and the Spanish Institute of Tourism in 2009 (http://www.sansebastianconference.com/en/), several experts from different OCDE countries highlighted the importance of estimating origin-destination matrix of domestic tourism in monetary units using alternative sources such as household surveys, mobility surveys, ad-hoc surveys to tourist establishments, traffic flows, etc.

Llano and De la Mata (2009) estimated the interregional monetary flows of the accommodation, restaurant and travel-agency sectors in Spain adopting a multiregional and bilateral perspective. Although tourism is an activity that directly or indirectly affects the whole economy, tourist demand in the three sectors looked at by the authors is approximately 71% of the internal consumption in tourism-characteristic products, according to the Satellite Tourism Account. In a subsequent work (De la Mata and Llano, 2010), the same authors carried out an initial analysis of this database by employing the gravity model to identify the main explicative factors for the intensity of total bilateral flows. Typology of tourist journeys was already singled out in this work as a potential area for further research. In the present article, we therefore investigate interregional flows according to two separate types of accommodation used by tourists: overnight stays at tourist establishments vs. stays at privately owned second homes.

Before describing the structure of the paper, it is necessary to make two important clarifications about its aim and scope.

First, we would like to stress some conceptual splits found in the current literature on trade of services and, more specifically, the tourist sector. On the one hand, services are considered to be non-traded goods by a large part of the literature on international trade. From this perspective, trade of services is considered to be intranational (or intraregional) without the possibility of finding international (or interregional) exports and imports. On the other hand, in several studies of tourism based on a balance-of payments-approach, the tourist trade takes place between "resident" and "nonresident" agents of the territorial unit under consideration (nation or region). In this approach, most of the activity related to tourism is considered to be either "exports" or "imports," leaving almost no room for the international (or intraregional) trade of tourism.

In contrast to these two extreme positions, our analysis follows an approach similar to the one used by the *Service Branch Surveys* published in most European countries (see Eurostat[2]), which itself follows the same approach as does common practice in the national (or regional) account system or input-output framework. In this paper, we are taking into consideration the activity of three sub-sectors ("Restaurant industry," "Accommodation," and "Travel Agencies") contained in the Spanish Annual Survey on Services (SASS) published by the INE (*Instituto Nacional de Estadística*; National Institute of Statistics) under the topic of tourism, according to Eurostat standards.

[2] http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&init=1&pcode=tin00057&language=en

Occasionally, we will refer to this as the *tourism sector* (in italics) to designate economic activity offered by the branch defined as the aggregation of "Restaurant industry," "Accommodation," and "Travel Agencies." This branch excludes any other expenditure related to transport, shopping, education, health, car rental, etc., which might be included in the extended concepts of "tourism," both in the context of balance of payments and in that of satellite tourist tables. In addition, the concept of "domestic trade in the tourist sector" in this article will designate every service belonging to the previously mentioned three areas that is consumed by Spanish residents, whether living in the same region (intraregional trade) or in any other Spanish region (interregional flow). Consequently, it is important to highlight that our concept of "domestic trade in the tourist sector" includes every service in the given categories demanded within each region, not necessarily only that hired by tourists.

The second clarification we would like to make is related to our methodological approach and the years covered by our databases. In this respect, the approach adopted in this paper aims to be a methodology that can also be implemented in other countries with similar statistics. Since the data on interregional displacement of people in many countries is collected from household and mobility surveys, we also want to analyze the extent to which the results are conditioned by the type of data used. For this reason, we developed two databases, together referred to as *2001*, which are based on two alternative surveys, one on tourist journeys (*Familitur 2001* [Spanish Institute for Tourist Studies, 2001]) and the other on mobility decisions (*Movilia 2001* [Spanish Ministry of Public Works, 2001]). Additionally, in order to offer a more recent point of reference that is not affected by the singularities of the year 2001 (the September 11 attack and the subsequent decline of tourism in most countries), we have also extended one of the databases to include the year 2007, using the recently published information from *Movilia 2007* (Spanish Ministry of Public Works, 2007).

The aim of the paper is fourfold. First, we are presenting a new database for the interregional trade of accommodation, restaurants, and travel agencies in Spain. Second, we estimated different gravity models for the total flows. Regarding this point, starting with the basic gravity equation, two different augmented models are described with the aim of dealing with the different nature of intra- and interregional trade flows. One of these augmented models allows for the estimation of the border effect, in the line of previous research in the field of interregional trade of goods. Third, we evaluate to what extent the results vary depending on the type of flow, marking the difference between overnight stays in touristic establishments and that in second homes. Through all these specifications, we were able to test the different elasticity of each kind of flow, in terms of the distance and pull-and-push factors driven by the gravity equation. Last, we tackle the spatial autocorrelation in the residuals, finding heterogeneous results for each type of flow.

The article is structured as follows. Section 2 briefly summarizes the methodology used for estimating the interregional flows of the restaurant, accommodation, and travel-agency sectors in Spain for 2001 and 2007. Then, in section 3, we present the gravity model as a convenient framework for analyzing bilateral monetary flows. This section includes a brief reference to some recent developments in the literature on spatial econometrics and spatial-interaction modeling. The results obtained are analyzed in Section 4 according to the different specifications of the gravity equation and the two typologies of tourist journeys under consideration. As a novelty, this section includes a specific section dealing with the presence of spatial autocorrelation effects affecting the gravity model. The paper concludes with some final remarks and suggestions for further research.

2 Estimating the intra- and interregional trade of some characteristic tourism sectors in Spain: Restaurants, accommodation, and travel agencies

The aim of this section is to describe the methodology for obtaining an Origin and Destination (OD) trade matrix for the “Restaurant industry,” “Accommodation,” and “Travel Agency” sectors as measured in current euros (€), where the intraregional flows are located in the main diagonal and the interregional flows in the off-diagonal. For the sake of clarity, we here offer only a brief description of the process (summarized in Figure 1 by a simple scheme), leaving all the details for a methodological appendix at the end of the paper. In addition, the appendix also contains a brief description of the two main official surveys on domestic tourism (*Familitur*) and mobility (*Movilia*) used in this article.

<<**Figure 1 about here**>>

As described in **Figure 1**, the methodology can be summarized in two steps: 1) estimating the amount of the sector’s production consumed by Spanish residents for each of the 17 Spanish regions; 2) determining for each region the share of this domestic trade accounted for by intra- and interregional trade, and the bilateral distribution of the latter.

Regarding the *first step*, the vector of regional production destined for domestic consumption can be obtained by combining existing information on regional net production (from SASS) and the international exports of the sector (corresponding to the Spanish balance of payments [SBP]).

Regarding the *second step*, it is necessary to develop an OD matrix of the expenditure made by residents of one region when travelling to other regions (independently of the motive of the journey, such as leisure, business, study, and culture) and linked to the three sectors considered in this study, restaurants, accommodation, and travel agencies. The estimate of this expenditure is obtained according to the following steps:

1) First of all, daily mean expenditure by residents of each region in these three activities is estimated using data from the 2001 *Familitur* survey (Institute for Tourism Studies, 2001);
2) Second, we investigate interregional journeys made by individuals that result in interregional expenditures in the tourist sector, using the two available alternative sources: the 2001 *Familitur* survey and the 2001 *Movilia* survey (Department of Public Works). For each of the two databases, we distinguish between overnight stays at "tourist establishments" (*TE*) and stays at "second homes" (*SH*). Both matrices are then added to a single matrix of total interregional expenditure of the tourist sector linked to the overnight stays.
3) Finally, intraregional expenditure (main diagonal of the origin-destination matrices) is obtained by subtracting total interregional monetary flows with an origin in each region from the vector of regional production of the three sectors considered in this study that are consumed by Spanish residents.

As a result, we obtain two alternative "bottom-up" estimates of intra- and interregional monetary flows in the tourist sector for 2001, making possible a separate analysis of the two typologies of interregional overnight stays: "flows related to overnights stays in tourist establishments" (*TEF*) and "flows linked with overnight stays in second homes" (*SHF*). Note that all the OD matrices obtained capture the direction of the trade flow of services rather than of the movement of people. As with balance of payments, direction of the journeys (people movement) is the opposite of trade flow of service (monetary flow). For instance, the expenditure generated by a German tourist in Spain represents an export of tourism from Spain to Germany. Similarly, a Spanish citizen living in

Madrid who travels to Valencia generates an interregional export from Valencia to Madrid. Our final OD trade matrices are, therefore, calculated in euros and register the exporting regions (considered to be the origins of the flows, which are the receptors of the people) in the rows and the importing regions (that is, the regions that receive the service and send the people) in the columns.

Consequently, for 2001 we obtain a pair of final matrices for intra- and interregional trade flows in euros for the Spanish *tourist sector* that is coherent with the main sources available in Spain: regional production for the sector as obtained from SASS, the international exports of the sector as obtained from the SBP, daily mean expenditure as derived from the *Familitur* survey, and the structure of interregional overnight stays as offered by the two main alternative sources available (*Familitur 2001* and *Movilia 2001*). In addition, for 2001 and for each dataset, we have four additional OD matrices with interregional monetary flows that are linked to overnight stays in tourist establishments and second homes.

Finally, departing from this detailed estimate of bilateral domestic monetary flows in Spain based on the two main surveys of overnight stays available for 2001, we also estimated a third alternative dataset based on *Movilia 2007*. In this case, the method used is exactly the same as that used for overnight stays in *Movilia 2001*. The estimation of unit costs by type of journey in 2007 was obtained by updating the detailed estimates for 2001 with the evolution of the corresponding rubrics (for hotels, restaurants, and coffee shops) from the Consumption Prices Index published by the Instituto Nacional de Estadística of Spain. By this procedure, we expect to introduce less noise in the prices than if we also had to estimate regional unit costs for 2007.

2.1 Descriptive analysis of the two alternative databases on interregional trade

Following Llano and de la Mata (2009), this section offers a brief comparative analysis of the results obtained from these alternative estimates. In our view, the main interest of this analysis lies in the possibility of comparing the flows obtained from the two most typical statistical sources of data about domestic displacements within the country, namely, household statistics on domestic tourism and mobility surveys. In addition, the comparison of flows in 2001 and 2007 offers a synthetic view of the persistence of spatial patterns over time.

Accordingly, **Table 1** contains the Pearson correlation coefficient of the two trade matrices of total flows for 2001.

<<Table 1 about here>>

<<Figures 2, 3, 4, 5, 6, and 7 about here>>

Figures 2, 3, 4, 5, 6, and 7 show the shape of the bilateral structure of the interregional flows arranged according to the ranking of the first estimate (based on *Familitur 2001*). It is interesting to note that, despite some differences, the shape of both estimates is relatively similar, a result coherent with the high coefficient obtained between equivalent flows.

Although the shape of the origin–destination flows obtained for both 2001 surveys is quite similar, it is important to note that the correlation “within the same category” (TEF–TEF or SHF–SHF) is larger than “between different categories” (TEF–SHF and vice versa). It appears, therefore, that each type of flow shows a similar behavior in both estimates and that the variables explaining the flows for each group could differ to some extent. Regarding the bilateral flows obtained for 2007, although the general structure is similar to the 2001 data, there are some differences. The most remarkable is the larger TE flows from Madrid (C5).

Similarly, **Figures 8** and **9** show in a map the largest bilateral TEF flows (in euros) according to the two alternative estimates described above for 2001. As can be observed, the largest monetary flows coincide in both cases and identify Madrid and Catalonia as the main importing regions and Andalusia and the Region of Valencia as main exporters.

Figures 10 and **11** show the corresponding main flows for SHF. Again, the largest flows coincide, identifying Madrid as the main importing region. Comparing the two categories of flows, it is interesting to note that, although there are strong flows connecting distant regions (i.e., Catalonia and Andalusia) for the TEF, the largest SHF flows appear between adjacent regions. This result is in line with the hypothesis that a larger negative elasticity for distance will be found in the SHF than in the TEF.

<<Figures 8, 9, 10, and 11 about here>>

Finally, in order to illustrate the evolution of the spatial patterns of aggregate interregional monetary flows, **Figures 12** and **13** shows the largest bilateral flows obtained in 2001 and 2007, based on the corresponding *Movilia* surveys. Note that, in general, the structure of the main interregional flows does not change much. However, it is worth noting the intense exports going from Andalusia to the distant Catalonia in 2001, accounting for more than 3% of the total interregional monetary flows for the sector in the country as a whole. Finally, in **Figures 14** and **15**, the largest bilateral flows in TE and SH are shown. Regarding TEF, we can see some differences when we compare these results with those obtained for 2001, specifically the larger number of flows between the inner regions and in particular the outflows from Madrid. When we look at the SHF, we can see that some changes in the main bilateral flows appear as compared to 2001. Nevertheless, we can identify some flows that are among the main interregional flows overall—specifically, the flows between Madrid and the geographically contiguous inner regions.

<<Figures 12, 13, 14, and 15 about here>>

3 The gravity equation: A framework for modeling bilateral trade

The gravity equation has been widely and successfully used to analyze the intensity of bilateral trade between pairs of nations and regions. In the equation's most basic formulation, bilateral trade between two geographic areas is directly proportional to their respective economic sizes and inversely proportional to the distance between them. More refined specifications of the model may include additional variables in order to capture effects such as transport accessibility, historical and cultural inertia, and network associations of all kinds, which would condition the direction and the intensity of the flows.

3.1 The basic model

Based on various contributions from the literature on empirical applications of the gravity model to international and interregional trade of goods and services in monetary units (Combes et al., 2005; Baldwin and Taglioni, 2006; Ceglowsky, 2006; Kimura and Lee, 2006), equation (1) suggests a general specification for modeling the intensity of trade between a pair of regions, *o* and *d*.

$$\ln y_{od} = \beta_0 + \ln X_o \beta_1 + \ln X_d \beta_2 + \ln dist_{od} \beta_3 + \varepsilon_{od} \qquad (1)$$

As with any balance of payment, the variable y_{od} denotes a dependent variable of bilateral monetary flows from region *o* to region *d* as a result of the total expenses in region *o* of tourists from region *d*. More specifically, in this case y_{od} denotes a vector of trade flow in the restaurant, accommodation and travel-agency sectors (with dimension [*n***n*, 1] = [17*17, 1]) between every pair (*o, d*) of the 17 Spanish regions obtained from the vectorization of the Y_{od} trade matrix ([n*n] = [17*17]). As we will see, depending on the specifications to be estimated, in this paper y_{od} may capture total bilateral flows, or flows related to stays in tourist establishments or in second homes, for either the 2001 or 2007 datasets.

According to equation (1), monetary bilateral flows between any pair of regions (*o, d*) are a linear function of a series of variables that capture the export capacity of the origin region (matrix X_o, with a vector of coefficients β_1), the absorption capacity of the destination region (X_d, with a vector of coefficients β_2), and the transport costs usually approximated by the distance between them ($dist_{od}$).

3.2 Alternative models

In this subsection, two alternative models are defined. These *augmented models* deal with the different nature of intra- and interregional flows. Before defining them, it is necessary to emphasize that, in this estimation of bilateral trade flows, intraregional flows are very intense and primarily dominated by restaurant-industry activity (De la Mata and Llano, 2010), a daily expenditure not necessarily linked to journeys and overnight stays. When we consider all these factors together, it is expected that the most explicative variables of intraregional flows are related to level of income and population of the region. In contrast, the intensity and direction of interregional flows will be directly related to those of interregional journeys (regardless of their actual motive) and to other factors that have an influence on the capability of emission and attraction respectively of tourists and, therefore, on the monetary flows they generate.

In this context, the first augmented model follows the literature on *border effects* (McCallum, 1995; Anderson and van Wincoop, 2003; Okubo, 2004; Combes et al., 2005; Gil-Pareja et al., 2005; De la Mata and Llano, 2010). Taking all this into account, the new model could be defined, by equation (2), as follows:

$$\ln y_{od} = \beta_0 + \ln X_o \beta_1 + \ln X_d \beta_2 + \ln dist_{od} \beta_3 + ownreg_{od} \beta_4 + \varepsilon_{od} \qquad (2)$$

This model incorporates a dummy variable, **ownreg**, which takes a value of 1 when the regions of origin and destination coincide (intraregional flows) and 0 otherwise. With this variable, we can compute the border effect (border = exp[**ownreg** coefficient]) defined in terms of how many times more a region trades with itself than with any other region of similar size and distance.

The second augmented model directly tackles the different nature of intra- and interregional flows, following the lessons of previous works (LeSage and Pace, 2008;

De la Mata and Llano, 2010). This model is defined by equation (3), where both types of flows are modeled in parallel:

$$\ln y_{od} = \beta_0 + \ln X_o \beta_1 + \ln X_d \beta_2 + \ln X_I \beta_3 + dist_{od} \beta_4 + \varepsilon_{od} \quad (3)$$

In this specification, the corresponding variables for the origin and destination regions (X_o and X_d) take a zero value for the intraregional flows, to prevent them from having an influence on the coefficients of the interregional flows. In contrast, the observations related to the intraregional flows are now explained by a new matrix of exogenous variables called X_I that takes a zero value for the interregional flows and the corresponding value for the intraregional ones. With this strategy, intra- and interregional flows are modeled together but use different sets of variables for each flow category. This procedure proves to be quite useful in this particular case, where the variables explaining intraregional trade (mainly related to the restaurant industry and journeys to privately owned second homes) are different from those explaining interregional trade (mainly conditioned by overnight stays at tourist establishments). Consequently, when intra- and interregional flows are modeled in parallel, the **ownreg** variable is excluded from the model as irrelevant.

3.3 Gravity model controlling for spatial autocorrelation

Apart from the previous extensions of the gravity model, it is interesting to address the potential presence of spatial-autocorrelation effects affecting the interregional trade flows of the three services considered here.

Lesage and Pace (2008) challenged the assumption that origin and destination (OD) flows in the classical gravity model, which are contained in the dependent variable, exhibit no spatial dependence. They note that the use of distance alone in a gravity model may be inadequate for modeling spatial dependence between observations. There are several possible explanations for most socioeconomic spatial interactions (migration, trade, commuting, etc.). For example, origins and destinations that are adjacent may exhibit estimation errors of similar magnitude if underlying latent or unobserved forces are at work so that missing covariates exert a similar impact on observations in these adjacent places. Agents located in adjacent regions may experience similar transport costs and profit opportunities when evaluating alternative nearby destinations. This similar positive/negative influence among neighbors could also be explained in terms of common factor endowments or complementary/competitive sector structures. In the line of recent developments

(Lesage and Pace, 2008), a spatial lag of the dependent variable ($W^{spa} y_{od}$) is introduced in (4), where (W^{spa}) represents a spatial weight matrix of the form suggested by Lesage and Pace (2008):

$$\ln y_{od} = \beta_0 + \rho W^{spa} \ln y_{od} + \ln X_o \beta_1 + \ln X_d \beta_2 + \ln X_I \beta_3 + dist_{od} \beta_4 + \varepsilon_{od} \qquad (4)$$

In a typical cross-sectional model with n regions, where each region represents an observation, spatial regression models rely on an $n \times n$ 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. By convention, $W_{ii} = 0$ prevents 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 origin and destination flows, where we are working with $N = n \times n$ observations, Lesage and Pace (2008) note that the spatial-lag variable captures both destination- and origin- based spatial dependence relations using an average of flows from neighbors to each origin and destination region. Specifically, this means that flows from any origin to a particular destination region may exhibit dependence on flows from this origin's neighbors to the same destination, a situation labeled *origin-based dependence* by Lesage and Pace (2008). Similarly, the spatial-lag vector captures *destination-based dependence*, reflecting the dependence between the flows from a particular region of origin to regions neighboring the destination region.

Lesage and Pace (2008) set forth nine models reflecting different restrictions on a general model. We applied model 5, based on a single weight matrix constructed using $W^{spa} = 0.5(W_o + W_d)$ with a parameter equal to $2\rho_d = 2\rho_o$. Destination-based dependence is captured by $W_d = I_N \otimes W$, representing an $N \times N$ spatial-weight matrix and $W_o = W \otimes I_N$ is another $N \times N$ spatial-weight matrix representing origin-based dependence.[3]. This model does not separate the impact of origin- and destination-dependent relations, instead representing a cumulative impact. For our model of monetary trade flows in the three tourist sectors with indirect spatial effects, we row-standardize the matrix W^{spa}, to form a spatial lag of the $N \times 1$ dependent-variable vector containing the vectorized matrix of flows. The scalar parameter ρ denotes the strength of spatial dependence in flows, and it should be clear that when this parameter

3 We use the symbol ⊗ to denote a Kronecker product.

takes a value of zero, the model in (4) simplifies to the independent-regression model in (3). This allows us to carry out a simple empirical test for the statistical significance of spatial dependence in the flows.

3.4 Specifications, variables, and expected results

Departing from the four models described above and the databases described in section 2, we now define several alternative specifications for the gravity equation. For the sake of brevity, we focus on the results obtained with the datasets based on *Movilia 2001* and *Movilia 2007*. The same analysis was carried out using a dataset based on *Familitur 2001*, which produced very similar results (available upon request).

In the first 10 specifications, the dependent variable (y_{od}) is a vector of aggregate bilateral monetary flows of the restaurant, accommodation, and travel-agency sectors. Among them, five specifications use the flows obtained from the dataset based on *Movilia 2001*: (***M1_01–M5_01***); the other five use flows based on *Movilia 2007*: (***M1_07–M5_07***). The specifications are used equally for each dataset. The first eight specifications (***M1_01–M4_01, M1_07–M4_07***) offer alternative combinations of variables based on equations 1, 2, and 3 and the last two specifications (***M5_01, M5_07***) are based on equation 4. **Table 2** shows all the specifications defined for aggregate intra- and interregional flows, indicating which dependent and exogenous variables, years, estimation procedures, and theoretical models are used for each one.

<<Table 2 about here>>

The first specification (**M1_01, M1_07**) corresponds to the simplest gravity model, where total monetary flows are explained by the variables describing the size of the origin and destination regions (GVA of the hotel sector at the region of origin and GDP for the destination) and the distance between them. In the second specification (**M2_01, M2_07**), we include variables to capture new characteristics of the regions: kilometers of beaches (**beach**), an index of average temperature relative to annual variation (**temperature**), and the dummy variable for the islands (**island**). We also include a dummy for a Spanish capital in Madrid (**capi**).

The third specification (**M3_01, M3_07**) is based on equation (2) and includes the dummy variable **ownreg** to capture the border effect. Specifications (**M4_01, M4_07**) are similar to the previous ones, but are based on the second augmented model described in equation (3). Finally, the last specification (**M5_01, M5_07**) is based on equation (4) and includes a spatial lag for the dependent variable.

The measure used for **distance** in all specifications is provided by the 2001 *Movilia* survey. First, we want to emphasize that this survey covers a large number of Spanish residents (46,000 interviews) and more than 50,000 (intraregional and interregional) trips throughout the year, regardless of the motive for the journeys. As it is reported in the methodology of *Movilia 2001*, the distance is computed as the great-circle distance between the actual points of origin and destination of the trips. In our view, this distance measure is of particular interest for our research: although it cannot be considered the "actual distance," it reflects the average distance connecting the actual spots of departure and arrival. This distance measure is especially representative in the case of coastal tourism, where, the relevant distance to be used is the one connecting point of origin with the coastal point of destination, but not major cities or the center of the polygon. Due to the definition of this variable, the origin-destination matrix of the distance variable is not symmetric, since the average distance connecting bilateral trips between any pair of regions will depend on the position of the actual points of departure and arrival within each region. In addition, the use of great-circle distance for trips connecting the Spanish islands with the rest of Spain may be closer to the real flight distance, flight being the main transport mode used for these kind of connections. In spite of the improvements introduced by this distance variable as compared to the typical distance variables found in the literature, we are well aware that the use of travel times or transport cost by different transport modes would be more accurate. Unfortunately, such variables are not available for Spain, or for most of the relevant countries.

The variable **gross value added** (**gva**) of the hotel industry captures the capacity of an exporting region to absorb demand; in other words, it captures the relevance of the part of the sector rooted in the region that produces the service and receives the tourists (X_o).

To explain the numerous journeys from inner to coastal regions, and with the helpful comments of an anonymous referee, we have also incorporated the variables **beach** and **temperature**. The **beach** variable, measured as the number of kilometers of the beach in each region, could be considered a clear improvement compared to other standard proxies found in the literature, such as kilometers of coastline. It is important to distinguish between these two variables when analyzing a country like Spain, where a large share of the coast in some regions is occupied by cliffs and inaccessible enclaves. For the **temperature** variable, different specifications were tested. Finally, the variable was defined as the ratio between the annual average temperature of the region of origin and its standard deviation through the year. Under this definition, the **O_temperature** variable is able to capture the positive effect on tourist exports of higher average temperatures, but it also penalizes higher variation across the year. Consequently, regions with high temperatures during the summer, but lower temperatures in the winter (i.e., in Spain, the inner regions) are assumed to be less attractive to tourists than others with a lower average temperature but less variation during the year (i.e., the Mediterranean coast or the islands). In our view, the inclusion of the amplitude improves the standard treatment of this factor found in other papers on the topic (Bigano et al., 2006; Lise and Tol, 2002; Maddison, 2001).

In conclusion, we can expect that the higher the temperature ratio, the bigger the region's capacity to attract tourists (and so the greater the resulting outflow in euros). Note that **beach** and **temperature** are complementary, since regions in the north of Spain may have a beachy coast but temperatures above the mean.

In addition, two new dummy variables (**O_Island**, **D_Island**) are included for an appropriate treatment of bilateral flows departing from or arriving on the islands**.** In these cases, different forces could interact with the previously noted factors of attraction and emission. On the one hand, the islands have specific characteristics that reinforce their capacity for attracting domestic tourists (good weather during the winter, nice coasts and leisure facilities, etc.). This effect is associated with a positive sign for the **O_Island** variable and a negative for the **D_Island**. On the other hand, the larger distances and more expensive transport modes required for the journey (aircraft and ship) may act as an additional impediment either for visiting or leaving the islands. This second effect is associated with a negative sign for both the **O_Island** variable and the **D_Island**. Moreover, it is important to bear in mind that Spanish citizens living in the islands may receive a national subsidy for 50% of their travel expenses to the Iberian Peninsula. Obviously, this compensation may partially counterbalance the negative effect expected for the **D_Island** variable (Ishikawa and Fukushige, 2007; Santana, 2009).

Next, we want to analyze in more detail the presence of alternative factors explaining the two main types of interregional tourist flows, namely, overnight journeys to *tourist establishments* (hotels, apartments, rural houses, camping facilities, etc.) and to *privately owned second homes*. **Table 3** describes the remaining specifications used when modeling specific types of journey, also indicating the years, the variables, and the datasets used for each one. The flows generated by overnights in tourist establishments are analyzed in four specifications labeled as **M1_01_TE, M1_07_TE** and **M2_01_TE, M2_07_TE**, while overnights in second-home flows are modeled in four specifications labeled as **M1_01_SH, M1_07_SH** and **M2_01_SH, M2_07_SH,** using our datasets derived from *Movilia 2001* and *Movilia 2007*. In addition, as we saw in subsection 2.1, due to singularities in the case of "second-home flows," new variables and estimation procedures (Tobit models) should be used.

<<Table 3 about here>>

We want to emphasize that a new variable is included when modeling monetary flows derived from overnight stays in second homes (SH). To evaluate the role played by demographic links between regions as a specific attractor for SH journeys, we define the vector M_{od}, which captures the number of people born in the region of origin (o) and living in the destination region (d). By means of this vector of interregional migration, we attempt to capture the sort of interregional demographic linkage behind the widely spread tendency to travel to hometowns and villages, where people are more likely to have a second residence. Note also that the X_d matrix in the specifications labeled as **M2_01_SH, M2_07_SH** also includes a dummy (**D_capi**) for the special behavior of Madrid as the main importer of second-home flows.

Summing up, in **Table 4** we offer an explanation of the variables and the expected sign included in all the specifications.

<<Table 4 about here>>

3.5 Estimation procedures

All models have been estimated by means of Ordinary Least Square (OLS) with White's consistent covariance matrix estimator. Although several authors have discussed the best methods for estimating gravity models, both for cross-section (Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2006) and panel data (Egger, 2005), in this paper we have decided to use OLS because it allows for comparisons with other papers already published. All variables were included in logs so that the coefficients would be interpreted as elasticities.

In addition, for cases of second-home flows**,** where a large number of zeroes exist, we use alternative econometric procedures, such as censored Tobit models estimated by maximum-likelihood procedures. This strategy follows the recommendation of different authors who suggest that OLS is not a consistent way to estimate the gravity equation when there is a large mass of zero-trade observations (Bikker and de Vos, 1992;

Soloaga and Winters, 2001, Anderson and Marcouiller, 2002; Rose, 2004; Márquez-Ramos and Martínez-Zarzoso, 2005; Linders and de Groot, 2006).

Finally, as reported in subsection 4.2, alternative spatial-autocorrelation models were estimated through Bayesian procedures, based on recent Matlab routines developed by LeSage and others (see www.spatial-econometrics.com).

4 Results

In this section, we analyze the results obtained for all the specifications defined above, as well as for a number of variations using alternative datasets and estimation methods.

4.1 Results for the aggregate flows

We start by showing, in **Table 5,** the coefficients estimated for the first eight specifications proposed for the gravity equation, four based on *Movilia 2001* and four on *Movilia 2007*.

In the specifications **M1_01** and **M1_07,** we use the simplest gravity model. All the coefficients are significant and show the expected sign, namely, positive for the variables capturing the emission and absorption capacity of the regions (GVA, GDP) and negative for distance. In relation to distance, it is interesting to note that the elasticity of domestic tourist flows (−1.42) is smaller than observed in other works dealing with the interregional flows of goods in Spain (Gil-Pareja et al., 2005; Requena and Llano, 2010). At the international level, Ceglowsky (2006) provides us with an interesting point of reference: when analyzing international flows of services for the OECD countries (1999–2000) and using a gravity model with a panel-data specification, he obtained an average elasticity of the trade flows (X + M) in relation to a distance of about −1.09 for goods and −0.90 for services. However, in other works that use the gravity model for international flows of tourism (without including intranational flows), elasticities in relation to distance are even lower (for example, −0.2 in Khadaroo and Seetanah, 2008).

In the specifications **M2_01** and **M2_07**, the variable **beach** is positive and significant for 2001 but negative for 2007, revealing a change in preferences during this period in favor of non-coastal destinations. In the **M2_01** and **M2_07** models, the **temperatures** index obtained a significant and positive coefficient. Regarding the dummy **capi** for capital, it is non-significant for origin, but positive and significant for destination, capturing its unusual importing behavior. Finally, the dummy for the **islands** shows non-significant coefficients, both for origins and destinations.

In the following specifications (**M3_01, M3_07**), the variable **ownreg** obtains a positive sign and a large coefficient of 2.618 for 2001 and 2.754 for 2007. These results are equivalent to a border effect of 13.71 (exp[2.618]) and of 15.70 (exp[2.754]) respectively, a higher level than observed in other works concerned with the interregional trade of goods in Spain and other countries[4]. It is interesting to note that the level of the border effect seems to be independent of the source of information used. In this case, the large border effect obtained should not be interpreted as an indicator of "exogenous restriction to trade," but as evidence of the relative importance in the restaurant industry of daily expenditures of residents in their own regions. It is also worth mentioning that the negative coefficient for the **distance** variable here decreases to the lowest level in all the specifications (−1.11/−1.95), and the dummy variable for **O_island** becomes negative and significant.

Specifications (**M4_01, M4_07**) substitute the **ownreg** variable with **Intra_GDP**, which captures intraregional trade flows only. The coefficients for all the new variables are significant and show the expected positive sign.

<<Table 5 about here>>

Next, we offer a robust check for this analysis. In **Table 10** (in the Appendix), eight specifications are estimated using the 2001 datasets and a Bayesian OLS procedure. The results are basically the same as the ones in **Table 5**. Using the Bayesian procedure, a positive effect for the **capi** dummy is also found in the origin; this reflects the higher attractiveness of Madrid as a tourist region, which is not captured by the rest of the variables. Also found is a positive effect for the **island** dummy as a destination, which is diluted once we control for intraregional flows.

4.2 Results according to type of flow

In this subsection, we analyze in more detail the presence of alternative factors explaining the two main types of interregional tourist flow, namely, overnight journeys to *tourist establishments* (TE) and to *privately owned second homes* (SH).

<<Table 6 about here>>

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4 In the international literature on border effect on interregional trade of goods in other countries, the "internal border effect" is as low as 2 and as high as 20 (Helliwell, 1996; Wolf, 2000; Combes et al., 2005)

Regarding interregional flows related to tourist establishments (TE), **Table 6** shows the results obtained using OLS with White's consistent covariance matrix estimator and the two datasets for 2001 and 2007. Most of the variables included in specifications **M1_01_TE**, **M1_07_TE**, **M2_01_TE**, and **M2_07_TE** are significant and show the expected signs. It is interesting to note the low negative elasticity found for the **distance** variable in all these specifications when compared to that obtained in the equivalent specifications in which all the flows were analyzed together. For example, the coefficients for **M1_01** (−1.426) and **M1_07** (−2.205) reported in **Table 5** are equivalent to the **M1_01_TE** (−1.163) and **M1_07_TE** (−1.818) coefficients. Note also that the coefficient obtained for **M1_07_TE** (−1.818) is much larger than that obtained for the 2001 datasets, even when the model includes only interregional flows for TE stays. It is also interesting to observe that the variable **O_Temperature** is significant and positive for the TE flows but the **beach** variable obtains a negative and significant coefficient for 2007. This change can be explained by a move from coastal to inner regions as popular tourist destinations between 2001 and 2007. Finally, a negative and significant sign is obtained for the inflows of the **islands**. This final result is consistent with an extra reduction of tourist flows caused by the larger transportation costs faced in traveling to these regions. Another explanation is the fact that the tourist supply entering the islands is primarily foreign rather than national. However, a positive and significant coefficient for outflows is found.

<<Table 7 about here>>

For journeys associated with stays in second homes (SH), the results are also promising for all the specifications. **Table 7** shows the results obtained for four specifications in which the dependent variable is (SH) using a Tobit model. Although the coefficients could not be interpreted as elasticities or compared directly to those obtained by the OLS with other types of flows, it is interesting to observe that most of the variables show non-significant coefficients with the same signs as in the previous estimates. The main exceptions are the **distance** and **migration** variables, which seem to be the main factors affecting this kind of flow. Regarding the rest of the variables, when we estimate the simplest gravity model, the variables are significant and bear the expected sign. The variable **GDP** is significant and has a positive sign, but when we introduce the **migration** variable we see some multicolinearity problems, because these variables are very closely related, so we have replaced it with **Income,** which is non-significant. As a result, we can expect that it was population more than income that drove the positive sign in **GDP**. It is important to highlight that the coefficients for **distance** in (**M1_01_SH**, **M1 07_SH**) are very high, but they are not directly comparable; they include a part of the migration effect, and as a consequence they reduce when including the rest of the variables. Regarding the rest of the variables, in the results for the database for 2001, we also find a significant positive coefficient for **D_capi** and a negative, significant coefficient for **O_capi.** This significantly different behavior disappears for 2007. Although further research is needed on this point, the observed variation in behavior could be explained by the Spanish real-estate boom and the resultant tendency for Spaniards to invest in second homes.

4.3 Results addressing the spatial-autocorrelation effects.

The results for the models controlling for the spatial-autocorrelation effects described in equation 4 can be found in **Table 9.** The first two columns (**M5_01**, **M5_07**) contain the results for total bilateral flows, and the next two columns contain the results for bilateral flows linked to stays in tourist establishments, and the last two for flows linked to stays in second homes. In the case of the aggregate and TE flows, we use a SAR model, and for the SH flows, a Tobit SAR model, both estimated by means of Bayesian procedures.

Regarding the results for the total bilateral flows, a positive and significant coefficient for the ρ coefficient is found, which confirms the presence of spatial autocorrelation. The rest of the coefficients keep their significance and signs, but a reduction in all the coefficients except for **ownreg** (which now is higher) is found in comparison with (**M3_01**, **M3_07**). The flows generated by stays in tourist establishments show a positive spatial autocorrelation for 2001 that disappears for 2007. In this regard, we want to remind the reader that the difference observed in the bilateral TEF between 2001 and 2007 (**Figures 8, 9, and 14**) which can be behind the difference between the significant levels of the two years. Moreover, we do not find empirical evidence for spatial-autocorrelation effects affecting second-home flows in either 2001 or 2007. Although these results require further research, they may be related to the different nature of each type of flow. For example, one may expect larger spatial-autocorrelation effects on TEF than on SHF, because of the way in which the destinations are chosen for both types of trip. In TEF, travelers with a specific origin (and from regions located nearby) could be attracted by the characteristics of a specific destination (or its geographical neighbors). By contrast, SH trips are more conditioned by ownership of the second home in a particular destination and may be more independent from flows from/to destination-contiguous regions.

5 Final remarks

The recent literature on border effect has emphasized the relevance of intrarregional trade flows of goods as compared to interregional and international flows. Due to the lack of data, no similar evidence has been found for trade of services. For the specific case of tourist services, domestic monetary flows have not received the attention they deserve, because of this lack of information. Circumventing this data restriction, in this article we have carried out an econometric analysis of intra- and interregional trade flows of the accommodation, restaurant, and travel-agency sectors in Spain by means of several specifications of the well-known gravity model. To the best of our knowledge, this is the first article doing so. For our purpose, we have used three alternative databases that contain information on monetary flows derived from domestic Spanish tourism for 2001 and 2007, based on the best data available on tourist-sector production at the regional level; we have also employed two alternative sources on interregional overnight stays (the *Familitur* and *Movilia* surveys).

The results obtained reveal the existence of an important border effect in favor of intraregional trade flows, primarily derived from the relatively large weight of restaurant-industry activity and its marked intraregional nature. Similarly, the results verified a minor elasticity of the trade flows in relation to distance when compared to the results obtained for other services and goods. We have also been able to identify some related variables linked to the socioeconomic and geographic characteristics of the regions (temperature, beach, or island) that play an important role as attraction or repulsion factors for domestic tourists. More specifically, the higher the ratio of temperatures in the exporting region, the larger the capacity to export these services. In addition, a positive “capital effect” for Madrid as an importing region is found. From the dynamic point of view, the results obtained show a slight change in the spatial pattern of trade between 2001 and 2007. For example, while a positive coefficient for the amount of beach is found in 2001, a negative coefficient is obtained for 2007. There is also found a higher coefficient for the distance variable for 2007.

We have investigated the heterogeneity of domestic flows, distinguishing between the two main types: journeys linked to overnight stays at tourist establishments and those linked to second homes. There has been found evidence supporting the idea that analyses in fields with high complexity should be done with this heterogeneity controlled for. As an example, the coefficient for the distance variable found for second-home trips is bigger than the one obtained for flows generated by overnights in tourist establishments. Furthermore, differences in the signs of some coefficients are found, revealing different geographical patterns by type of overnight stay. While a positive coefficient is found for the capital as a tourist-exporting region, a negative effect is obtained in second-home flows. Being an island is confirmed as an attraction factor in tourist flows but makes no difference in second-home flows.

Finally, we have tested the presence of spatial autocorrelation following Lesage and Pace (2008), finding it for some specific flows and years. A positive spatial autocorrelation is confirmed for the aggregate flows, while it is not significant for the second-home flows. The results for the tourist flows are not conclusive, finding a positive and significant effect in 2001 and no effect in 2007. Further research is recommended regarding this last issue, using alternative models and spatial weight matrices.

6 References

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7 Methodological appendix

7.1 The two main surveys on domestic tourism and mobility in Spain

- ***Familitur*** is one of the main surveys published by the Instituto de Estudios Turísticos (Spanish Institute for Tourist Studies or IET). It records information on all the trips made by Spanish households in the reference period. The survey includes information on the origin and destination of the trips (Nuts 2), type of accommodation, transport mode, number of overnight stays, etc. *Familitur* information is broken down into three basic blocks, analyzing households, individuals and trips. The survey has been published on a yearly basis since 2000 and is designed to properly cover all the Spanish regions (Nuts 2) except Ceuta and Melilla. However, the structure of the survey has changed considerably during the period. The interviews are carried out monthly. The target population of the study is individuals living in Spain in family dwellings. In 2001, *Familitur* surveyed 10,800 households, three times in the year (32,400 interviews). The sample consisted of 1,200 sections distributed among the 17 Spanish regions (autonomous communities).

- ***Movilia*** is the main survey published on mobility in Spain. It is published by the Ministerio de Fomento (Ministry of Public Works), and focuses on the mobility patterns of Spanish residents, their characteristics and their determinants. The survey is structured on two levels: a) daily mobility of people within the main metropolitan areas; and b) larger displacements (with a length larger than 100 km) or those of lower distances but with an overnight stay out of the region of residence. Our paper is based on this second level. The survey uses a panel sample of individuals, who are interviewed by telephone every two months. Each individual describes the trips made during the last two months. The target population is residents over 16 years old living in family houses during the largest part of the year. The survey covers mobility including domestic and international trips. The sample is representative for all Spanish regions (Nuts 2), except Ceuta y Melilla. The survey records information on the origin and destination of trips, distance traveled, the purpose of the trip, the number and type of overnight stays, and the transport mode used. The second level of the Movilia survey has been published twice, in 2001 and 2007. In Movilia 2001 the number of people interviewed was around 12,500, the number of interviews was around 46,000, and the number of trips described was close to 50,000.

7.2 Some details about the estimation methodology

In this section of the appendix, we briefly describe the methodology used for estimating intra- and interregional monetary flows linked to the Spanish tourist sector in 2001 (Llano and de la Mata, 2009).

As shown in equations (2) and (3), to obtain the regional production of the tourist sector destined for domestic consumption (*DO*), we take as our starting point the vector of regional net production of the sector (*TO*) for 2001, offered by the Spanish Annual Survey of Services (SASS). We proceed to subtract from it another vector of similar dimension that contains the international exports (*IX*) of tourism. This (*IX*) vector was obtained by the regionalization—according to the share of each region in the total expenditure of foreign tourists (*FTE*) (EGATUR, 2004)—of the total international export of tourism (*TIXT*) taken from the Spanish balance of payments (SBP).

$$DO_O = TO_O - IX_O \tag{1}$$

$$IX_O = TIXT_O * \frac{FTE_O}{\sum FTE_O} \tag{2}$$

In order to calculate the bilateral trade flows of the tourist sector, it is necessary to have an OD matrix of the expenditure made by residents of one region when travelling to other regions and linked to the tourist sector. For this purpose, an estimation of daily mean expenditure by residents of every region is required. For this purpose, we distinguish between overnight stays at tourist establishments and stays at second homes. At this point it is important to highlight that: 1) Data on "tourist journeys" by *Familitur* (2001) includes overnight stays at tourist establishments (all kinds of establishments) plus stays at second homes with duration longer than four nights, and given the available information, it is impossible to separate the mean expenditure corresponding to these two types of journeys; 2) the mean expenditure included in the categories of "tourist journeys" and "second homes" includes expenditures that are not included in the definition of the tourist sector considered in this article, such as transportation, shopping, or car rental. For this reason, the mean expenditure as published by *Familitur* has to be downscaled by the share of these items, which should not be included in the ETE and ESH vectors. Taking into account the limitations of this source, a series of different adjustments are required to obtain coherent daily mean expenditures by region and tourist (as derived from *Familitur 2001*). We have, accordingly, obtained two vectors of daily mean expenditure in 2001. The first vector includes expenditures linked to hotels, restaurants, and travel agencies for journeys to tourist establishments (TE), and the second includes only expenditures related to the restaurant industry for journeys to second homes (SH). From these estimates of daily mean expenditure by person, region and type of journey, and the available information about overnight stays by type of journey, we obtain the bilateral flows; that is, the share of interregional flows that corresponds to each importing region. Equations (3) and (4) describe how the number of interregional overnight stays linked to tourist establishments (*TE*) are valued according to the daily mean expenditure obtained for these journeys (*ETE*), while the number of interregional overnight journeys linked to second homes (*SH*) are valued by the corresponding second-home mean expenditure (*ESH*).

$$TEF_{od} = ETE_{o} * TE_{od} \tag{3}$$

$$SHF_{od} = ESH_{o} * SH_{od} \tag{4}$$

As a result, we obtain an estimate of interregional monetary flows generated by each of the two typologies of interregional overnight stays. Both matrices are then added to a single matrix of interregional expenditure in the tourist sector (*F*) linked to the overnight stays (equation 5):

$$F_{od} = TEF_{od} + SHF_{od} \tag{5}$$

However, the intraregional flows are obtained as the difference between the vector of production for national consumption (*DO*) and the sum of the rows of interregional trade matrix, obtained through the bottom-up procedure (equation 6).

$$F_{oo} = DO_{o} - \sum_{o \neq d} F_{od} \tag{6}$$

Consequently, we are able to obtain a pair of final matrices for intra- and interregional trade flows in euros for the Spanish tourist sector that is coherent with the main sources available.

A similar procedure is used for estimating an alternative dataset based on *Movilia 2007*.

7. Tables

Table 1. Pearson Correlation Index between the Familitur and Movilia estimates (2001).

		Familitur_2001			Movilia_2001		
		Total	**TEF**	**SHF**	**Total**	**TEF**	**SHF**
Familitur_2001	**Total**	1.000					
	TEF	0.997	1.000				
	SHF	0.597	0.537	1.000			
Movilia_2001	**Total**	0.954	0.947	0.625	1.000		
	TEF	0.955	0.950	0.602	0.999	1.000	
	SHF	0.533	0.475	0.944	0.599	0.572	1.000

The correlation is significant at the 0.01 level in all cases

Table 2. Specifications and variables using aggregate intra- + interregional flows

Specification	Dependent Variable *Yod*	Model	Estimation Method	Variables in X_O	Variables in X_d	Variables in X_I	Other Variables
M1_01	Movilia 2001	Eq 1	Classic-OLS Bayesian-OLS	GVA	GDP		Distance
M2_01	Movilia 2001	Eq 1	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance
M3_01	Movilia 2001	Eq 2	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance, Ownreg.
M4_01	Movilia 2001	Eq 3	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi	GDP	Distance,
M1_07	Movilia 2007	Eq 1	Classic-OLS Bayesian-OLS	GVA	GDP		Distance
M2_07	Movilia 2007	Eq 1	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance
M3_07	Movilia 2007	Eq 2	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance, Ownreg.
M4_07	Movilia 2007	Eq 3	Classic-OLS Bayesian-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi	GDP	Distance,
M5_01	Movilia 2001	Eq. 4	Bayesian SAR	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance, Ownreg, Spatial Lagged flow
M5_07	Movilia 2007	Eq. 4	Bayesian SAR	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi		Distance, Ownreg, Spatial Lagged flow

Table 3. Specifications and variables using type-specific interregional flows

Specification	Dependent Variable *Yod*	Model	Estimation Method	Variables in X_O	Variables in X_d	Other Variables
M1_01_TE	Tourist Establishments Movilia 2001	Eq 1	Classic-OLS	GVA	GDP	Distance
M2_01_TE	Tourist Establishments Movilia 2001	Eq 1	Classic-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi	Distance,
M2_07_TE	Touristic establishments Movilia 2007	Eq 1	Classic-OLS	GVA	GDP	Distance
M2_07_TE	Touristic establishments Movilia 2007	Eq 1	Classic-OLS	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi	Distance,
M3_01_TE	Tourist Establishments Movilia 2001	Eq. 4	Bayesian SAR	GVA, Beach, Island, Capi, Temperature	GDP	Distance, Spatial Lagged flow
M3_07_TE	Touristic establishments Movilia 2007	Eq. 4	Bayesian SAR	GVA, Beach, Island, Capi, Temperature	GDP, Island, Capi	Distance, Spatial Lagged flow
M1_01_SH	Second Homes Movilia 2001	Eq 1	Tobit model	GVA	GDP	Distance
M2_01_SH	Second Homes Movilia 2001	Eq 1	Tobit model	GVA, Capi, Island	Income, Capi Island	Distance Migration
M2_07_SH	Second Homes Movilia 2007	Eq 1	Tobit model	GVA	GDP	Distance
M2_07_SH	Second Homes Movilia 2007	Eq 1	Tobit model	GVA, Capi, Island	IncomeP, Capi Island	Distance Migration
M3_01_SH	Second Homes Movilia 2001	Eq. 4	Tobit SAR model	GVA, Island, Capi	Income, Capi, Island	Distance, Migration
M3_07_SH	Second Homes Movilia 2007	Eq. 4	Tobit SAR model	GVA, Island, Capi	Income, Capi, Island	Distance, Migration

Table 4. Variables included in the models with their expected signs

Variables	Description	Expected sign in origin	Expected sign in destination
Y_{od}	Bilateral monetary flow of the *tourist sector* between regions o and d (Own elaboration). Depending on the specifications it could be: – Total flows – Tourist establishment flows. – Second-home flows		-
GVA	Gross Value Added of the hotel industry (Spanish Regional Accounts, INE, 2001)	Positive	-
Beach	Km of beaches in the region (Adeac)	Positive	-
Island	Dummy (=1 if is an island; =0 otherwise)	?	Negative
Temperature	Temperature index = Average temperature / St.Dev. (Aemet, 2001, 2007)		Positive
Capi	Dummy (=1 if Madrid; =0 otherwise)	Positive	Positive
GDP	Regional Gross Domestic Product (INE, 2001, 2007)	-	Positive
Cont	Contiguity dummy variable (1 if regions "o" "d" are contiguous, 0 otherwise)		Positive
M_{od}	Interregional migration stock (Spanish Register, 2001, 2007)		Positive
Distance	Average distance (Movilia_2001, Movilia_2007)		Negative

Table 5. Results for eight alternative specifications of the gravity equation.

Dependent variable: Bilateral total flows in millions of Euros, based on Movilia 2001 and 2007. Classic OLS estimation using White's heteroskedasticity-consistent covariance matrix estimator. T-statistics are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1.

	M1_01	M2_01	M3_01	M4_01	M1_07	M2_07	M3_07	M4_07
Constant	-8.651***	-5.972***	-8.057***	-6.197***	-13.938***	-15.936***	-16.985***	-15.354***
	(-5.315)	(-3.552)	(-5.584)	(-4.182)	(-6.530)	(-6.183)	(-7.450)	(-6.728)
O_GVA	1.081***	0.911***	0.901***	0.803***	1.278***	1.408***	1.357***	1.284***
	(11.744)	(9.763)	(10.246)	(9.147)	(14.378)	(10.820)	(11.122)	(10.546)
O_Beach		0.085**	0.072**	0.115***		-0.149***	-0.149***	-0.110**
		(2.459)	(2.367)	(3.406)		(-2.852)	(-3.167)	(-2.297)
O_Temperature		0.372***	0.254***	0.223***		0.715***	0.598***	0.578***
		(5.124)	(3.731)	(3.134)		(7.757)	(6.662)	(6.341)
O_Island		-0.125	-0.283	-0.173		-0.413	-0.579**	-0.443
		(-0.500)	(-1.450)	(-0.836)		(-1.398)	(-2.334)	(-1.661)
O_Capi		0.352	0.318	0.688***		-0.078	-0.019	0.361
		(1.275)	(1.200)	(2.639)		(-0.216)	(-0.056)	(1.094)
D_GDP	1.068***	1.050***	0.973***	0.936***	0.945***	0.946***	0.879***	0.857***
	(14.256)	(13.837)	(13.224)	(12.279)	(12.487)	(13.294)	(13.708)	(12.982)
D_Island		0.199	-0.319	-0.306		0.345	-0.165	-0.063
		(0.554)	(-0.909)	(-0.779)		(1.007)	(-0.511)	(-0.180)
D_Capi		0.364*	0.585***	0.757***		0.240	0.420*	0.629***
		(1.906)	(2.606)	(3.671)		(0.312)	(1.877)	(3.614)
LDistance	-1.426***	-1.667***	-1.114***	-1.138***	-2.205***	-2.499***	-1.954***	-2.000***
	(-13.184)	(-14.822)	(-8.620)	(-8.025)	(-17.492)	(-20.746)	(-15.361)	(-15.217)
Ownreg			2.618***				2.754***	
			(7.592)				(8.299)	
Intra_Gdp				2.412***				2.174***
				(14.825)				(15.401)
Adj. R2	0.643	0.684	0.727	0.721	0.719	0.764	0.802	0.803

Table 6. Results for stays in "tourist establishments (TE)."

Dependent variable: monetary flows for 2001 and 2007 related to stays in "tourist establishments," based on Familitur and Movilia. Classical OLS estimates uses White's heteroskedasticity-consistent covariance matrix estimator. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	M1_01_TE	M2_01_TE	M1_07_TE	M2_07_TE
Constant	-8.994***	-11.83***	-15.33***	-17.18***
	(2.734)	(4.206)	(1.972)	(2.484)
O_GVA	1.356***	1.431***	1.193***	1.212***
	(0.185)	(0.242)	(0.0890)	(0.107)
O_Beach		-0.0389		-0.103**
		(0.0561)		(0.0513)
O_Temperature		2.759***		2.804***
		(0.825)		(0.586)
O_Island		-0.660*		-0.426
		(0.356)		(0.309)
O_Capi		-0.251		0.674**
		(0.412)		(0.301)
D_GDP	1.160***	1.096***	0.980***	0.916***
	(0.102)	(0.110)	(0.0752)	(0.0746)
D_Island		0.534**		0.518***
		(0.253)		(0.194)
D_Capi		-0.450		-0.365
		(0.668)		(0.380)
LDistance	-1.163***	-1.335***	-1.818***	-1.963***
	(0.155)	(0.242)	(0.132)	(0.136)
Adj. R2	0.450	0.500	0.666	0.711

Table 7. Results for "second-home flows (SH)." Tobit model.

Dependent variable: monetary flows for 2001 and 2007 related to stays in "Second homes," based on Familitur and Movilia. *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.

	M1_01_SH	M2_01_SH	M1_07_SH	M2_07_SH
Constant	10.06	-17.22	-23.22***	-16.43
	(14.05)	(40.58)	(5.145)	(13.72)
O_GVA	1.973**	1.198	1.245***	0.453**
	(0.815)	(0.918)	(0.217)	(0.222)
O_Island		-0.415		-1.334
		(3.785)		(1.321)
O_Capi		-6.495**		-0.877
		(3.135)		(0.785)
D_GDP	2.976***		1.873***	
	(0.766)		(0.241)	
D_Income		2.846		1.478
		(3.945)		(1.356)
D_Island		0.959		0.439
		(4.211)		(0.797)
D_Capi		4.903*		0.927
		(2.607)		(0.705)
LMigration		2.689***		1.500***
		(0.570)		(0.167)
LDistance	-11.98***	-8.810***	-4.351***	-2.695***
	(1.335)	(1.227)	(0.344)	(0.317)
Log Likelihood	-443.408	-425.453	-444.400	-414.948

Table 8. Bayesian Spatial Autoregressive Model

Dependent variable: monetary flows for 2001 and 2007. Total flows, touristic establishments and second-home flows based on Movilia. *** p<0.01, ** p<0.05, * p<0.1. Standard deviation in parentheses.

	M5_01	M5_07	M3_01_TE	M3_07_TE	M3_01_SH	M3_07_SH
Constant	-5.910***	-13.358***	-0.140	-13.970***	4.938	-18.473
	(1.196)	(1.425)	(1.307)	(1.510)	(0.331)	(15.818)
O_GVA	0.700***	1.075***	0.748***	1.139***	0.453	0.491*
	(0.067)	(0.074)	(0.068)	(0.077)	(1.464)	(0.281)
O_Beach	0.071**	-0.117***	0.077**	-0.112***		
	(0.030)	(0.032)	(0.032)	(0.034)		
O_Island	-0.109	-0.487**	-0.160	-0.508**	1.695	-0.998
	(0.233)	(0.211)	(0.243)	(0.233)	(1.538)	(1.140)
O_Capi	0.320	0.191	0.389*	0.312	-3.267***	-0.948
	(0.259)	(0.250)	(0.267)	(0.252)	(-2.665)	(0.966)
O_Temperature	0.191***	0.527***	0.218***	0.576***		
	(0.069)	(0.066)	(0.073)	(0.071)		
D_Gdp	0.883***	0.785***	0.967***	0.842***		
	(0.067)	(0.052)	(0.067)	(0.052)		
D_Income					0.737	1.594
					(0.501)	(1.538)
D_Island	0.183	0.231	-0.067	0.159	0.915)	0.570
	(0.247)	(0.216)	(0.231)	(0.217)	(0.908)	(0.862)
D_Capi	0.573***	0.483**	0.564***	0.496***	3.705***	0.817
	(0.237)	(0.203)	(0.241)	(0.203)	(2.836)	(0.966)
LMigration					1.184***	1.552*
					(5.499)	(0.194)
LDistance	-0.956***	-1.692***	-1.020***	-1.863***	-4.044***	-2.822*
	(0.097)	(0.091)	(0.099)	(0.080)	(-8.377)	(0.402)
Intra	2.800***	3.104***				
	(0.303)	(0.240)				
Rho	0.101**	0.101***	0.053***	0.041	-0.018	0.113
	(0.044)	(0.041)	(0.023)	(0.033)	(-0.210)	(0.097)
Adj. R^2	0.711	0.790	0.439	0.680		

Statistical Appendix

Table 9. Ranking for the exporting and importing regions using the estimate based on Familitur's survey (2001)

	Tourist Establishments Flows (TEF)		Second-Home Flows(SHF)	
	Ranking Exporting Regions	Ranking Importing Regions	Ranking Exporting Regions	Ranking Importing Regions
1	Comunidad Valenciana	Madrid	Castilla León	Madrid
2	Andalucía	Cataluña	Castilla - La Mancha	País Vasco
3	Castilla León	País Vasco	Cantabria	Comunidad Valenciana
4	Cataluña	Castilla León	Comunidad Valenciana	Castilla-La Mancha
5	Madrid	Comunidad Valenciana	Extremadura	Asturias
6	Galicia	Andalucía	Madrid	Cataluña
7	Balears (Illes)	Aragón	Andalucía	Murcia
8	Castilla - La Mancha	Asturias	Navarra	Castilla León
9	Canarias	Castilla - La Mancha	Asturias	Aragón
10	Cantabria	Extremadura	Cataluña	Andalucía
11	Asturias	Galicia	Aragón	Rioja (La)
12	Extremadura	Murcia	País Vasco	Navarra
13	Murcia	Navarra	Murcia	Extremadura
14	Aragón	Canarias	Rioja (La)	Galicia
15	País Vasco	Balears (Illes)	Galicia	Cantabria
16	Navarra	Rioja (La)	Balears (Illes)	Balears (Illes)
17	Rioja (La)	Cantabria	Canarias	Canarias

Table 10. Robust check with Bayesian OLS estimation and 2001 figures.

Dependent variable: Bilateral total flows in millions of Euros**,** based on Movilia 2001 and 2007.
*,**,***. The variables are significant at 1, 5, and 10% respectively. Standard deviation is in parentheses.

	M1_01	**M2_01**	**M3_01**	**M4_01**	**M1_07**	**M2_07**	**M3_07**	**M4_07**
Constant	-7.667***	-4.803***	-5.277***	-4.036***	-12.141***	-13.661***	-12.986***	-11.936***
	(1.193)	(1.368)	(1.163)	(1.168)	(1.485)	(1.743)	(1.433)	(1.428)
O_GVA	0.915***	0.801***	0.725***	0.664***	1.080***	1.204***	1.123***	1.074***
	(0.064)	(0.075)	(0.065)	(0.065)	(0.063)	(0.086)	(0.073)	(0.072)
O_Beach		0.102***	0.079***	0.109***		-0.109***	-0.125***	-0.093***
		(0.035)	(0.030)	(0.032)		(0.039)	(0.032)	(0.033)
O_Temperature		0.322***	0.194***	0.177***		0.648***	0.565***	0.550***
		(0.079)	(0.70)	(0.074)		(0.079)	(0.067)	(0.067)
O_Island		-0.153	-0.198	-0.133		-0.528**	-0.615***	-0.520***
		(0.264)	(0.221)	(0.235)		(0.255)	(0.208)	(0.215)
O_Capi		0.368*	0.384*	0.637***		0.167	0.246	0.461**
		(0.287)	(0.259)	(0.271)		(0.277)	(0.251)	(0.245)
D_GDP	1.069***	1.021***	0.908***	0.880***	0.923***	0.891***	0.812***	0.804***
	(0.071)	(0.071)	(0.066)	(0.067)	(0.063)	(0.060)	(0.050)	(0.051)
D_Island		0.515**	-0.072	0.054		0.422**	-0.003	0.109
		(0.242)	(0.210)	(0.240)		(0.218)	(0.186)	(0.198)
D_Capi		0.415*	0.665***	0.783***		0.374**	0.568***	0.627***
		(0.252)	(0.238)	(0.244)		(0.218)	(0.197)	(0.192)
LDistance	-1.183***	-1.528***	-1.008***	-1.031***	-1.950***	-2.190***	-1.823***	-1.868***
	(0.086)	(0.096)	(0.094)	(0.102)	(0.088)	(0.082)	(0.081)	(0.078)
Ownreg			2.679***				2.954***	
			(0.300)				(0.245)	
Intra_Gdp				2.161***				1.955***
				(0.177)				(0.084)
Adj. R2	0.629	0.673	0.715	0.709	0.709	0.752	0.791	0.793
Year	2001	2001	2001	2001	2007	2007	2007	2007

7. Figures

Figure 1. Scheme describing the methodology for estimating bilateral domestic flows.

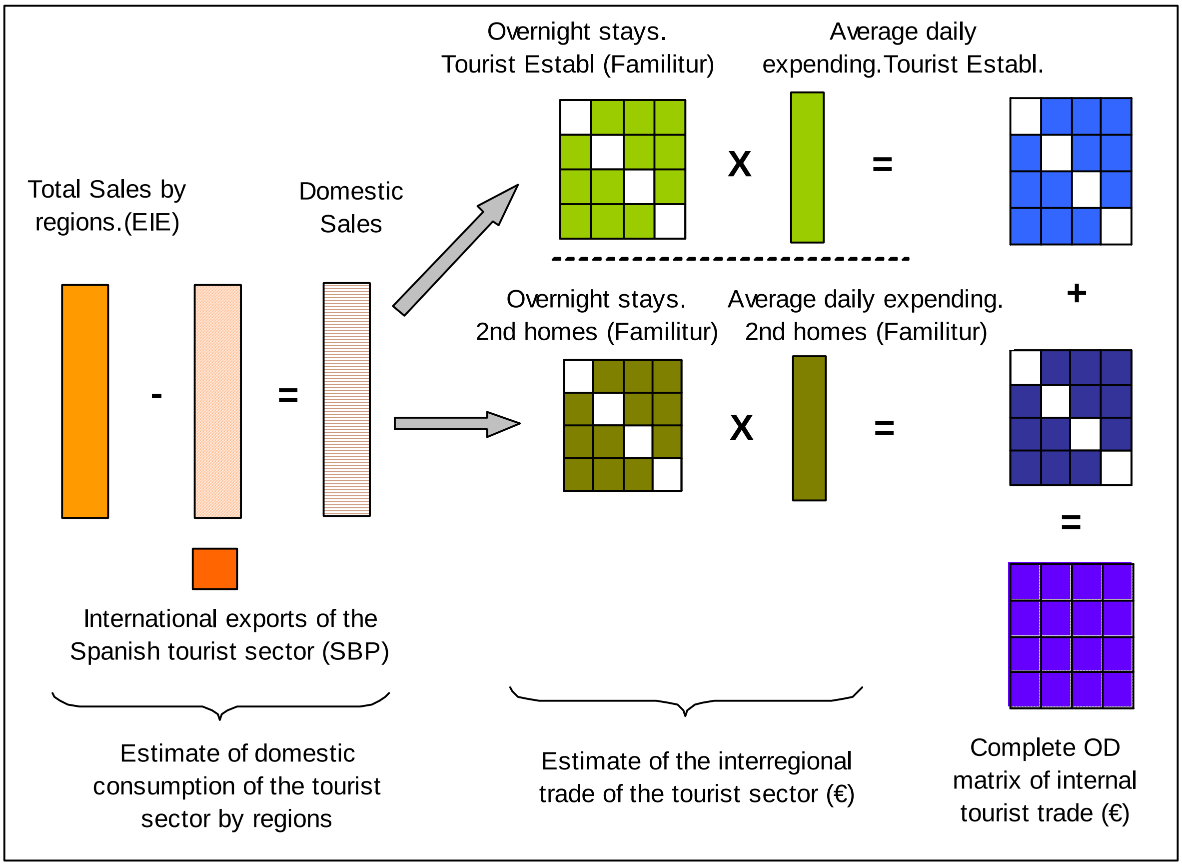


Figure 2. Bilateral flows in €. Tourist establishments. Familitur 2001.
Ranked according to the Familitur order

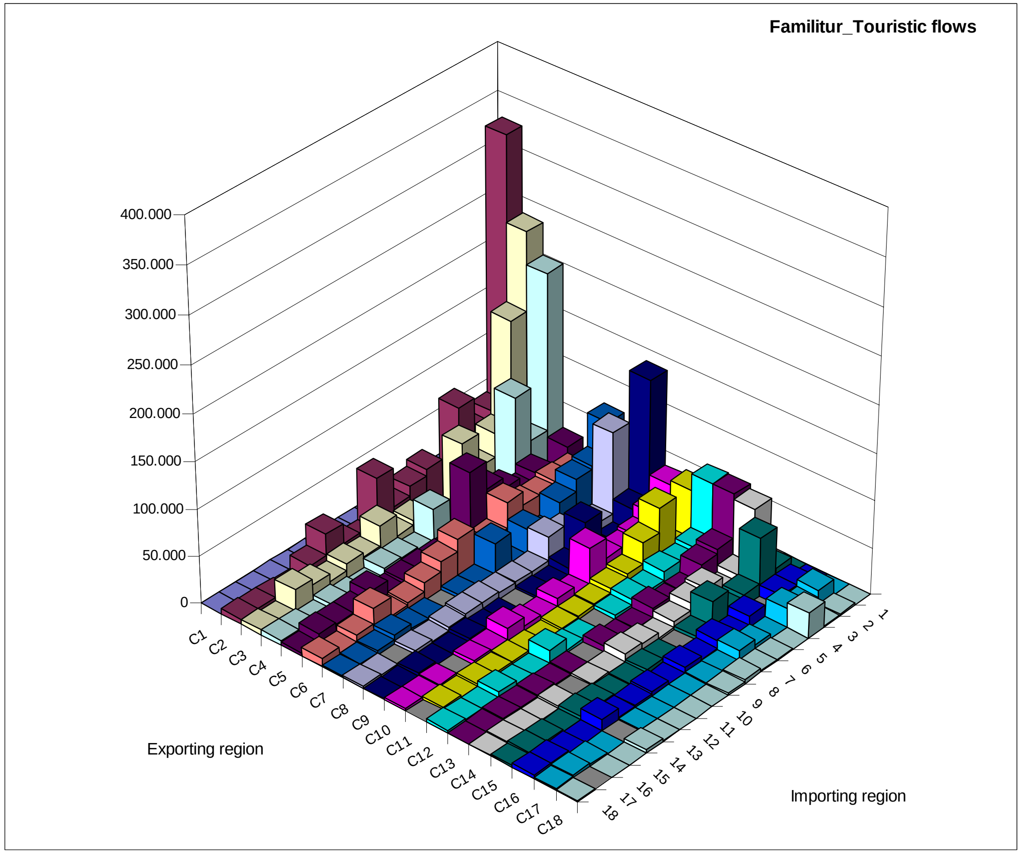
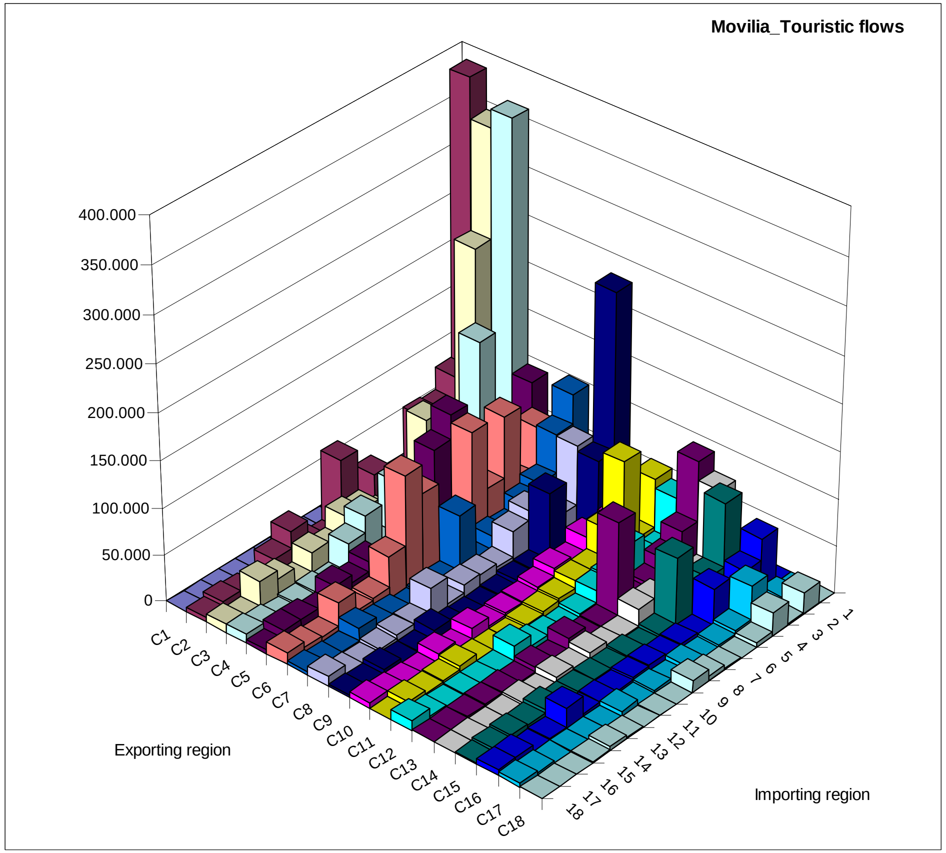


Figure 3. Bilateral flows in €. Tourist establishments. Movilia 2001.
Ranked according to Familitur order



* The corresponding names of the regions are reported in Table 6 in the Annex.

Figure 4. Bilateral flows in €. Second-Home Flows. Familitur 2001

Ranked according to the Familitur order

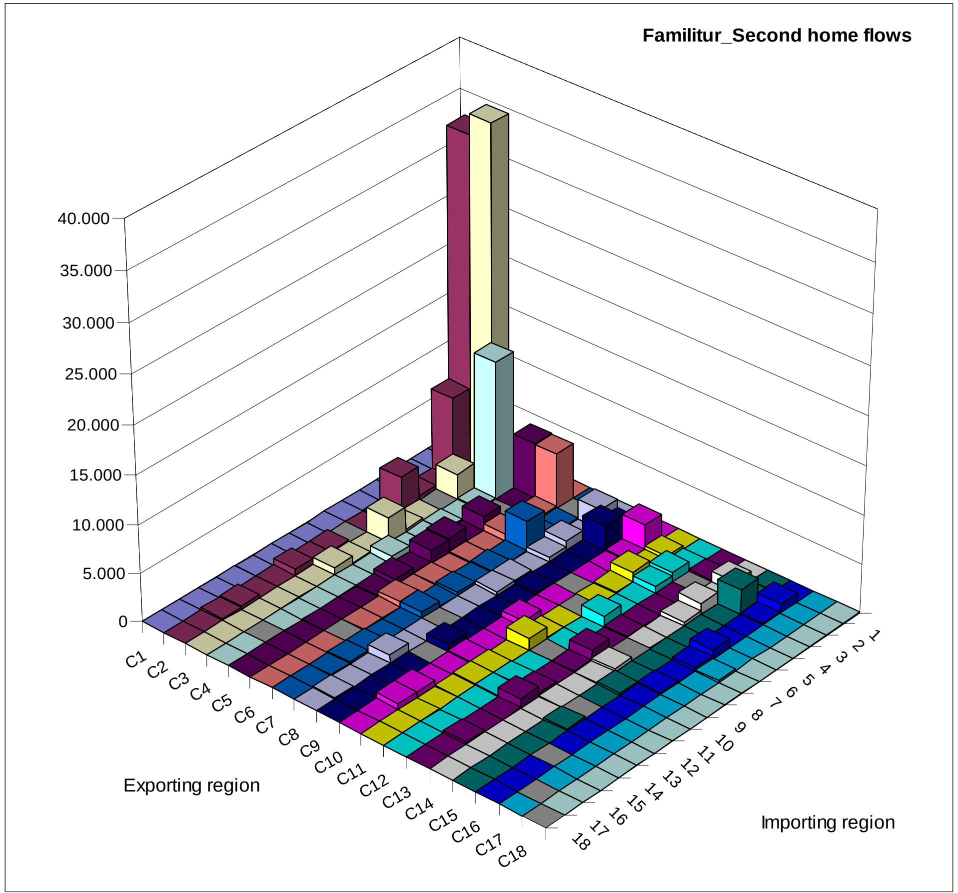


Figure 5. Bilateral flows in €. Second-Home Flows. Movilia 2001.

Ranked according to Familitur order

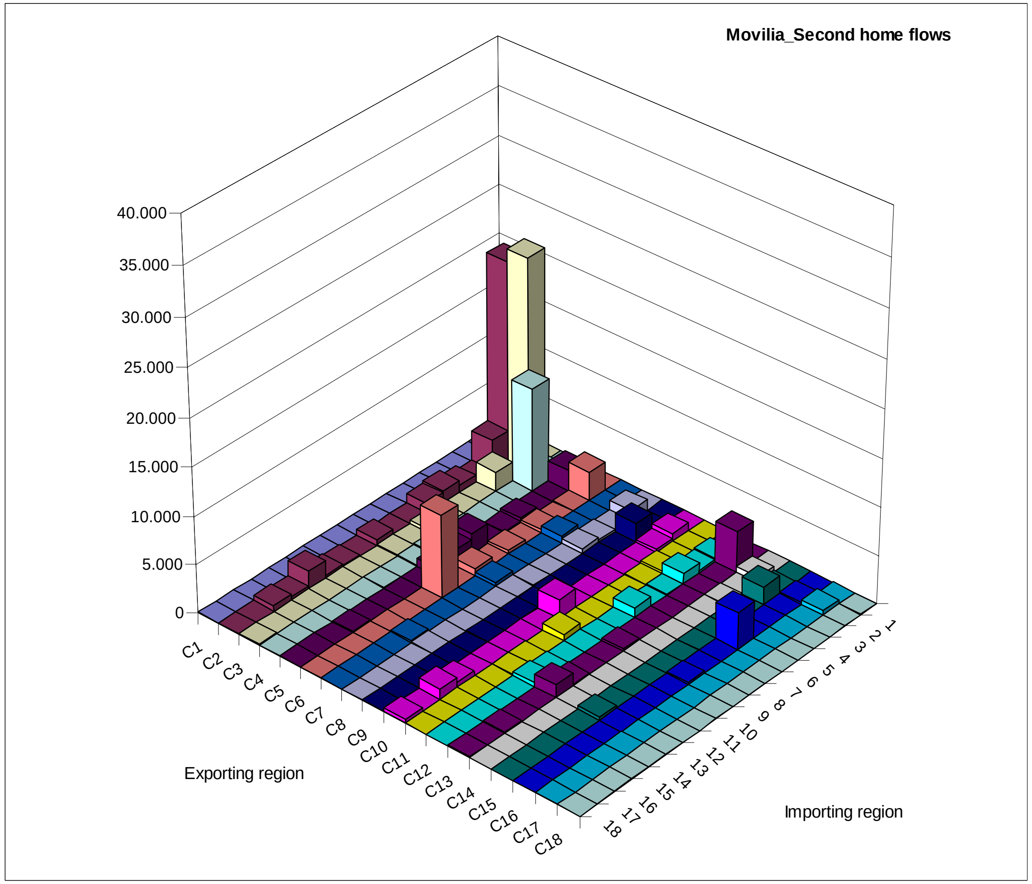


Figure 6. Bilateral flows in €. Tourist establishments. Movilia 2007
Ranked according to the Familitur 2001 order

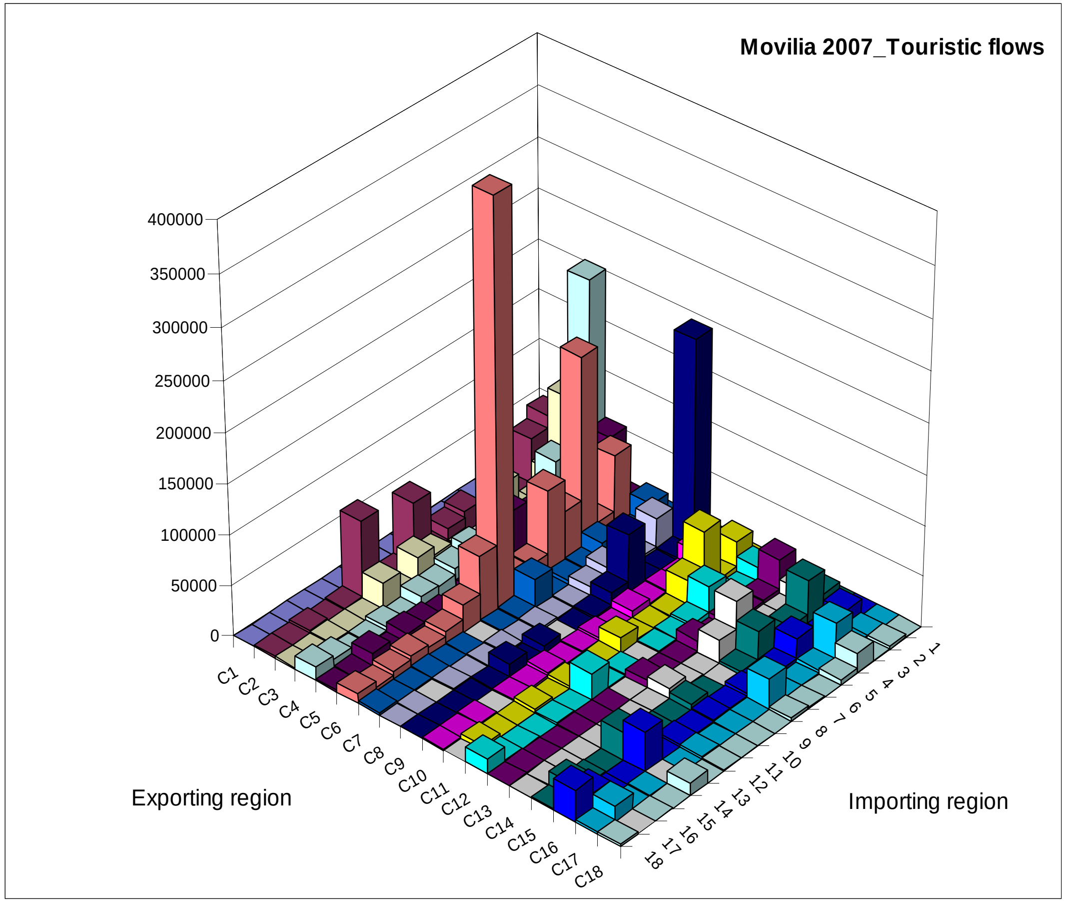
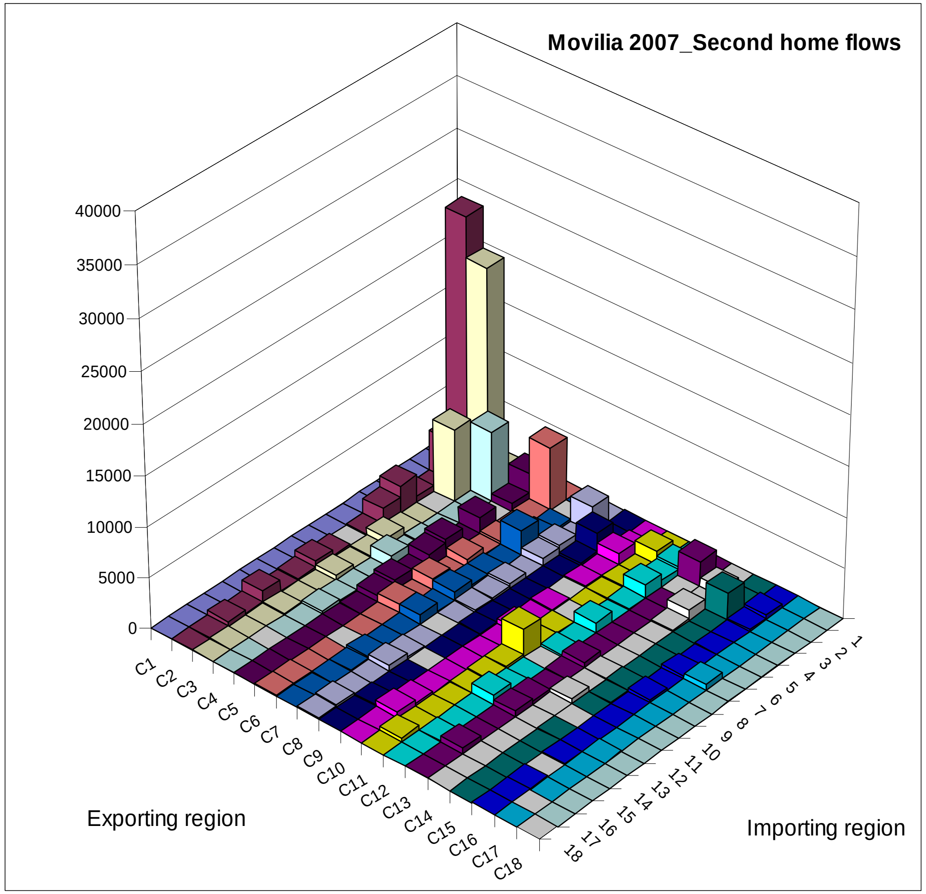


Figure 7. Bilateral flows in €. Second-Home Flows. Movilia 2007.
Ranked according to Familitur 2001 order



* The corresponding names of the regions are reported in **Table 10** in the Statistical Annex.

Figure 8. Bilateral flows in €. Tourist Establishments Flows (TEF). Based on Familitur 2001.

Units: in % of total TEF interregional flows.

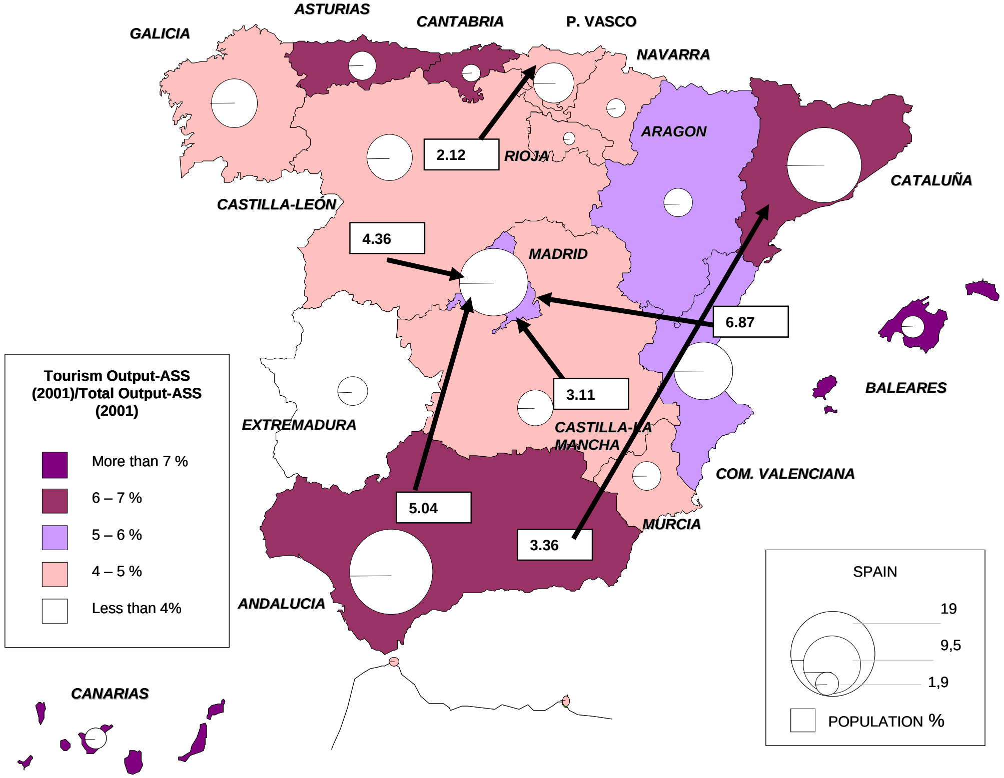


Figure 9. Bilateral flows in €. Tourist Establishments Flows (TEF). Based on Movilia 2001.

Units: in % of total TEF interregional flows.

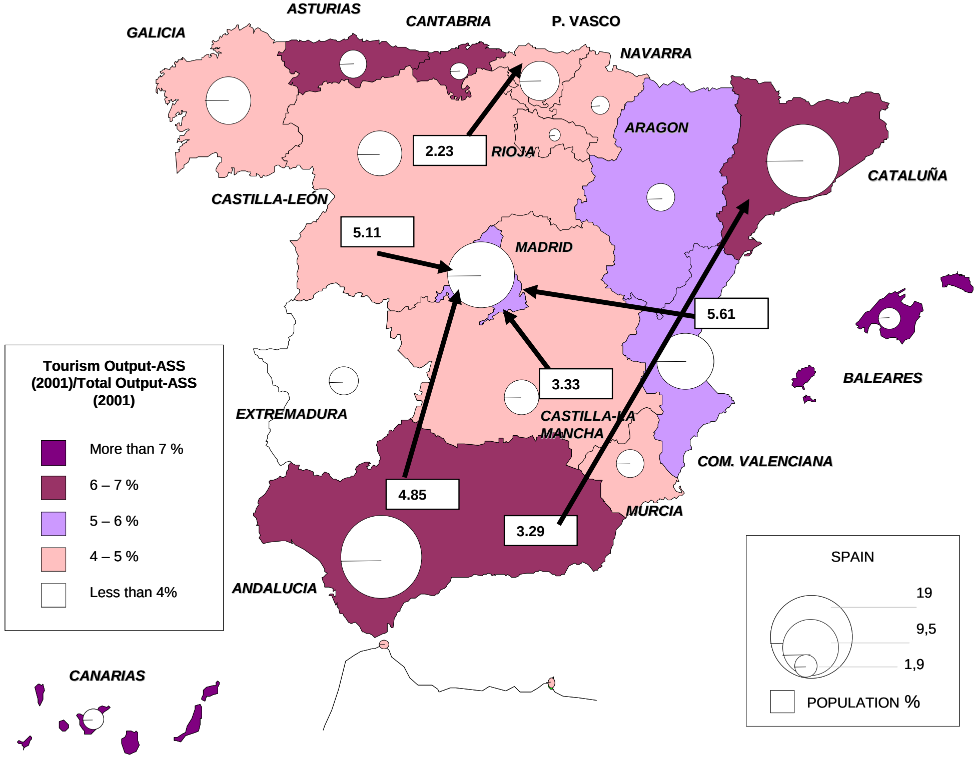


Figure 10. Bilateral flows in €. Second-home flows (SHF). Based on Familitur 2001.

Units: in % of total SHF interregional flows.

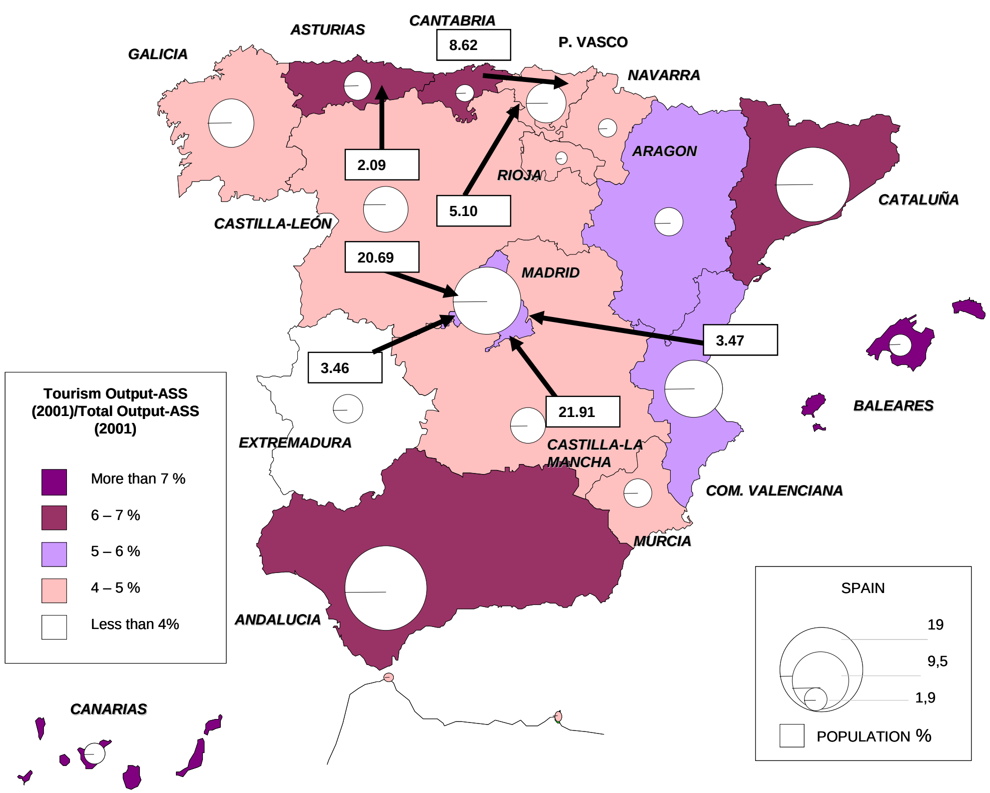


Figure 11. Bilateral flows in €. Second-home flows (SHF). Based on Movilia 2001.

Units: in % of total SHF interregional flows.

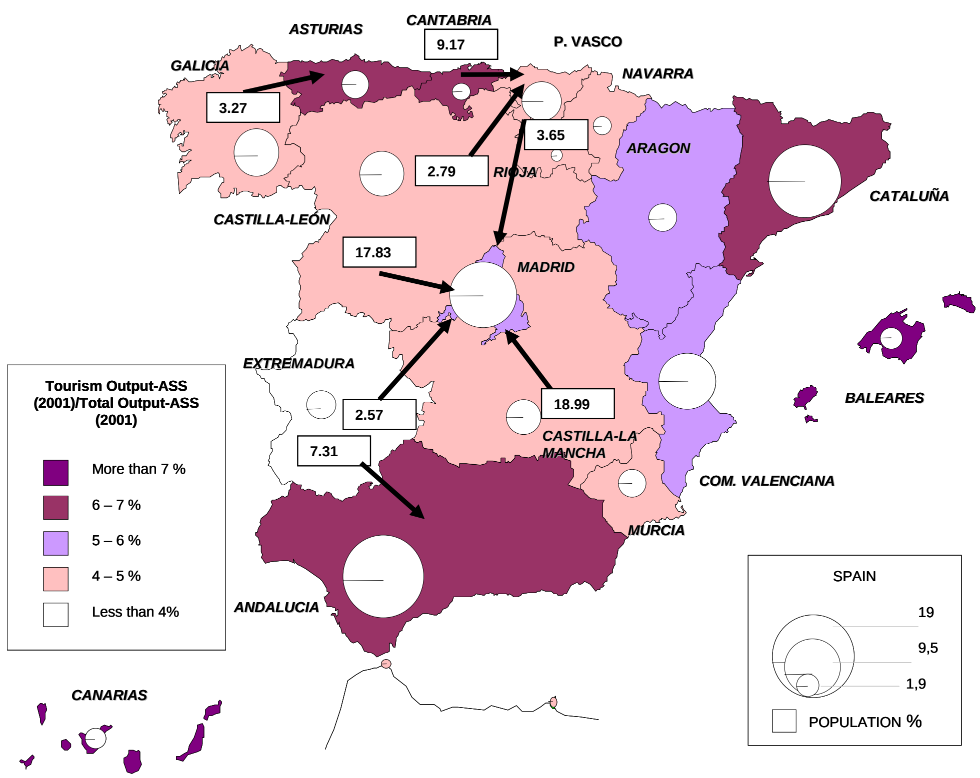


Figure 12. Bilateral flows in €. Total flows.
Based on Movilia 2007.
Units: in % of total interregional flows.

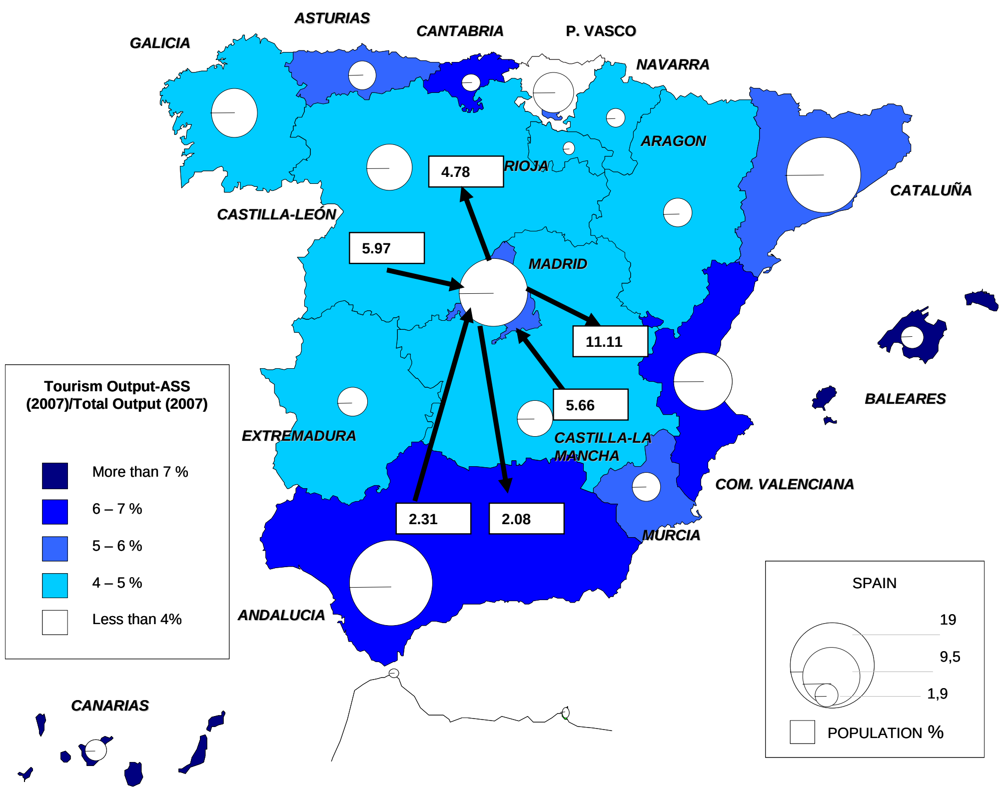


Figure 13. Bilateral flows in €. Total flows.
Based on Movilia 2001.
Units: in % of total interregional flows.

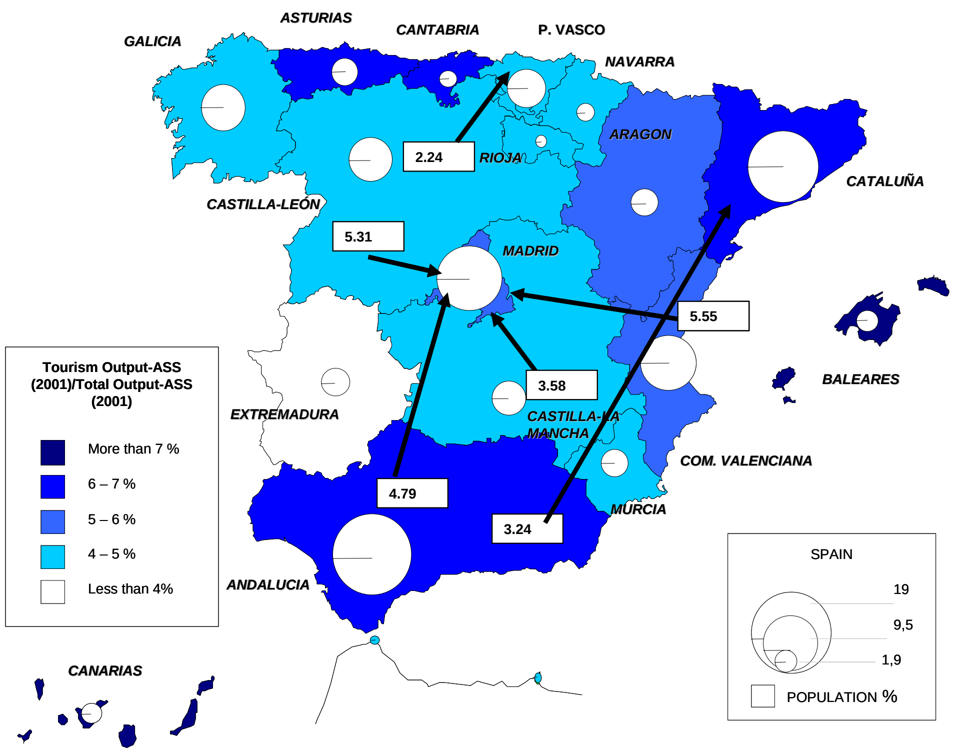


Figure 14. Bilateral flows in €. Tourist Establishments Flows (TEF). Based on Movilia 2007.
Units: in % of total TEF interregional flows.

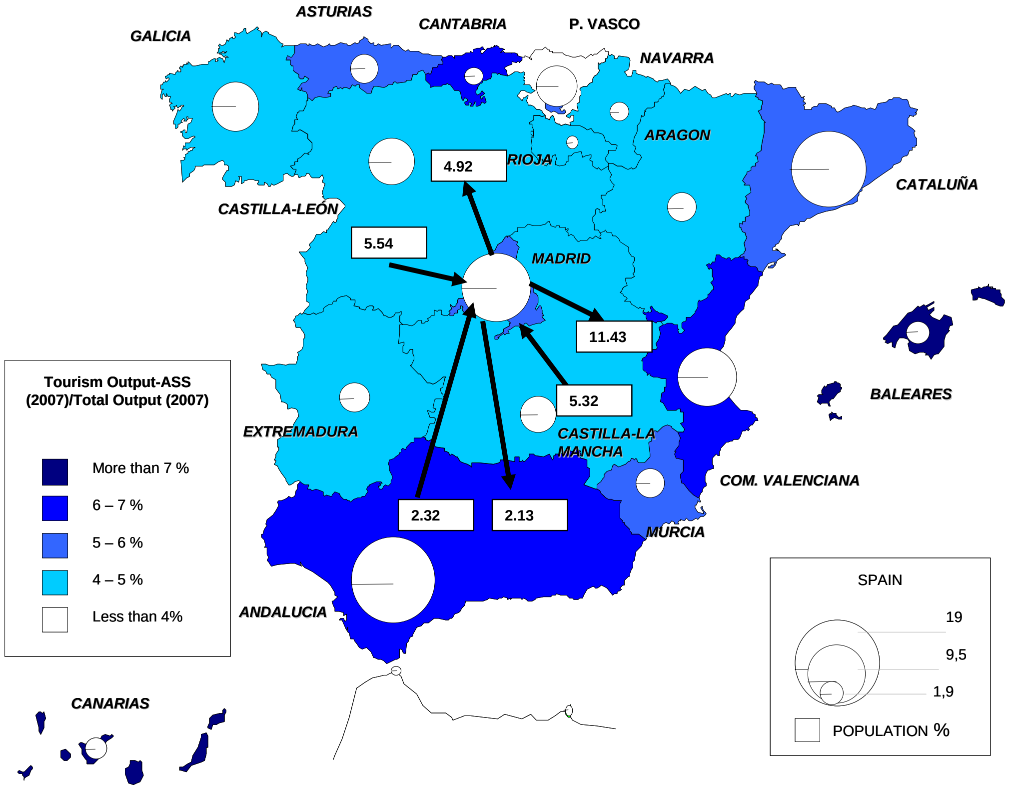


Figure 15. Bilateral flows in €. Second-home flows (SHF). Based on Movilia 2007.
Units: in % of total SHF interregional flows.