TOURISM AND URBAN TRANSPORT:

HOLDING DEMAND PRESSURE UNDER SUPPLY CONSTRAINTS

Daniel Albalate
&
Germà Bel

Universitat de Barcelona & ppre-IREA

Tel: 34.934021946
Fax: 34.934024573
e-mails: albalate@ub.edu , gbel@ub.edu

Corresponding Author: Germà Bel

Addresses (both authors the same) :
Dr. Daniel Albalate & Dr. Germà Bel
Dep. Política Econòmica – UB
Facultat Econòmiques – Torre 6, Planta 3
Avd. Diagonal 690
08034 Barcelona, Spain

Abstract

Scholars and local planners are becoming increasingly interested in the contribution of tourism to economic and social development. In the European cities that currently lead the world rankings for tourist arrivals, local governments have actively promoted tourism. Mobility is an essential issue for tourists visiting large cities, since it is a crucial factor for their comfort. It also facilitates the spread of benefits across the city. This study uses an international database of European cities to examine whether city planners respond to the additional demand for urban transport by extending service supply. Our results confirm that tourism intensity is a demand-enhancing factor in urban transport. However, cities do not seem to address this pressure by increasing services. Tourism appears to exert a positive externality on public transport, since it provides additional funding for these services, but it also imposes external costs on resident users because of the congestion caused by supply constraints.

Keywords: Tourism, Urban Transport, Local government.
JEL codes: H70**;** J68; L83; L98; R41.

Acknowledgements We thank the Spanish Commission of Science and Technology for financial support (SEJ2006-04985).

Tourism and urban transport: Holding demand pressure under supply constraints

1. Introduction.

The UNWTO World Tourism Barometer reports that international tourist arrivals reached 898 million in 2007 and are expected to rise to almost 1.6 billion by the year 2020. Europe, the region with the highest figures, expects to receive 527 million tourists by 2010 and over 700 million by 2020. These forecasts predict that Europe will receive more than half all the world's tourist at the end of the present decade (Table 1).[1] As a result, tourist arrivals play an important role in the economic development and the wealth of nations. In fact, according to the World Trade Organization, receipts from international tourism represented approximately six per cent of worldwide exports of goods and services in 2003. The spread of visitor expenditure on accommodation, food, drink, local transport, entertainment and shopping represents substantial benefits for local recipients.[2]

<< Insert table 1 about here >>

A significant share of tourist visits focus on a particular city as the main destination. Tourism today makes an important contribution to a city's economic success and social dynamism, and for this reason many cities in Europe have actively promoted the tourist industry in recent decades. Some examples are Barcelona (Spain), Berlin (Germany) and Amsterdam (The Netherlands), where the number of tourist visits has increased spectacularly over this period. These cities, together with traditional European tourist destinations such as London, Paris and Rome must deal with the pressures derived from the rise of the tourist industry.

---

[1] These figures were forecast before the worldwide economic down-turn in the second half of 2008. Tourism growth rates in the coming years may well be affected by this recession.
[2] See WTO Tourism Highlights (2007) for more information and data regarding tourism performance, economic impact, and forecasts.

Tourists arriving at international cities need mobility, and few decide (or can afford) to hire private transport. Because of this, the public transport system is an essential service for this population, especially in cities large enough to need bus, metro and train systems. However, in congested cities with weak public transport networks, the influx of tourists exerts additional demand pressure on the transport system. Tourists may end up competing with residents for limited urban resources, a situation that may cause significant negative local externalities which may even cancel out the positive ones related to their expenditure.

Several scholars have already stressed the importance of transport networks and infrastructure in tourism development (Kaul, 1985; Chew, 1987; Abeyratne, 1993; Prideaux 2000; Khadaroo and Seetanah, 2007, 2008). However, Lumdson and Page (2004) warn that academic specialists in the areas of transport and tourism have largely remained compartmentalized. One likely reason for this is the difficulty in identifying tourism transport as a discrete functional entity in order to conduct analysis and define policies (Page 1999). Indeed, there are very few articles in transport journals that make specific reference to tourism, just as there are few references to transport in tourism journals. Specifically, little attention has been given to competition between tourists and 'hosts' for public transport (Hall, 1999).

As the International Association of Public Transport recognized in the core brief prepared by the Regional Transport Committee in March 2003, public transport must adapt and accommodate to the new demand pressure presented by tourism and leisure. In fact, leisure and tourism services do not always require high investments, since tourism can optimize the use of existing staff, fleets, and infrastructure during slow periods.

For these reasons, we believe that it is important to establish whether or not city planners consider the number of tourist arrivals in their cities as a factor in the design of urban mass transport supply. The main hypothesis of the current study is that they do not, and that they base their projections for supply on other factors such as fiscal considerations, the needs of the city's residents, and features of the city itself. We expect to find that tourism clearly increases demand for public transport but does not positively influence service supply.

A reason for this policy is that city planners consider that it is possible to derive the maximum benefit from tourists merely by holding supply at the same level and tolerating a certain degree of congestion during tourist seasons, in order to take advantage of economies of scale and density. This would explain why in tourist seasons we find severe congestion in urban transportation systems while in the rest of the year the same supply can provide adequate service for local citizens. In this way, tourists subsidize local users of the transportation system by providing higher occupancy factors and increased revenues in off-peak periods (as opposed to peak periods on working days). Indeed, cross subsidies from international tourists to national users of transportation systems have been found for the Spanish airports in Bel and Fageda (forthcoming).

Our paper contributes to the existing literature by analyzing the effect of tourist arrivals on urban transport demand and supply. To do so, we use an international sample of European cities and a multivariate econometric analysis. The paper also provides interesting insights on factors explaining urban transport systems from both sides of the story (demand and supply). Our results confirm the hypothesis by showing that tourism is an obvious demand pressure but has no effect on the determination of supply. We also discuss the different impacts of the variables used to explain supply and demand equations.

The rest of the paper is organized as follows. In the next section we explore the relationship between tourist arrivals and urban transportation, while the third section describes the empirical strategy applied to test the main hypothesis. Section four present our main results. Section five concludes.

2. Relationship with the literature.

Transport supply comprises a broad range of modes, from large infrastructures such as airports to bus network systems within cities. It is an essential utility for tourists as they move around the city, visiting urban attractions, returning to their accommodation, and so on. In fact, as Page (2005) describes, the transport and tourism industries are very closely linked .

Hall (1999, p. 181) identified four different roles with respect to the supply side of tourist transport. First, linking the origin market with the tourist destination; second, providing access and mobility within a wide destination area (region or country); third, offering access and mobility within a tourist attraction; and providing travel along a recreational route.

Most research has been devoted to analyzing the effects of the development of transport linking source markets and tourist destinations. Kaul (1985) emphasized the importance of the transport system as a key factor in developing tourism attractiveness and activities. Chew (1987) discussed how the expansion of air transport allows the expansion of the range of available areas – and particularly the Asia Pacific region – for affluent tourists from Europe and America. More recently, the growth of the low-cost model has helped to expand international intra-continental tourism, by providing more frequent and cheaper transportation to tourist destinations (Bel, forthcoming). Crouch and Ritchie (1999) noted the competitive advantage that a proper supply of infrastructure – particularly transport infrastructure – provides for tourism development. More recent work, such as the studies by Naudé and Saayman (2005) and Khadaroo and Seetanah (2007, 2008), provides multivariate empirical analysis on the relationship between transport supply and tourism development.

Other authors have focused their attention on the role of transport within the wider destination area. Lundgren (1982) analyses tourist flows between metropolitan and rural destinations, and Pearce (1987) focuses on tourist transportation between a city – considered as a locational base – and other tourist destinations around that city.

However, much less attention has been paid to the third role stressed by Hall (1999), that of providing access and mobility within a tourist attraction or destination. Given its importance as a necessary service to improve quality, offering efficient urban transport can help to derive maximum benefits from tourism and to spread these benefits across the city.[3] Indeed, better transport performance heightens comfort and efficiency during a tourist's stay. In the opposite scenario – if the ability of tourists to travel to a preferred destination is hampered by inefficiencies in the transport systems – then they may well seek alternative destinations (Khadaroo and Seetanah, 2008) or the number of attractions visited during their stay may fall.

As a result, the obvious demand pressure on urban transport systems produced by tourism should be accommodated by local governments and city planners. According to Kaul (1985), this accommodation is an essential ingredient of the development and success of tourism, and must continue to grow in order to meet an increasingly diverse demand. For this reason, planners must meet two objectives in their design of public transport supply in response to tourism. The first is to provide efficient and comfortable transport systems to cater for tourist needs and to maximize the benefits derived from their stay. The second is to minimize the negative externalities received by local citizens from transport congestion, especially during tourist seasons.

However, some of the cities that have experienced spectacular increases in tourism in recent years have not followed these recommendations. A good example of this is Barcelona (Spain), which is considered one of Europe's most attractive international tourist destinations. Since 2003 no major changes have been introduced in the city's public transport supply – the metro supply has risen by 11% in four years, while the bus supply

[3] Kaul (1985) recognizes that transport plays an important role in the successful creation and development of new attractions and also stimulates city transformation.

has remained the same. Over the same period the number of taxis has in fact fallen, by 1%. At the same time, numbers of international tourists, usually the population most in need of urban public transportation, have grown by almost 50% in four years.[4] Clearly, the urban public transport supply has not accommodated the new demand pressures from tourists. Urban transport congestion in the high tourist season has risen and both the quality of the service and the income from tourism have fallen.

In off-peak hours and holidays, however, the presence of tourists in the transportation system can facilitate the provision of the service at times there are too few local users to justify maintaining normal frequencies and quality standards. So, in this way, tourists cross-subsidize local users. Again, the example of Barcelona is very helpful to illustrate the existence of these cross subsidies. Only two of the bus services in the metropolitan area of Barcelona are financially profitable: the route connecting the airport to the city center, and the *Bus Turistic* (the city tour bus). Both these services are closely linked to tourism. The revenues from these lines are used to offset the permanent operational deficits run up by the rest of the transportation system, since there is a single agency that regulates, manages and funds the system as a whole. [5] We can gain an idea of the impact of the tourist routes on the rest of the urban transportation system from the fact that the revenue from the city tour bus in 2007 was more than 30 million Euro, approximately 20% of the total revenue from the city's urban bus routes for the same year. [6] This share is all the more remarkable if we consider that the number of passengers on this service accounted only 1% of the total number on the city's entire network.

[4] We consider only international tourists, because domestic tourists in Europe can travel by private cars, since many destinations in Europe are within easy reach by road. International tourists are obviously less likely to bring their own cars.

[5] The Public Metropolitan Agency in charge of the transportation system in Barcelona is the "Entitat Metropolitana del Transport". This agency is responsible for providing the service and for contracting private operators in the contracted-out routes. The agency manages the funding of the system as a single network by covering loss-making operations with public budget contributions, as well as via the profits made on the route connecting the city to the airport.

[6] Official data are obtained from the city council of Barcelona (Department of Statistics). Inter-urban and night routes are excluded.

Tourism causes negative externalities for the mobility of local residents, who tend to object to tourism for this reason and blame the local authorities for the lack of public planning. However, tourists using urban transport systems provide substantial revenue and may even cross-subsidize local residents, since the average price paid by tourists on urban transport is likely to be higher than that paid by local users who take more advantage of multi-trip and other special discount schemes.

3. Empirical Strategy.

In this section we describe the data used and the models considered to test our hypothesis.

3.1 Data

The data used in this research were obtained from the Mobility in Cities Database (MCD), which is provided by the International Association of Public Transport (UITP). This database offers 120 indicators of public transport from 50 cities worldwide, though in fact most of them are in Europe. In order to improve the homogeneity of the sample, we used information from 45 European cities and did not include cities from outside Europe.

Table 2 shows the cities and some of their socio-demographic characteristics in order to illustrate the variability of our sample. **Table 3** classifies these cities by region. This variety captures a wide range of social and economic attributes and heterogeneous institutional frameworks, and avoids the risk that results might be biased by the presence of certain types of city. Nonetheless, we should stress that Mediterranean and central European metropolitan areas are slightly more represented than the rest of the regions (Northern and Eastern).

<< Insert tables 2 and 3 about here >>

Additionally, we use information regarding tourist arrivals compiled by the Euromonitor International, which ranks the 150 cities with the highest number of annual tourist arrivals in the world. Using this ranking, we construct a variable of tourism intensity to account for both supply and demand in public transport, as we explain in the next sub-section.

3.2 The Model

Here we extend the empirical model presented in Albalate and Bel (2008) on factors explaining urban public transport systems by introducing tourism intensity variables. The equation system to be estimated in order to explain urban transport supply and demand for these 45 European cities can be expressed in the following double log specification form:

$$Supply_i = \ln(\frac{place-km}{population})_i = \alpha + \beta_1 \ln(GDP_i) + \beta_2 \ln(DENS_i) + \beta_3 \ln(PRICE_i)$$
$$+\beta_4 \ln(OCOST_i) + \beta_5 \ln(FLEET_i) + \beta_6 D^{capital}{}_i + \beta_7 TOUR_i + \varepsilon_1 \qquad (1)$$

$$Demand_i = \ln(\frac{passenger-km}{Population})_i = \delta + \lambda_1 \ln(GDP_i) + \lambda_2 \ln(DENS_i) + \lambda_3 \ln(PRICE_i) +$$
$$\lambda_4 \ln(PUB\_SPEED_i) + \lambda_5 \ln(MOTOR_i) + \lambda_6 \ln(FLEET_i) + \lambda_7 D^{capital}{}_i + \lambda_8 TOUR_i + \varepsilon_2 \qquad (2)$$

where the first equation refers to supply and the second to demand. The sub-index *i* refers to each particular city. The dependent variables are, respectively, the number of place-km per capita in the case of the supply equation, and the number of passenger-km per capita for the demand equation.

Several variables enter the supply and demand equations as covariates in order to explain urban transport systems. The variables and their expected relationships with dependent variables are described below.

GDP: Gross domestic product per capita. This variable captures income and economic activity. Richer cities can provide better, more extensive transport systems. At the same time, trips are positively correlated with income, and for this reason we expect positive impacts on both demand and supply equations.

DENS: Urban population density. This variable captures the city's characteristics and form. Denser cities are expected to have larger transport systems since supply becomes profitable by taking advantage of scale and density economies. Density is considered to explain both transport demand and supply.

PRICE: Average price charged to urban transport users. Prices are usually regulated by public authorities and are rarely driven by market forces (demand). Price-setting is usually a political matter, and for this reason price does not cause endogeneity problems in the supply equation. Because of this rigidity, we do not expect prices to influence transport supply. However, prices affect demand decisions and for this reason we will expect strong impacts on transport demand.

OCOST: Average operating cost of one public transport place-km. This variable reflects the operating cost of providing each place-km. We therefore expect a negative relationship between the operational cost and transport supply. The more expensive the service, the lower the number of place-km offered by public authorities.

FLEET: The fleet of vehicles available for public transport purposes. Within this category we identify the number of buses (BUSES), metro trains (METRO) and trams (TRAM). The higher the number of vehicles, the higher the number of place-km per capita. In addition, the provision of more vehicles suggests better service and as a result, higher transport demand. Therefore, this variable is expected to affect both equations positively.

$D^{capital}$: A dummy variable taking value one if the city is a political capital and zero otherwise. This variable will help us to identify possible biases deriving from the status of the city and the service-specific characteristics of capitals. Out of 45 cities in our sample, 22 were capitals (48%).[7]

PUB_SPEED: Average speed of public transport vehicles in operation. As speed is associated with service quality, we expect positive relationships between speed and transport demand.[8]

MOTOR: Motorization, constructed as the number of private vehicles per thousand inhabitants. More private vehicles tend to reduce the incentive to use public transport. For this reason we expect negative relationships between car ownership and public transport demand.[9]

TOUR: Tourism intensity. This is a categorical variable considering the number of tourist arrivals. This variable (the key variable for testing our hypothesis) is constructed using the world ranking of tourist arrivals provided by *Euromonitor International.* Since several cities in the database do not appear in the World Ranking of the 150 cities with the most tourist arrivals, it is better to avoid the use of the number of arrivals as a continuous variable. We therefore decided to create an index of tourism intensity, named TOUR. TOUR is a categorical variable constructed as follows. In the cities among the world's top 25 for numbers of tourist arrivals, the categorical variable takes value 6. Cities coming between 26th and 50th are assigned the value 5, cities between 51st and 75th a value of 4, and so on until value 0, which is given to the last cities in the table (126th to 150th).[10] **Table 3** displays the values given to the variable TOUR for each city in the sample.

---

[7] Within these 22 political capitals we count Amsterdam, since it is the official capital of the Netherlands. Nonetheless, the government head office is in The Hague.

[8] One can argue that speed also affects transport supply since it decreases operational costs. However, we have already introduced operational costs in the supply equation.

[9] Low supply of public transport may increase the need for private vehicles. In this regard, motorization would be affected by public transport supply. The inverse relationship is not so clear. For this reason we avoid the use of motorization in the supply equation. In fact, even when we introduce this variable, our results do not change and motorization itself is not statistically significant at all.

[10] Other arbitrary distributions of values for this categorical variable do not change our estimation results.

<< Insert table 4 about here >>

<< Insert table 5 about here >>

Descriptive statistics and expected signs associated with the variables defined above are displayed in **table 5.** The correlation matrix for all these variables can be consulted in the appendix (**Table A1**).

In fact, equations 1 and 2 can be considered reduced form equations in the sense that we also use full form equations by identifying different vehicle types within the FLEET variable. This disaggregation involves a modification of the extension made in equations 1 and 2 of the empirical model by Albalate and Bel (2008). As a result, the full form equations to be estimated (equations 3 and 4) can be expressed as follows:

$$Supply_i = \ln(\frac{place-km}{population})_i = \alpha + \beta_1 \log(GDP_i) + \beta_2 \ln(DENS_i) + \beta_3 \ln(PRICE_i)$$
$$+\beta_4 OCOST_i + \beta_5 BUSES_i + \beta_6 METRO_i + \beta_7 TRAM_i + \beta_8 D^{capital}{}_i + \beta_9 TOUR_i + \varepsilon_1 \quad (3)$$

$$Demand_i = \ln(\frac{passenger-km}{Population})_i = \delta + \lambda_1 \ln(GDP_i) + \lambda_2 \ln(DENS_i) + \lambda_3 \ln(PRICE_i) +$$
$$\lambda_4 \ln(PUB\_SPEED_i) + \lambda_5 \ln(MOTOR_i) + \lambda_6 \ln(BUSES_i) + \lambda_7 \ln(METRO_i) +$$
$$\lambda_8 \ln(TRAM_i) + \lambda_9 D^{capital}{}_i + \lambda_{10} TOUR_i + \varepsilon_2 \quad (4)$$

where this time BUSES, METRO and TRAM refer to the number of vehicles per million inhabitants by each of these three modes. The last columns in **table 5** present our hypotheses on the expected impacts of the covariates used on each dependent variable.

4. Estimation and Results.

4.1 Cluster Analysis.

Before presenting our econometric estimation, we first compare and cross city characteristics and the tourism index. This is not the core of our analysis because we wish to test how tourism intensity affects public transport supply and demand. This relationship will be studied using the econometric strategy presented. Nonetheless, it is important to our analysis to establish whether similar cities – similar in terms of socio-demographic, economic and transport perspectives – enjoy similar rates of tourist arrivals. If this is the case, the use of a tourism intensity variable would capture these characteristics and bias the interpretation of the role played by tourism in urban public transport systems.

A first step is to use a cluster analysis, which encompasses different algorithms and methods for grouping observations according to their similarity in such a way that the degree of association between two objects (cities) is maximal if they belong to the same group, and minimal otherwise. Once all cities are grouped according to their characteristics, we will compare them with the tourism intensity index in order to see whether similar cities receive a similar number of tourist arrivals or whether, as expected, there are other important factors that explain a city's attractiveness to tourists other than their socio-demographic and economic attributes.

The type of cluster analysis undertaken is known as K means. The objective of this strategy is to minimize the sum of squares within a group or cluster when dividing the sample into categories. This method assigns each observation to the nearest cluster in terms of its centroid. The distance measure is Euclidian. In a K means cluster analysis we must first determine a number of clusters. In this case, in order to facilitate comparison with the tourism intensity index we assume the existence of six groups of cities (k=6). Given a fixed number of desired k clusters, the method assigns observations to these clusters so that the means across clusters (for all variables) are as different from each other as possible.

The variables used to group our cities are some important socio-demographic and economic characteristics, as well as a pair of variables affecting transportation. These variables are: Population, GDP per capita, Urban population density, Motorization, and the number of public transport vehicles per million inhabitants. Results of this grouping strategy are displayed in **table 6**.

<< Insert table 6 about here >>

As the table shows, this strategy is enough in a few groups to roughly predict the number of tourist arrivals. Therefore, city characteristics and the transportation system are relevant by themselves to explain their relationship with tourism in these groups of cities. The phenomenon is particularly intense in the case of groups 4 and 5. However, in most cases, this is not enough to determine the relationship between tourism and city characteristics, and we need other factors to explain tourism attraction diversity. Therefore, we do not need to suffer from colinearity with the introduction of a tourism intensity variable in our specification. In fact, this variable is not highly correlated with any of the variables of our specification, as we show in the correlation matrix in the appendix (**table A1**).

4.2 Econometric estimates.

We first estimate our equation system using the Heteroskedasticity-Robust Ordinary Least Squares estimator (OLS) separately for each equation. We then implement a SUR model (Seemingly Unrelated Regression, also called joint generalized least squares or Zellner estimation), which jointly estimates the equation system allowing for correlation between error terms through equations.[11] This latter strategy is used when it is unrealistic to expect errors in a set of equations to be uncorrelated. This is a more efficient estimator than OLS. Indeed, substantial efficiency gains are expected while contemporaneous disturbances in different equations are highly correlated.[12] The SUR method uses the correlations between the errors in different equations to improve the regression estimates, but requires an initial OLS regression to compute residuals. The OLS residuals are used to estimate the cross-equation covariance matrix.

Table 7 displays our results for separate and joint estimations. Overall explanatory power is high for every method of estimation and for every equation, especially for those of demand. As a first stage, we compare reduced and full models for supply and demand equations. The full model includes the specific type of vehicle – which depends on the transport mode. The reduced model only uses an aggregate variable for all vehicles (FLEET). The results of F-tests of joint significance show that reduced form models perform better than the full models. Moreover, this disaggregation does not add significant explanatory power to the model (R^2) and we lose some degrees of freedom due to the increased number of parameters. For this reason, we decided to apply the SUR model only for reduced form equations.[13] We also checked that the relationships between the variables found to be statistically significant in the reduced form models did not undergo important changes, confirming the robustness of their effects on the dependent variables.

Leaving tourism intensity aside, interesting results arise from our estimations of the factors explaining urban transport systems. As in Albalate and Bel (2008), in separate estimations we find that GDP, the number of total vehicles and being a capital city, all produce positive impacts on the supply side of transport systems. In contrast, operational cost is the main variable pushing in the opposite direction by affecting negatively the

[11] In SUR strategy the equations are estimated as a set to increase efficiency.
[12] See the seminal work by Zellner (1962) on Seemingly Unrelated Regression Equations.
[13] For simplicity's sake we only provide reduced form equations in our SUR model. Nonetheless, including the rest of variables by using full form equations does not change the model's results.

number of place-km per capita (supply). The rest of the variables, including the average price of a passenger-km, are not statistically significant.

Regarding demand equations we find that GDP, the fleet of vehicles provided, and being capital city status are positively correlated with the number of passenger-km per capita. On the other hand, private motorization and the average price of public transport have a statistically significant but negative impact on transport demand. The rest of variables do not have any statistically significant impact. Once each equation is determined separately, we run a joint SUR model and find that the results provide only a few changes. In fact, only the coefficient associated with private vehicle motorization loses its statistical significance.

Our results support our main hypothesis on the relationship of tourism and urban transportation. As expected, the variable of tourism intensity (TOUR) is highly statistically significant in demand determination when estimated either separately or jointly with urban transport supply. However, its coefficient is not statistically significant for supply equations. Tourist arrivals push urban transportation demand upwards, but we do not find that cities with higher tourism intensity present higher public transport supply. This result seems to confirm our initial hypothesis, that is, that public transport supply does not seem to accommodate tourism intensity. The cities with the highest demand for public transport due to tourism do not increase the supply of this service, but hold higher demand with the same number of place-km per capita.

<<Insert table 7 about here >>

To show that our results are not driven by the decision to construct a tourism intensity variable based on a categorical nature, we replicate the same estimation model but substitute the TOUR variable with the absolute number of tourist arrivals in the city. With this change we lose the observations of those cities not included in the ranking of 150 cities with most tourist arrivals, but it is useful as a robustness check of our main result. This variable is now named TOUR_ARRIVALS and the new results are displayed in **table 8**.

<< Insert table 8 about here >>

As shown, the continuous variable related to tourism intensity still presents the same impacts as the categorical variable. Moreover, even losing several observations and making the sample smaller, most coefficients retain the relationships that were found previously. This can be understood as a sign of robustness in those relationships. In the supply equation we again find that tourism is not considered in the design of the number of place-km per capital served. In contrast, its coefficient is statistically significant and positive in the demand equation. Therefore, we can affirm that, even when several observations are lost and the estimation is less robust than the previous one, the main result is not affected by the choice of variable used to consider tourism. In fact, we believe that tourism intensity is better identified by this continuous variable, but we understand that – in terms of the whole estimation model – the results derived from its use are less robust. In addition, changes in the initial sample do not seem to affect the main relationships, especially that of tourism with urban public transport systems.

5. Final remarks.

Tourism represents an obvious demand pressure for urban mass transportation, as the econometric estimations presented here confirm. Nonetheless, this pressure does not seem to be addressed by the supply side. In fact, our results suggest that tourism does not directly affect supply decisions regarding the annual number of place-km delivered.

The rationale behind this planning strategy could be based on the incentive provided by tourist arrivals as a revenue-increasing factor that helps to fund the transportation systems. Tourists' need for intensive mobility and the fact that they cannot usually take advantage of the discount packages designed for local users means that their additional demand pressure also helps funding, especially during off-peak periods. In this regard, tourists using urban public transportation raise the occupancy rate of vehicles, making the maintenance of frequencies and service quality less costly in periods in which local demand is not high. As a result, tourism is seen by planners as an effective way to subsidize the transport service. From the local point of view, this can be considered as a positive externality of their arrival. Tourist arrivals are usually concentrated around weekends and during holiday periods, times when local residents make less use of public transportation; the main reason for residents' trips is work-related travel, and this need is much higher on weekdays during non-vacation seasons. Therefore, this time and space divergence between residents and tourists favors the strategy of using tourist customers to fund transportation in low-demand slots and/or seasons.

However, if tourist arrivals coincide with peak-time periods in the public transport system, the additional demand pressure from tourism imposes negative external costs on local commuters in terms of comfort and congestion, given the supply invariance confirmed by the present study. In this case, tourist arrivals imply a negative externality on local users of public transportation by making travel and access less comfortable. In fact, this additional demand pressure merely aggravates the social costs of transport in congested periods if pricing is not designed with a view to internalizing externalities. As Page (2005) 2003; p. 319) asserts, "tourism can emerge as a source of conflict between hosts and visitors in destinations where its development leads to perceive and actual impacts".

As a consequence of both these externalities, city planners must balance the positive and negative effects of tourist use of public transportation by managing supply. On the one hand, if the city does not take advantage of the opportunity offered by tourists to fund services because of the increased occupancy factor in off-peak periods and holidays, then the system will incur larger deficits. This foreign cross-subsidy allows city planners to reduce the average charges to local users (or alternatively reduce budget subsidies to the transportation system).

Moreover, planners must be aware that regular supply in peak-time periods that coincide with high tourist arrivals can aggravate the competition for limited resources and urban spaces between residents and tourists. Therefore, there is a balance that has to be considered and managed when using cross subsidies from tourists as a contribution to transport funding. Ignoring negative externalities when they emerge could make the service provided less efficient and less convenient, and may damage the reputation of the city as a tourist destination in the long run, particularly if the global industry continues to produce new tourist destinations that are keen to compete with the ones already established.

References

Abeyratne, R. (1993). Air transport tax and its consequences on tourism. *Annals of Tourism Research*, 20 (3), 450-460.

Albalate, D. & Bel, G. (2008). Factors explaining urban transport supply and demand in large European cities. Working papers of the Research Institute on Applied Economics. Universitat de Barcelona.

Bel, G. (forthcoming). How to compete for a place in the World with a hand tied behind your back: The case of air transport services in Girona. *Tourism Management*, forthcoming.

Bel, G, & Fageda, X. (forthcoming). Preventing competition because of solidarity: Rhetoric and reality of airport investments in Spain. *Applied Economics*, forthcoming.

Chew, J. (1987). Transport and tourism in the year 2000. *Tourism Management*, 8 (2), 83-85.

Crouch, G.I. & Ritchie, J.R.B. (1999). Tourism, Competitiveness, and Societal Prosperity. *Journal of Business Research*, 44 (3), 135-152.

Hall, D.R. (1999). Conceptualising tourism transport: inequality and externality issues. *Journal of Transport Geography*, 7 (3), 181-188.

Kaul, R. (1985). *Dynamics of tourism: A trilogy,* 111. New Delhi: Transportation and Marketing.

Khadaroo, J. & Seetenah, B. (2007). Transport infrastructure and tourism development. *Annals of Tourism Research*, 34 (4), 1021-1032.

Khadaroo, J. & Seetenah, B. (2008). The role of transport infrastructure in international tourism development: A gravity model approach. *Tourism Management*, 29 (5), 831-840.

Lumdson, L. & Page, S.J. (2004) *Tourism and transport: issues and agenda for the new millennium*, Elsevier, Oxford.

Lundgren, J.E. (1982). The tourist frontier of Nouveau Quebec: Functions and regional linkages. Tourism Reviews. 37 (2), 10-16.

Naudé, W.A. & Saayman, A. (2005). Determinants of tourist arrivals in Africa: A Panel Data Regression Analysis. *Tourism Economics*, 11 (3), 365-391.

Page, S.J. (1999) *Transport and tourism*. Harlow: Longman.

Page. S.J. (2003) *Tourism Management: Managing for change.* Butterworth-Heinemann, Elsevier. Burlington MA.

Page, S.J. (2005) *Tourism and Transport: global perspectives*. Harlow: Pearson/Prentice Hall. Second Edition.

Pearce, D. (1987). *Tourism today: A geographical analysis*. Harlow: Longman.

Prideaux, B. (2000). The role of the transport system in destination development. *Tourism Management*, 21 (1), 53-63.

World Trade Organization (2007). *Tourism Highlights 2007 Edition.* The World Trande Organization: Madrid.

Zellner, A. (1962) An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American Statistical Association,* 57 (298), 348-368.

TABLES

Table 1. International tourist arrivals forecasts by region (1995-2020)

Region	**1995**	**2010**	**2020**	**Share 2010**
Total	565	1,006	1,561	100
Africa	20	47	77	4.8
Americas	109	190	282	18.8
East Asia/Pacific	81	195	397	19.4
Europe	338	527	717	52.4
Middle East	12	36	69	3.6
South Asia	4	11	19	1.1
Type of journey	**1995**	**2010**	**2020**	**Share 2010**
Intraregional (a)	464	791	1,183	3.8
Long-haul (b)	101	215	378	2.4

Source: UVWTO Highlights 2008

Table 2. European cities in the database and socio-demographic characteristics

Metropolitan Area	Population	GDP	Urban Pop. Density	%Jobs central business district
Amsterdam	850,000	34,100	57.3	19
Athens	3,900,000	11,600	65.7	17.4
Barcelona	4,390,000	17,100	74.7	12.5
Berlin	3,390,000	20,300	54.7	n.a.
Bern	293,000	35,500	41.9	15.2
Bilbao	1,120,000	20,500	51.9	11.8
Bologna	434,000	31,200	51.6	29.9
Brussels	964,000	23,900	73.6	26.3
Budapest	1,760,000	9,840	46.3	10.2
Clermont-Ferrand	264,000	24,200	44.5	14.5
Copenhagen	1,810,000	34,100	23.5	10.2
Dublin	1,120,000	35,600	25.9	n.a.
Geneva	420,000	37,900	49.2	19.2
Gent	226,000	26,700	45.5	n.a.
Glasgow	2,100,000	20,600	29.5	16.7
Graz	226,000	29,600	31	19.4
Hamburg	2,370,000	38,800	33.9	n.a.
Helsinki	969,000	36,500	44	16.1
Krakow	759,000	7,010	58.4	n.a.
Lille	1,100,000	21,800	55	6.8
Lisbon	2,680,000	17,100	27.9	46.3
London	7,170,000	36,400	54.9	21.8
Lyons	1,180,000	27,100	40	15.5
Madrid	5,420,000	20,000	55.7	34.6
Manchester	2,510,000	22,400	40.4	10.4
Marseilles	800,000	22,700	58.8	23.4
Milan	2,420,000	30,200	71.7	n.a.
Moscow	11,400,000	6,060	161	12.2
Munich	1,250,000	45,800	52.2	33
Nantes	555,000	25,200	34.7	19.6
Newcastle	1,080,000	18,400	42.5	18.4
Oslo	981,000	42,900	26.1	14
Paris	11,100,000	37,200	40.5	14
Prague	1,160,000	15,100	44	37.2
Rome	2,810,000	26,600	62.6	22.6
Rotterdam	1,180,000	28,000	41.4	18.9
Sevilla	1,120,000	11,000	51.1	22.2
Stockholm	1,840,000	32,700	18.1	13.7
Stuttgart	2,380,000	32,300	35.3	7.85
Tallinn	399,000	6,880	41.9	n.a.
Turin	1,470,000	26,700	46.1	11.8
Valencia	1,570,000	14,300	50.2	n.a.
Vienna	1,550,000	34,300	66.9	12.1
Warsaw	1,690,000	13,200	51.5	58
Zürich	809,000	41,600	44.5	12.2

Source: Mobility in Cities Database (UITP)

Table 3. European cities in the database by region.

Mediterranean	**Center-Europe**	**Northern**	**Eastern**
Athens	Amsterdam	Copenhagen	Budapest
Barcelona	Berlin	Dublin	Krakow
Bilbao	Bern	Glasgow	Moscow
Bologna	Brussels	Helsinki	Prague
Clermont-Ferrand	Geneva	London	Tallin
Lille	Gent	Manchester	Warsaw
Lisbon	Graz	Newcastle	
Lyons	Hamburg	Oslo	
Madrid	Lille	Stockholm	
Marseilles	Munich		
Milan	Paris		
Nantes	Rotterdam		
Rome	Stuttgart		
Seville	Vienna		
Turin	Zürich		
Valencia			
16 (35%)	15 (33%)	9 (20%)	6 (13%)

Note: In parenthesis we provide the share of each category over the whole sample.

Table 4. Values given to the TOUR variable for each city.

City	Tour (value)	City	Tour (value)
Amsterdam	6	Lyons	4
Athens	0	Madrid	6
Barcelona	6	Manchester	4
Berlin	5	Marseilles	1
Bern	0	Milan	5
Bilbao	2	Moscow	6
Bologna	0	Munich	5
Brussels	0	Nantes	0
Budapest	5	Newcastle	2
Clermont-Ferrand	0	Oslo	3
Copenhagen	4	Paris	6
Dublin	6	Prague	6
Geneva	3	Rome	6
Ghent	2	Rotterdam	0
Glasgow	4	Seville	4
Graz	2	Stockholm	4
Hamburg	4	Stuttgart	0
Helsinki	4	Tallinn	4
Krakow	4	Turin	0
Lille	0	Valencia	3
Lisbon	5	Vienna	6
London	6	Warsaw	5
		Zurich	4

Table 5. Independent variables. Definition, descriptive statistics and expected sign.

Regressors	Definition	Mean	Std. Dev.	Max	Min	Impact on Supply	Impact on Demand
GDP	Gross Domestic Product per inhabitant (Euro)	25,577	10,361	45,800	6,060	+	+
DENS	Urban population density	49.29	21.59	161.0	18.1	+	+
PRICE	Average cost of one public transport passenger-km for the traveler (0.01 Euro)	9.32	5.00	23	0.6		-
OCOST	Average operating cost of one public transport place-km (0.01 Euro)	3.42	1.55	8.06	0.48	-	
FLEET	Total public transport vehicles per million inhabitants	1,072	406	2,500	430	+	+
BUSES	Total public transport buses per million inhabitants	775.2	47.79	1900	321	+	+
METRO	Total public transport metro wagons per million inhabitants	156.53	24.95	564	0	+	+
TRAM	Total public transport tram wagons per million inhabitants	140.71	29.97	830	0	+	+
MOTOR	Private passenger cars per thousand inhabitants	468	119	41.8	14.1		-
PUB_SPEED	Average speed of public transport vehicles in operation	27.54	1.11	32	14		+
$D^{capital}$	Binary variable taking value 1 if the city is a political capital and 0 otherwize.	0.48	0.07	1	0	+/-	+/-
TOUR	Categorical variable. Proxy of tourist arrivals. Values from 0 to 6	3.4	0.33	6	0	+/-	+
TOUR_ARRIVALS	Continuous variable. Number of tourist arrivals. (thousands)	2,448	516.40	15640	180	+/-	+

Table 6. Cluster analysis (K means method). Number of groups (k=6). Variables employed for grouping: Population, GDP, Urban population density , Motorization and total public transport vehicles per million inhabitants.

Group 1	TOUR	Group 2	TOUR	Group 3	TOUR	Group 4	TOUR	Group 5	TOUR	Group 6	TOUR
Budapest	5	Athens	0	Bern	0	Glasgow	4	London	6	Amsterdam	6
Copenhagen	4	Barcelona	6	Bologna	0	Hamburg	4	Moscow	6	Bilbao	2
Stockholm	4	Berlin	5	Clermond-Ferrand	0	Lisbon	5	Paris	6	Brussels	0
Turin	0	Madrid	6	Geneva	3	Mancester	4			Dublin	6
Valencia	3			Ghent	2	Milan	5			Helsinki	3
Viena	6			Graz	2	Rome	6			Krakow	2
Warsaw	5			Nantes	0					Lille	0
				Tallin	4					Lyons	4
										Munich	5
										Newcastle	2
										Oslo	3
										Rotterdam	0
										Seville	4
										Zurich	4
Average	3.85	**Average**	4.25	**Average**	1.37	**Average**	4.66	**Average**	6	**Average**	2.93

Table 7. Least-squares estimates and Seemingly unrelated regressin results.

Dependent Variables (log demand ; log supply)						
	Reduced model (OLS)		Full model (OLS)		Reduced model (SUR)	
Regressors	**Supply (1)**	**Demand (2)**	**Supply (3)**	**Demand (4)**	**Supply (5)**	**Demand (6)**
GDP	0.7186*** (0.1775)	0.6047*** (0.1971)	0.7996*** (0.1785)	0.5953*** (0.1438)	0.6891*** (0.1562)	0.6438*** (0.1650)
DENS	0.1569 (0.1206)	0.0038 (0.1005)	0.0191 (0.1384)	-0.9530 (0.1438)	0.1470 (0.1399)	0.0371 (0.1415)
PRICE	0.0212 (0.1114)	-0.5936*** (0.0983)	0.1501 (0.1107)	-0.5466*** (0.0935)	0.0118 (0.0999)	-0.5909*** (0.1037)
OCOST	-0.6383*** (0.1483)	-	-0.8916*** (0.1640)	-	-0.5958*** (0.1327)	-
FLEET	0.4914*** (0.1187)	0.4098*** (0.1345)	-	-	0.4930*** (0.1294)	0.3534** (0.1377)
Buses	-	-	0.1698 (0.1244)	0.1124 (0.1337)	-	-
Metro	-	-	0.04726**	0.0092 (0.0286)	-	-
Tram	-	-	0.0738*** (0.0192)	0.0626** (0.0231)	-	-
$D^{capital}$	0.2663** (0.1224)	0.1514 (0.1206)	0.2500** (0.1180)	0.1723 (0.1019)	0.2638** (0.1153)	0.2191* (0.1203)
TOUR	0.0267 (0.0303)	0.0607** (0.0282)	0.0262 (0.0290)	0.0805*** (0.0286)	0.0287 (0.0252)	0.07562*** (0.0257)
PUB_SPEED	-	0.5597 (0.3435)	-	0.4981 (0.3161)	-	0.1400 (0.1580)
MOTOR	-	-0.4421* (0.2216)	-	-0.5001** (0.2278)	-	-0.2568 (0.1806)
N. of observations	45	44	45	44	45	44
R^2	0.68	0.80	0.71	0.81	0.68	0.76
Test F (Joint Significance)	23.21***	29.41***	11.61***	23.26***	-	-
Chi2 (Joint Significance)	-	-	-	-	98.94***	159.16***

Note 1. Standard errors in parenthesis: Robust to heterocedasticity. Each model includes an intercept.
Note 2. Significance at 1% (***), 5% (**) and 10% (*).
Note 3. For demand equations we lose one observation due to lack of information regarding public speed in one of the cities of our sample. Deleting PUB_SPEED in demand equations does not change other coeficient's statistical significance.

Table 8. Least-squares estimates and Seemingly unrelated regressin results. Cities within the ranking of 150 cities with more tourist arrivals.

Regressors	Dependent Variables (log demand ; log supply) Reduced model (SUR) Supply (7)	Demand (8)
GDP	0.6367*** (0.1444)	0.7231 (0.1769)
DENS	0.1186 (0.1337)	-0.0081 (0.1561)
PRICE	-0.0035 (0.0942)	-0.6736*** (0.1160)
OCOST	-0.5931*** (0.1182)	-
FLEET	0.4384*** (0.1185)	0.2796** (0.1411)
$D^{capital}$	0.2461* (0.1266)	0.1576 (1.04)
TOUR_ARRIVALS	0.0487 (0.0506)	0.1171** (0.0550)
PUB_SPEED	-	-0.0482 (0.1782)
MOTOR	-	-0.3198* (0.1878)
N. of observations	34	34
R^2	0.75	0.79
Chi2 (Joint Significance)	104.37***	140.39***

Note 1. Standard errors in parenthesis: Robust to heterocedasticity. Each model includes an intercept.
Note 2. Significance at 1% (***), 5% (**) and 10% (*).
Note 3. Cities excluded: Athens, Bern, Bologna, Brussels, Clermont-Ferrand, Lille Nantes, Rotterdam, Stuttgart and Turin.

APPENDIX

Table A1. Correlation matrix.

	GDP	DENS	PRICE	OCOST	FLEET	BUSES	METRO	TRAM	MOTOR	PUBSPEED	$D^{capital}$	TOUR
GDP	1											
DENS	-0.3912	1										
PRICE	0.5539	-0.3814	1									
OCOST	0.6490	-0.2052	0.5251	1								
FLEET	-0.0696	-0.0322	-0.1419	-0.1915	1							
BUSES	-0.0299	-0.2349	0.1400	-0.1544	0.7286	1						
METRO	0.1285	0.2539	-0.1374	-0.0044	0.3675	-0.1470	1					
TRAM	-0.2013	0.0909	-0.3919	-0.1417	0.5733	0.0286	0.1379	1				
MOTOR	0.3910	-0.1768	-0.0219	0.4562	-0.1210	-0.0551	-0.1120	-0.0648	1			
PUBSPEED	0.4111	0.0955	0.0628	-0.0135	-0.0365	-0.1523	0.3911	-0.1620	-0.1266	1		
$D^{capital}$	-0.0043	0.1471	-0.2465	-0.1715	0.4345	0.1375	0.4507	0.2867	-0.1756	0.2515	1	
TOUR	-0.0558	0.1781	-0.1393	-0.2985	0.3681	0.0884	0.4680	0.2148	-0.2307	0.2273	0.5674	1