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The role of transport infrastructure in international tourism development: A gravity model approach ☆

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Abstract

We employ a gravity framework to evaluate the importance of transport infrastructure in determining the tourism attractiveness of destinations. The analysis is based on a panel data set of bilateral tourism flows among 28 countries over the decade 1990–2000. We find that, on top of tourism infrastructure and other classical determinants, transport infrastructure is a significant determinant of tourism inflows into a destination. Disaggregated continent-wise analysis reveals that the sensitiveness of tourism flows to transport infrastructure does vary, depending on origins and destinations. We also find evidence of repeated tourism around the world, the more so from high-income origins and to high-income destinations.

Keywords: Tourism flows; Gravity model; Dynamic panel; Transport infrastructure

1. Introduction

Scholars (Chew, 1987; Gunn, 1988; Inskeep, 1991; Martin & Witt, 1988 among others) have often argued that the infrastructure base of a country is a determinant of the attractiveness of a tourism destination. In particular transport infrastructure, which provides the vital base for transportation services, is presumed to be an important determinant in this respect. Kaul (1985) recognises the role of the transportation network as an essential component of successful tourism development and states that "transport plays an important role in the successful creation and development of new attractions as well as the healthy growth of existing ones." Provision of suitable transport has transformed dead centres of tourist interest into active and prosperous places attracting multitudes of people. That the provision of transport infrastructure is a precondition for the development of tourism has also been posited by Chew (1987), Abeyratne (1993) and Prideaux (2000). Although many writers acknowledge the need for efficient transport as an overall element in a successful programme of tourism development, little work has been undertaken to investigate the significance of transport as a factor in destination development.

This paper analyses the determinants of international tourism flows, with focus on transport capital as a potential input in the tourism equation. With tourism being a form of international trade, the factors explaining tourism flows are investigated in the context of a gravity model. Countries in the sample are modelled as both tourist origins and destinations. We study a panel of 28 countries (selected as per data availability) over the decade 1990–2000 to investigate the role of transportation infrastructure in overall tourism development. Importantly, the dynamic panel data methodology adopted in this paper accounts for the possibility of endogeneity in tourism.

The overall panel data is subsequently disaggregated into four different sub-panels of continent-wise destinations, namely Europe, America, Asia and Africa. This analysis allows a comparative assessment of the sensitivity of

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tourism flows to different determinants on a continent-wise destination basis. It is presumed that factors determining the choice of tourists to visit less developed continents (Africa and Asia) are different from those influencing their choice to visit more developed continents (Europe and America).

A further disaggregation formulation on the basis of continent-wise origins is also analysed for still more insight into the debate. This analysis is motivated by the fact that leisure tourism is essentially a luxury good and that the majority of tourist generating regions are indeed high-income ones.

The rest of the paper is organised as follows: Section 2 deals with the theoretical underpinnings of the role of transport infrastructure in the tourism attractiveness of a destination and also briefly reviews the major studies in the literature. Section 3 explains the model specification and data collection and also discusses the empirical results. Section 4 concludes.

2. Literature review

2.1. The role of transport infrastructure[2] in destination development

Prideaux (2000) defines the transport system relevant to tourism as "the operation of, and interaction between, transport modes, ways and terminals that support tourists into and out of destinations and also the provision of transport services within the destination." A good and attractive transportation system rests to a large extent on quality and availability of transportation infrastructure comprising air services and airport, land transport systems and routes and water transport infrastructures as well. In fact the transport system is responsible for connecting tourism origins to tourism destinations and providing transport within the tourism destination, e.g. to attraction, hotels and shopping. A destination should be easy to get to and around, particularly if the country is geographically dispersed.

Moreover improved transport infrastructure, particularly for the case of road and land transport, likely leads to reduced cost of transport. Road capacity improvements (such as more lanes, improved reliability, higher quality road surfacing, improved safety through more and wider lanes and improved signage) reduce fuel consumption, wear and tear, and transit time of traffic. Such hard transport infrastructure investments do impact on the cost and quality of tourism experience.

Inhabitants of developed countries, from where the majority of tourists originate, are used to modern transport infrastructure that enables high quality service. These tourists prefer to maintain essentially the same comforts as at home while traveling (Cohen, 1979; Mo, Howard, & Havitz, 1993).[3] If the ability of tourists to travel to preferred destinations is inhibited by inefficiencies in the transport system such as uncompetitive prices or lengthy and uncomfortable journey, the likelihood that they will seek alternative destinations may increase.

Tourism resort has also often been cited as an important attractor of tourism, especially for the high-class segment. Prideaux (2000) posits that a critical mass of public infrastructure (including transport) is essential for enabling the setting up of high-quality resorts in a country. If this critical mass is not available, the operators would themselves have to incur these infrastructure costs, thereby adding to the capital and operating costs of tourism development and thus reducing competitiveness.

The above discussion implies that transport infrastructure is a prospective determinant of tourism attractiveness. However, to date, empirical studies on the importance of transport infrastructure for the development of the tourism industry have been particularly lacking.

2.2. Related research

Research assessing the role of transport infrastructure in tourism development is scarce. In many tourism studies, the relationship between transport and tourism is defined only in terms of accessibility, that is, transport is seen as a link between tourist generating regions and tourist destination regions. Some authors have examined the history of tourism from the perspective of the development of various transport modes (Dickman, 1994) while others (Mill & Morrison, 1985 among others) have taken an interdisciplinary perspective, viewing transport as only one of many components which together constitute the tourism system. Models of tourism flows have also been developed, but with transport having a limited role. Lundgren (1982), for instance, views transport from a geographic perspective and analyses tourism flows between metropolitan and rural destinations. However his model treats transport as a subsidiary element of the spatial hierarchy between rural and metropolitan destinations. Pearce (1981) (cited in Pearce, 1987) also notes the role of transport within the context of the city as a regional staging post from where visitors travel to other centres and resorts. Again transport is acknowledged but subsumed to other factors that concentrate on the role of traveler flows to and from major urban centres. In summary these earlier studies, though recognising the link between tourism and transport, fail to identify any specific causal relationship.

Other studies have evaluated the role of overall infrastructure in the attractiveness of a destination using survey analysis. Gearing (1974) offer one of the most comprehensive resource inventories in determining the

[2] Smith (1994) and Crouch and Ritchie (1999) provide a good theoretical treatment of the role of service infrastructure in creating a tourism product experience.

[3] Mo et al. (1993), using survey methodology, find that tourists prefer to travel to countries that have the same infrastructures as in their home country.

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attractiveness of a tourist destination by taking Turkey as a case study. They identify the following list of attribute groups as being important, namely natural factors, social factors, historical factors, recreational and shopping facilities, food and shelter. The authors also stress on the infrastructure (featuring highways and roads, water, electricity and gas, safety services, health services and communications) of the destination as an important determinant. Subsequently Ritchie and Zins (1978) and Ferrario (1979) also identify more or less the same factors. Braithwaite et al. (1998) (in Tourism Task Force, 2003) report infrastructure, which include air and marine access, road and rail access, and non-transport tourism infrastructure, as sizeable elements. More recent studies by Murphy, Pritchard, and Smith (2000) for the case of Victoria in Canada, Kozak and Rimmington (1999) for Turkey and McElroy (2003) for 51 islands highlight the importance of infrastructure, particularly government financed infrastructure, for a destination success.

Departing from survey analysis, other studies are based on the estimation of an international tourism demand equation. Witt and Witt (1995) and Lim (1997) provide a comprehensive overview of the regression analysis, model specification, attributes and proxies. More recent empirical work by Eilat and Einav (2004) and Naudee and Saayman (2005) study the determinants of tourism flows in the case of African countries using panel data regression approach. These authors identify available infrastructure as a relevant factor, in addition to the classical factors. However they focus on tourism infrastructure exclusively.

3. Methodology and analysis

3.1. The gravity model

Tourism is essentially a form of international trade. Thus a natural way of investigating the determinants of tourism flows is by means of a gravity model, duly augmented. The gravity model of international trade was developed independently by Tinbergen (1962) and Poyhonen (1963). In its basic form, the amount of trade between two countries is assumed to be increasing in their sizes, as measured by their national incomes and decreasing in the cost of transport between them as measured by distance between their economic centres (see McCallum, 1995 and Boisso & Ferrantino, 1997). Other authors, for instance Q8 Linnemann (1966), include population as an additional measure of country size. Gravity models have achieved empirical success in explaining various types of interregional and international flows, including migration, commuting, hospital patients and international trade (see Cheng & Wall, 2004). The recent popularity of gravity models[4] has also been highlighted by Eichengreen and Irwin (1998) who call it the "workhorse for empirical studies of international trade."

[4]For some limitations of gravity see Hasan (2001).

A gravity model of trade is here employed to model tourism flows among 28 countries[5] (selected on the basis of data availability), treated both as origin and destination. The independent variables in the analysis are the baseline gravity variables plus other determinants of tourism flows. This leads to a rich data set which improves estimation accuracy and flexibility and is believed to yield more convincing results. The data set is subsequently disaggregated into continent-wise sub-panels for comparative and deeper analysis. Particular emphasis is, in the present study, laid on the importance of transport capital in overall tourism attractiveness.

The independent variables include the different characteristics of the origin and destination country and may be either fixed or varying. In addition to the price variable, we include three additional groups of variables that are (i) relevant to the origin–destination relationship, (ii) destination specific and (iii) origin specific.

The gravity function is specified as follows:

$$TR_{odt} = f(GDPO_{ot},\ CPI_{dt},\ DISTAN_{od},\ TOURINF_{dt},\ ROAD_{dt}, AIR_{dt},\ PORT_{dt},\ POP_{ot},\ LANG_{od},\ BORD_{od},\ PROX_{od}) \quad (1)$$

o is used to index countries of origin, d to index countries of destination and t to index time. The dataset includes 28 countries (selected depending on data availability), all of them coming in as origin and destination, and the period under study is the decade 1990–2000. This yields 756 different country pairs.

To assess the availability of the overall transport infrastructure of the countries in the sample, three separate proxies are included, namely the length of paved roads divided by the size of the country (*road*), the total number of terminals in international airports in each country (*air*) and the number of ports (*port*) in each country. *Road* is included in the economic equation as it proxies for the availability and quality of internal land transportation and is aimed at capturing not only the role of transport within the tourism destination (to attraction, hotels, shopping) but also the provision of safe, comfortable, competitively priced and fast services among others (Prideaux, 2000). It is important to note that this measure has been used by a number of authors, particularly in the assessment of the economic importance of the overall transport infrastructure (see Canning, 1999; Canning & Bennathan, 2000 among others). *Air* is a measure of airport infrastructure and is judged important as tourism is overwhelmingly dependent on this mode of transport. *Port* proxies the availability of port infrastructure and is believed to be relevant, especially for cruise tourism. The limitations of using the above proxies are known, for instance that they are basically general physical measure of transport infra-

[5]List of countries in the panel: Australia, Austria, Brazil, Canada, China, Egypt, France, Germany, Greece, Hong Kong, India, Italia, Jamaica, Japan, Kenya, Malaysia, Mauritius, Maroc, Nigeria, Poland, Singapore, South Africa, Spain, Switzerland, Tunisia, Thailand, United Kingdom and United States.

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structure. Though one would have wished to construct transport capital stocks for better measurement, this was not possible due to unavailability of transport investment data to feed capital stock models such the Perpetual Inventory Method. In effect *road*, *air and port*, as defined above, are the only consistent measures available for the sample and the years of study. All three measures are included separately in the economic model in an attempt to gauge their relative importance. The data comprise the Canning (1999) database, extended by data from the International Road Federation (IRF), World Air Transport Statistics, World Port Source and from various countries' Central Statistical Office (CSO). The dependent and other key independent variables used are summarised in Table 1.

The corresponding econometric model (reduced-form augmented gravity model) is written as follows:

$$tr_{odt} = \alpha + \beta_1\, gdpo_{ot} + \beta_2\, cpi_{dt} + \beta_3\, dist_{od} + \beta_4\, tourif_{dt} + \beta_5\, road_{dt} + \beta_6\, air_{dt} + \beta_7\, port_{dt} + \beta_8\, pop_{ot} + \beta_9\, lang_{od} + \beta_{10}\, bord_{od} + \beta_{11}\, prox_{dt} + \varepsilon_{odt}. \quad (2)$$

The specification is log linear and the small letters denote that the variables are in natural logarithm; α is a constant, that is the unobserved perceived quality of destination d in a given year t to residents of origin o; ε_{odt} is an individual error term which is distributed i.i.d. across country pairs and over time. Beta (β) is a vector of parameters.

Pair-wise correlation between the variables varies in the range −0.23–0.61 in our sample, suggesting that multi-collinearity is not a serious issue.

3.2. Dynamic panel data regression analysis (the Generalised Method of Moments approach)

The possibility of endogeneity and dynamism in tourism cannot be catered for in a static panel data framework. In the context of tourism, Naudee and Saayman (2005) argue that there are "persistence/reputation effects" that apply over time in tourist decision on holiday destinations, for instance tourists returning to a particular destination after having a good experience. In fact, once people have been on holiday to a particular country and have liked it, they may generally return to that destination. There is much less uncertainty associated with holidaying again to that country compared with travelling to a new destination. The above arguments have not received due attention in the literature and it is believed that an analysis encompassing the above within a dynamic framework would yield important insights into the debate.

The incorporation of dynamics into the model necessitates the above equation to be rewritten as an AR (1) model as follows.

$$tr_{odt} - tr_{odt-1} = \alpha_t + v\, tr_{odt-1} + \beta x_{odt} + \mu_{odt}. \quad (3)$$

The left hand side is the log difference in tourism flows from the origin to the destination country over a period t, tr_{odt} = the log of tourism flows at the start of that period; x_{odt} = the vector of explanatory variables, that is $x = [gdpo, cpi, distan, tourinf, road, air, port, pop, lang, bord, prox]$ and α_t = the period specific intercept terms to capture changes common to all countries; μ_{odt} = the time variant idiosyncratic error term.

This can easily be shown to be equivalent to (see Arrelano & Bond, 1991)

$$\Delta tr_{odt} = \alpha_t + (v+1)\Delta tr_{odt-1} + \beta\, \Delta x_{odt} + \Delta\mu_{odt}. \quad (4)$$

Since tr_{odt-1} might be endogenous to the error term through u_{odt-1}, a problem of endogeneity exists and it will therefore be inappropriate to estimate the above by OLS. To overcome this problem, an instrumental variable needs to be used for Δtr_{odt-1}. First step Generalised Method of Moments (GMM) estimators (Arrelano & Bond, 1991) is employed since as it has been shown to result in more reliable inference (Blundell & Bond, 1998). Q9

A central issue before making the appropriate specification, often ignored by past researchers, is to test whether the variables are stationary. Panel unit root test on both the dependent and independent variables has been carried out using the approach of Im, Pesaran, and Shin (1995). The results support stationarity at the 5% significance level. Similar results are obtained for the sub-samples.

Table 1 (column 1, aggregate panel) reports the first step GMM estimator of Eq. (4) for the aggregate panel set. The estimated equation passes the diagnosis test of Sargan,[6] which is a test for overidentifying restrictions. Moreover, using the Arellano–Bond test of first order and second autocorrelation, we reject the presence of second-order autocorrelation in the residuals. This validates the use of suitably lagged endogenous variables as instruments. Transport capital (as captured by the three proxies) carries a positive and significant coefficient, implying that transport capital is an important ingredient in accounting for tourism flows and does add to the overall attractiveness of a destination. Airport infrastructure appears to be a relatively more important transport element, as international tourism is essentially air based. Indeed better airport infrastructure must have permitted the accommodation of wide body passenger jets, creating the opportunities for mass intercontinental travel (Thurot, 1980; Prideaux, 2000).

Other determinants are seen to concur with the existing literature in general. In particular, the panel data regression results in an income elasticity of 0.8, confirming that the tourism product is not a necessity. The price elasticity of −0.7 shows that differences in cost of living matter to a large extent and that tourists are sensitive to the price level, although our estimate is on the lower side compared to that of recent works (see Eilat & Einav, 2004; Lim, 1997; Naudee & Saayman, 2005 among others). The positive coefficient of *prox* interestingly indicates that destinations become more attractive with a number of alternative

[6]The null hypothesis of the Sargan test postulates that the over-identifying restrictions are not valid (i.e. the instruments for the endogenous variables are correlated with the error term), hence the model is not properly specified.

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Table 1
Summary of variables used in the model

Variable	Measure	Description	Supporting reference	Data source
TR	Tourist arrival	Total number of tourist arrivals per annum	Witt and Witt (1995) and Lim (1997)	World Tourism Organisation (2003), Year book of tourism statistics (Annual Publications) and individual countries CSO
GDPO	Income of origin	Average real income per capita	Witt and Witt (1995), Lim (1997), Eilat and Einav (2004), Naudee and Saayman (2005)	Penn World Table 6.1
CPI	Relative prices	CPI of a destination country adjusted by the $ exchange rate	Witt and Witt (1995), Lim (1997), Eilat and Einav (2004), Naudee and Saayman (2005)	Penn World Table 6.1.
DISTAN	Distance	Distance is measured by the distance in kilometres between the capital cities of the origin and destination country.	Witt and Witt (1995), Lim (1997), Crouch (1995)	Gallup, Sachs, and Mellinger (1998)
TOURINF	Tourism infrastructure	Number of hotel rooms available in the country	Witt and Witt (1995), Lim (1997)	Tourism Satellite Accounts World Tourism Organisation (WTO).
POP	Population	Size of population.	Witt and Witt (1995), Lim (1997), Loree and Guisinger (1995), Asiedu (2002)	Penn World Table 6.1.
LANG	Common language	A dummy that takes the value of 1 if origin and destination country have a common first language; 0 otherwise	Witt and Witt (1995), Lim (1997), Eilat and Einav (2004)	John Haven's international trade datawebsite: http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html
BORD	Common border	Dummy that takes a value of 1 if origin and destination country share a common border; 0 otherwise	Witt and Witt (1995), Lim (1997), Eilat and Einav (2004)	John Haven's international trade data website: http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html
PROX	Proximity	Dummy that takes a value of 1 if destination country has a number of alternative destinations in proximity (trip chaining); 0 otherwise	Fotheringham (1981)	Auhor's judgement

destinations in close proximity, thus confirming trip chaining behaviour on the overall. Distance between countries, common language, border and tourism infrastructure are reported to be important elements in the tourism equation as well. As expected the greater the population of the origin country, the greater the number of tourists. The significant and positive coefficient (though relatively small) on the lagged tourism flow variable may be interpreted as a sign of repeated tourism around the world.

The rich data set also enable further disaggregation of the panel into tourism flows to various continent destinations and tourism flows from various continent origins for comparative and deeper analysis. In the first case such analysis permits to compare the behaviour, particularly with respect to transport, of tourists travelling to different continent destinations. It is presumed that determinants of tourism flows to destinations with higher standard of living (such as the European and American continents) might be different to those of destinations with relatively lower standard of living (such as Asia and Africa). The second sub-analysis is undertaken on the premise that leisure tourism is a luxury good and that the majority of tourist generating regions is indeed from high-income origins.[7]

The above hypotheses are indeed supported by the study. The results of the first step GMM estimates are reported in Tables 1 and 2. Referring to tourism flows to various continents in Table 1 (columns 3–6), transport infrastructure is confirmed to have played an important role together with tourism infrastructure. This is more pronounced for the case of developed continent destinations (Europe and America) which in fact have invested massively in efficient transport infrastructure to accommodate high level of tourism flows. Airport infrastructure is again observed to have been a relatively important element in tourism generation, this being especially true to European and American destinations. Tourism infrastructure is also seen to play an important part in explaining tourism development. Investigating the other

[7]Eilat and Einav (2004) also argue that tourist outflows from these countries may be due to other reasons, such as immigration.

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Table 2
Dynamic panel data estimation: continent-wise destination[a]

Variable	Total sample	European destinations	Asian destinations	American destinations	African destinations
constant	0.02	0.13	0.25	0.23	0.01
	(1.95)*	(3.35)***	(2.41)**	(2.25)**	(1.12)
$touris_{t-1}$	0.13	0.33	0.52	0.21	0.06
	(1.72)*	(2.25)**	(4.23)***	(2.54)***	(1.33)
dgdpo	0.81	0.51	0.26	0.34	0.26
	(1.89)*	(1.68)*	(1.67)*	(1.79)*	(2.23)**
dcpi	−0.73	−0.79	−0.14	−0.52	−0.15
	(−4.36)***	(−1.99)*	(−1.53)	−(1.78)*	(−1.44)
ddistan	−0.22	−0.22	−0.1	−0.22	−0.23
	−(2.37)**	(−1.93)*	−(1.92)*	−(2.24)**	−(1.82)*
dtourinf	0.22	0.13	0.33	0.16	0.56
	(3.56)***	(1.79)*	(1.83)*	(2.26)**	(4.32)***
droad	0.13	0.15	0.19	0.16	0.08
	(2.15)**	(1.89)*	(2.23)**	(1.91)*	(1.95)*
dair	0.18	0.20	0.14	0.31	0.06
	(1.93)*	(2.12)**	(1.94)*	(3.23)***	(2.15)*
dport	0.06	0.11	0.03	0.06	0.02
	(1.77)*	(1.94)*	(1.34)	(2.12)*	(1.23)
dpop	0.30	0.36	0.32	0.24	0.41
	(1.81)*	(1.95)*	(1.34)	(1.69)*	(0.26)
dlang	0.15	0.17	0.03	0.12	0.04
	(1.88)*	(1.95)*	(1.11)	(1.74)*	(1.53)
dbord	0.23	0.28	0.3	0.1	0.12
	(1.99)*	(2.12)*	(1.85)*	(1.52)	(1.69)*
dprox	0.12	0.14	0.17	0.05	0.08
	(1.75)*	(2.22)**	(2.01)*	(1.23)	(1.53)
Diagnosis tests					
Sargan test	Prob>chi2 = 0.13	Prob>chi2 = 0.26	Prob>chi2 = 0.51	Prob>chi2 = 0.17	Prob>chi2 = 0.22
Arellano–Bond test of 1st order autocorrelation	Prob>chi2 = 0.16	Prob>chi2 = 0.15	Prob>chi2 = 0.13	Prob>chi2 = 0.23	Prob>chi2 = 0.23
Arellano–Bond test of 2nd order autocorrelation	Prob>chi2 = 0.11	Prob>chi2 = 0.09	Prob>chi2 = 0.31	Prob>chi2 = 0.26	Prob>chi2 = 0.32

Dependent variable dtr = d ln TR (log of difference tourism origin–destination flow, 1990–2000).
*Significant at 10%. **Significant at 5%. ***Significant at 1%.
The small letters denotes variables in natural logarithmic and the heteroskedastic-robust z-values are in parentheses and prefix d denotes variables in first difference. The estimates passes the diagnosis test related to Sargan test of overidentifying restrictions and Arellano–Bond first and second order autocorrelations.
[a]A visualisation of the results on a map is available in Figs. A1 and A2.

determinants, the intercept is positive and significant in all destinations except for the African case,[8] implying that tourism in general carries a good perception (see Naudee & Saayman, 2005) on the Asian, American and European destinations. As expected tourists travelling to European and American destinations face larger income and price elasticities. Relatively higher income elasticity confirms that these destinations are seen as more luxury products. As such tourists are also highly price sensitive to these destinations and this can be explained by the fact that the latter usually have relative high price levels. Travelling to low-income destinations (Africa and Asia) is comparatively less price sensitive given the low price level. Trip chaining tourism is observed to be present in European and Asian destinations. Distance and population growth of the origin country are all observed to have the expected sign and significance throughout, although they differ in their magnitudes. The lagged tourist arrivals variable is positive and significant for all cases except for Africa. This suggests the presence of repeated tourism around the world, except for African destinations (Table 3).

Europeans and Americans, and to a lesser degree the Asians, attach sizeable importance to transport infrastructure when choosing their destination. Overall tourists are particularly sensitive to land and air infrastructure, as judged by their coefficients.

The explanation based on Cohen (1979) and Mo et al. (1993) may be relevant, namely that tourists prefer to maintain the same comforts as in their home country while traveling. Transport might have also enhanced their experience as spelled out in the theoretical review. On the other hand tourists from low-income origins, especially from Africa, do not appear to be sensitive (column 4) to the level of transport infrastructure in their destination countries. They may have the perception that transport infrastructure outside Africa is necessarily better than transport infrastructure inside Africa. Tourists from all regions are seen to be sensitive about factors such as level of

[8]Naudee and Saayman (2005) find similar results in their studies.

Table 3
Dynamic panel data estimation: continent-wise origin

Variable	European origin	Asian origin	American origin	African origin
constant	0.13	0.007	0.13	0.021
	(2.21)**	(1.75)**	(1.69)*	(1.82)*
$touris_{t-1}$	0.36	0.25	0.44	0.11
	(5.3)***	(2.06)*	(2.15)**	(1.05)
dgdpo	0.56	0.63	0.43	0.98
	(2.23)**	(2.19)**	(1.81)*	(2.23)**
dcpi	−0.36	−0.63	−0.14	−0.92
	(−2.12)**	(−2.34)**	−(1.72)*	(−2.41)**
ddistan	−0.07	−0.21	−0.15	−0.36
	(−1.97)*	(1.79)*	(1.84)*	(1.84)*
dtourinf	0.29	0.14	0.38	0.05
	(2.25)*	(1.86)*	(2.44)**	(1.52)
droad	0.38	0.13	0.23	0.006
	(3.23)***	(2.11)**	(3.39)***	(0.05)
dair	0.33	0.19	0.25	0.12
	(2.92)**	(1.99)*	(1.93)*	(1.27)
dport	0.06	0.1	0.05	0.09
	(1.83)*	(1.62)	(1.34)	(1.38)
dpop	0.12	0.23	0.14	0.42
	(0.23)	(0.89)	(1.94)*	(1.23)
dlang	0.15	0.04	0.11	0.08
	(1.93)*	(1.45)	(1.81)*	(1.54)
dbord	0.32	0.21	0.12	0.27
	(2.33)**	(1.96)*	(1.78)*	(1.89)*
dprox	0.24	0.12	0.27	0.07
	(2.14)**	(1.53)	(1.99)*	(1.34)
Diagnosis tests				
Sargan test	Prob > chi2 = 0.31	Prob > chi2 = 0.34	Prob > chi2 = 0.27	Prob > chi2 = 0.17
Arellano–Bond test of 1st order autocorrelation	Prob > chi2 = 0.11	Prob > chi2 = 0.22	Prob > chi2 = 0.11	Prob > chi2 = 0.11
Arellano–Bond test of 2nd order autocorrelation	Prob > chi2 = 0.41	Prob > chi2 = 0.17	Prob > chi2 = 0.12	Prob > chi2 = 0.41

Dependent variable dtr = d log TR (log of difference tourism origin-destination flow, 1990–2000).

development and tourism infrastructure in destination countries (with Europeans and Americans being more concerned) and price levels (with Africans and Asians being more concerned). Tourism infrastructure reports positive and significant coefficient in nearly all cases (except for African origin) and is more pronounced for the case of tourists from Europe and America. The coefficients on distance, population of origin country, common language and border all have the expected signs and are all statistically significant. The 'proximity' variable seems to indicate that 'trip chaining' might be more present for European and American tourists. The dynamic analysis shows that repeated tourism is mostly from Europe and America and to a lower degree from Asia whereas repeated tourism is not a common practice of the Africans. Studies with respect to sub-panels divided into low/high income[9] destinations and low/high income origin countries have also been carried out (results available upon request from the authors). The findings from the latter analysis are consistent with the findings displayed in the paper.

A summary of results from dynamic panel data estimates interestingly suggests that the level of transportation infrastructure, in addition to tourism infrastructure and other classical determinants, may have played an important role in the tourism equation.

We should point out that no differentiation between the different types of tourism has been made explicitly in our analysis. This is mainly due to the data unavailability on types of tourism. Tourism encompasses different types and apart from 'traditional tourism' linked with beach, culture, business/conference tourism, there exists nowadays other types of tourism, namely Health and Relaxation tourism, Archaeological tourism, Adventure tourism and Ecological tourism. The latter two types of tourism are rapidly growing in popularity as tourists seek unusual holidays. They represent a type of niche tourism and involve exploration or travel to remote areas, often inaccessible and possibly hostile, and engagement with nature. They typically include mountaineering expeditions, trekking, bungee jumping, rafting, wilderness adventures (flora and fauna), safari and rock climbing. The above thus might not necessarily call for high quality of transportation, especially inland transport as tourists prefer wilderness and the rawness of the destination. This also probably explains why the coefficient on road infrastructure for African destination turns out to be insignificant, South Africa and Kenya (the two largest toruism attractors) being renowned for

[9]where a high-income country is one whose GDP per capita > $10,000.

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their safari and wilderness. Thus in modelling the importance of transport in a destination's attractiveness, one should be careful about the interpretation of the results and should take into account the types of tourism.

4. Summary

This paper employs a gravity model of trade to the tourism services industry for 28 countries over the decade 1990–2000 to investigate the role of transportation infrastructure in tourism flows using a dynamic panel framework. The rich data set is subsequently disaggregated into different sub-panels pertaining different continent-wise destinations and origins for comparative analysis. GMM panel estimates report the significance of transport capital in general. Further analysis suggests that transport infrastructure is a more sensitive factor when travelling to African and Asian destinations. It is believed that tourists value the availability of efficient, reliable and safe travelling to relatively unknown destinations, reflecting the Cohen hypothesis. African tourists do not appear to be sensitive to the availability of such infrastructure and it is argued that they may have the perception that transport infrastructure outside Africa is necessarily better than transport infrastructure inside Africa. The other determinants are seen to concur with the existing literature. For instance tourism is found be both income and price elastic and this is more pronounced for the case of European and American destinations and African and Asian originating countries. Repeated tourism is also reported for all continent destinations, except for Africa.

As far as policy implications are concerned government should integrate transportation policies into tourism planning, especially for those countries with poor infrastructure. Investing in tourism infrastructure, marketing efforts and liberalising air access might not be enough without efficient transportation support infrastructure. Thus ad-hoc government spending cuts and neglected infrastructure needs within limited public finance should be thought over again. Policy makers should have an explicit focus on long-term planning and requirements. They should develop an integrated, efficient and affordable transport system which is sustainable from social, economic and environmental points of view. Broad participation of different interest groups, particularly from the tourism sector and consumers is essential for the effectiveness of such planning. The latter should also incorporate the development of a land management regime to avoid misuse of land.

It is believed that the government would be better off in taking advantage of the infrastructural and developmental loans from the World Bank and other international institutions instead of proceeding with capital expenditure cuts from the budget. In addition the case of private financing and joint public/private financing arrangements should be encouraged as long as there is addition to the country's stock of transport capital, no matter who is financing it. Governments should ensure that the private sector has sufficient incentives to invest in transport capital and in its services as well by developing an efficient institutional framework, improving the legislative and regulatory environment and removing unnecessary bureaucratic procedures and practices. However, independent analysis should be undertaken at each country's level to investigate the relationship between transport capital and tourism further as this may allow prescription of more country specific implications and suggestions.

Uncited references Q10

Hellinwell; Heston, Summers, & Aten (2002); Nordstrom (2002).

Appendix A

See Tables A1 and A2 and Figs. A1 and A2. Q11

Table A2
Top ten tourist destinations 1998 (millions)

Country	Tourist arrivals
France	70
Spain	47.7
US	46.4
Italy	34.8
UK	25.8
China	25.1
Mexico	19.8
Canada	18.8
Poland	18.8
Austria	17.4

Source: WTO (2003). Q4

Table A1
World tourism arrivals by regions, 1985–2000 (in thousands)

Region	1985	% Share	1990	% Share	1996	% Share	2000	% Share
Africa	9710	2.9	15,090	3.3	19,593	3.3	28,284	4
Americas	66,430	20.1	93,570	20.4	115,572	19.5	128,164	18.6
Asia Pacific	30,843	9.4	53,109	11.6	89,774	15.2	111,372	16
Europe	213,795	64.9	286,708	62.4	347,329	58.7	390,903	57
Middle East	6240	1.9	7577	1.6	15,121	2.5	24,183	3.5
South Asia	2540	0.8	3179	0.7	4475	0.8	6870	1
World	329,558	100	459,233	100	591,864	100	687,000	100

Source: UN World Tourism Organization, 2006.

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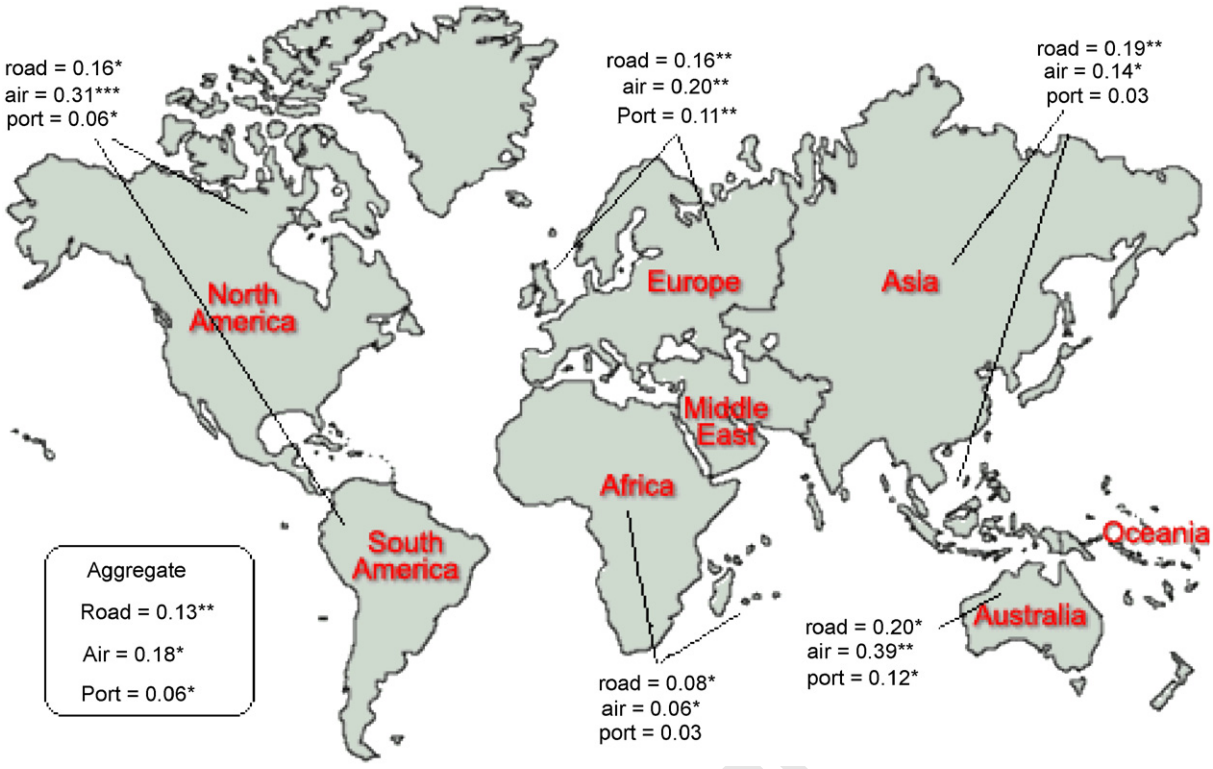

Fig. A1. Summary of estimated coefficients illustrating the importance of different types of transport for tourism flows to various continents.

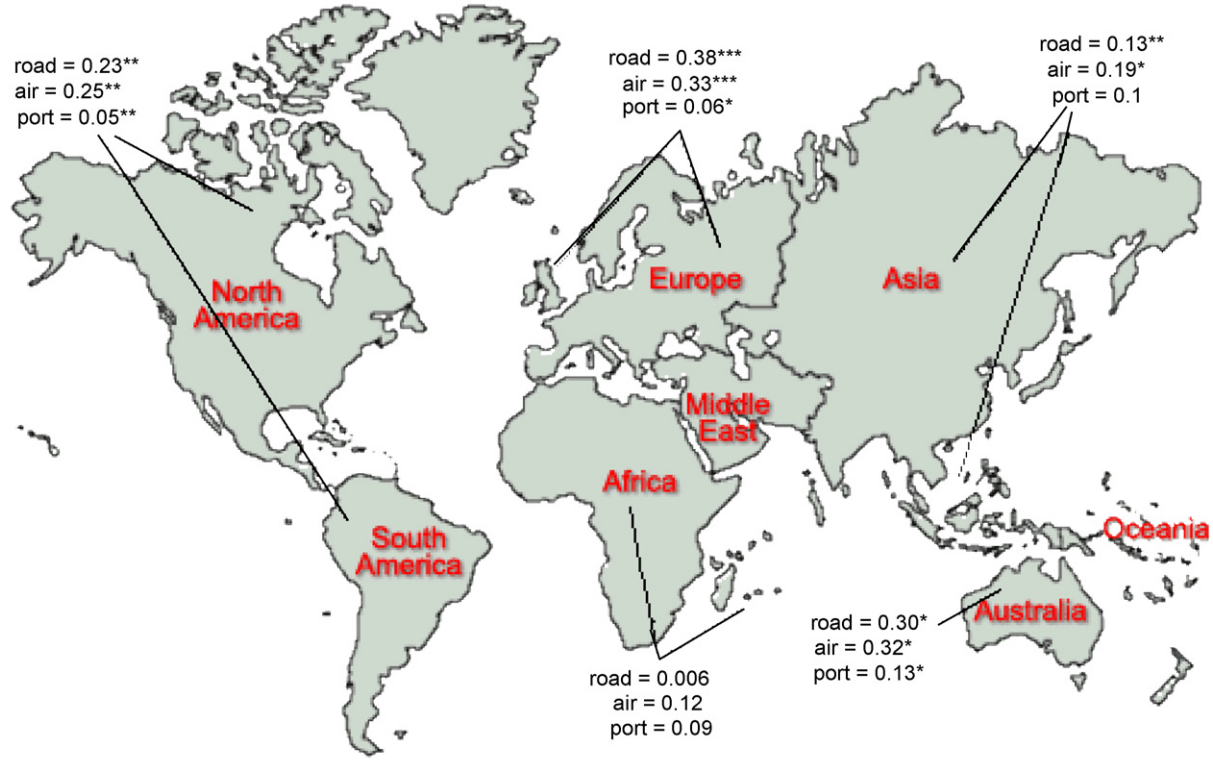

Fig. A2. Summary of estimated coefficients illustrating the importance placed on different types of transport from tourist from different origin.

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