Annals of Tourism Research 48 (2014) 1–10

Contents lists available at ScienceDirect

Annals of Tourism Research

journal homepage: www.elsevier.com/locate/atoures

Gravity models for tourism demand: theory and use

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ARTICLE INFO

Article history:
Received 25 July 2013
Revised 13 March 2014
Accepted 9 May 2014
Available online 3 June 2014

Keywords:
Gravity model
Tourism demand modeling
Structural determinants

ABSTRACT

Neglected by the tourism demand literature for the last decades, gravity models have re-emerged as a way for modeling tourism demand when the role of structural factors on tourism has to be evaluated. From the initial formulation of the gravity model, more sophisticated specifications have been developed including a more complete set of explanatory variables and allowing differentiation between origin and destination countries. In this paper, we propose a theoretical background to the gravity model for bilateral tourism flows derived from the individual utility theory. The issues in distinguishing the recent versions of gravity models from aggregated demand models are shown and the suitability of this methodology when structural factors have to be evaluated and quantified in the context of tourism demand is discussed.

Introduction

Developed during the sixties, gravity models use an analogy to Newton's universal law of gravitation to describe the patterns of international trade. The model considers that bilateral flows between two countries are directly proportional to the countries' economic masses and inversely proportional to the distance between them. Gravity models have been found to fit well and have been extensively used to explain international flows of trade, migration and foreign direct investment. For example, this model has been applied to estimate the effects of economic and non-economic

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http://dx.doi.org/10.1016/j.annals.2014.05.008

events on international flows of goods (Anderson & Van Wincoop, 2003; McCallum, 1995; Rose, 2000), migration (Gil-Pareja, Llorca, & Martínez, 2006; Karemera, Oguledo, & Davis, 2000) and foreign direct investment (Bergstrand & Egger, 2007; Eichengreen & Tong, 2007; Head & Ries, 2008).

The basic gravity model can be expressed as:

$$F_{IJ} = B\frac{(GDP_I)^{\alpha}(GDP_J)^{\lambda}}{(Dist_{IJ})^{\xi}}U_{IJ} \quad (1)$$

where F_{IJ} denotes the international flow between regions I and J; GDP refers to the gross domestic product of each regions; Dist is the distance between region I and region J; U_{IJ} is a log-normal distributed error term; and B, α, λ and ξ are parameters to be estimated. For estimation purposes, expression (1) can be transformed using natural logarithms (Ln) to:

$$LnF_{IJ} = \beta + \alpha LnGDP_I + \lambda LnGDP_J + \xi LnDist_{IJ} + \varepsilon_{IJ} \quad (2)$$

Where ε_{IJ} is a normal error term with $E(\varepsilon_{IJ}) = 0$ and $\beta = \ln(B)$.

Since tourism can be considered as a special type of trade in services, movement of international travelers and tourists were analyzed through the gravity approach in the initial emergence of the model (Durden & Silberman, 1975; Gordon, 1973; Kliman, 1981; Malamud, 1973; Pyers, 1966; Quandt & Baumol, 1969; Wilson, 1967). In that case, some authors have used population instead of GDP for measuring regions' economic mass (e.g. Taplin & Qiu, 1997). However, despite the initial popularity of the gravity models in tourism demand modeling, one of the main problems of this type of specification is its lack of theoretical foundation. Furthermore, as pointed out by Sheldon and Var (1985), in its initial formulation, gravity models predict that tourism flows from region I to region J are the same as those from region J to region I a circumstance that is not common in the case of tourism flows.

Nowadays, international economists recognize that the gravity specification for international trade can be supported by Heckscher-Ohlin models, models based in differences in technology across countries, and the models that introduce increasing returns and product differentiation (Deardorff, 1998). One of the most referenced papers on this area is Anderson and Van Wincoop (2003) since the authors developed a well-founded gravity model that provides consistent and efficient estimates by considering both multilateral and bilateral trade resistances. However, it seems clear that the theoretical support for trade gravity models is not valid for international tourism flows.

Consequently, it is not surprising that probably due to this lack of theoretical background in the tourism context, gravity models were neglected in the tourism literature during the eighties and the nineties. An illustration of this abandonment can be found in the fact that surveys on tourism demand modeling by Lim (1997, 1999), Li, Song, and Witt (2005) or Song and Li (2008) do not explicitly cite gravity models. In contrast, within the international trade literature, where a theoretical background is provided, gravity models are generally accepted to explain bilateral trade flows. In that case, this specification has been proved to be stable over time and across different samples of countries, specifications and methodologies, standing among the most used empirical regularities in international economic analysis.

However, fuelled by the success in international trade exercises, the gravity equation has re-emerged within the tourism demand literature during the last decade. Indeed, Kimura and Lee (2006) show that trade in services is better predicted by gravity equations than trade in goods. Keum (2010) explores the validity of the gravity equation to explain tourism flows, presenting a general explanation about the patterns of international tourism flows. Moreover, the empirical evidence supports the gravity model in terms of applicability and robustness to the flow of trade and tourism.

The gravity equation can be reformulated and applied to explain bilateral tourism movements on the basis that "the degree of interaction between two geographic areas varies directly with the degrees of concentration of persons in the two areas and inversely with the distance separating them" (Witt and Witt, 1995; p. 459). This "distance" can have physical, psychological, social and economic components. Bergstrand (1985) established some theoretical foundations for the model, deriving the gravity equation as "a reduced form from a partial equilibrium subsystem of a general equilibrium trade model with nationally differentiated products" (Bergstrand, 1985, p. 475). Doing so requires, as