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Modeling Caribbean Tourism Demand: An Augmented Gravity Approach

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Abstract

This study uses a gravity framework to model tourism demand for the Caribbean. The basic model is augmented by Linder's hypothesis—tourist flows are partly determined by the similarity in preferences between the destination and source markets—and climate distance, which measures the gap between climate conditions in origin and destination countries. The results indicate that traditional gravity variables are significant in explaining demand for the region. Habit persistence has the largest impact on demand, a result which holds promise for regional policymakers. Evidence is also unearthed that similarity in preferences between the region and its source markets, and climate distance are important demand determinants.

Key words: Linder's hypothesis, tourism climate distance, gravity, Caribbean

Introduction

Increasing globalization and market liberalization have spurred international flows of services. As part of international transactions in the service sector, tourism has flourished. Given its scale, it is now an essential component of international trade and ranks fourth as an export category after fuels, chemicals and automotive products (United Nations World Tourism Organization, UNWTO, 2011).

Tourism can be considered more important to the Caribbean than to any other region in the world. Indeed, the World Travel and Tourism Council (WTTC) ranks the region first in terms of the sector's contribution to national economies (WTTC, 2011). In 2010 total long-stay arrivals to the region were estimated at just over 20.1 million, compared to approximately 4 million in 1970. This translates into an annual rate of growth of about 6% over this period. Its contribution to the economic growth of Caribbean countries averages 15% of gross domestic product (GDP), reaching a high of 84.1% in Antigua and Barbuda (WTTC, 2004). Yet, the Caribbean's shares of international arrivals and receipts have merely kept pace with other regions' (see UNWTO, 2011). Given the importance of tourism to the economic and developmental fortunes of the region, questions of critical importance to regional policymakers are: What determinants drive demand in the region?

The neoclassical theory of consumer choice, the dominant framework for analyzing tourism demand in the literature, overlooks several particularities of the phenomenon, notwithstanding its theoretical foundations. Archer (1976) criticizes the analysis of tourism demand for its focus on traditional economic theory, even though it has long been established that demand is influenced by social, political, and technological factors in addition to economic variables. Indeed, Lipsey and Steiner (1981) note that factors other than price and income account for at least 30% of the variation in the demand for goods and services. Additionally, even though several studies in the tourism literature have demonstrated the ability of non-price and non-income factors to affect destination choices (Gray 1970; Um and Crompton 1990), many articles continue to ignore their influence on the demand for tourism. The inability of the traditional neoclassical economic framework to exploit the well-known properties of tourism goods and services makes it an incomplete approach for modeling tourism demand. This limitation should be addressed.

Although being undeniably a service-based economic activity, tourism is also a tradable product whose sale is intrinsically directed towards external markets, with the act of consumption depending on the displacement of the consumer to the destination. One of the important influences on this trade is distance from market and it is this concept that provides a starting point for this paper, namely the extent to which the distance variable is significant in explaining tourism flows. Indeed, Williams and Zelinksky (1970) argue that distance is one of the most important factors affecting travel patterns.

Against this background, the aim of this paper is to conceptualize a model of international tourism demand for the Caribbean with a special focus on the concept of distance. One strand of the tourism literature holds that geographic distance is a dissuasive element of destination choice, as the displacement of an individual to the destination entails physical, temporal and monetary costs (Taylor and Knudson 1973). Another line of research argues that geographic distance lends positive utility to tourists. Baxter (1979) shows that the journey itself, as a component of the tourism product, can give satisfaction in its own right so that, on occasion, longer distances are preferred. The definition of distance, though, has moved beyond geographic or absolute interpretation, and is now understood also in a relative context. As Kreisel (2004) notes, previous interpretations of geographical space based only on spatial aspects is obsolete and is not synonymous with "real" space (p. 167). Further, people behave with respect to relative space, which does not possess the metric properties of geographic distance (Gatrell 1983). From a tourism perspective, Hall (2005) asserts that the "distribution of travel behavior in space and time reflects an ordered adjustment to the factor of distance" (p. 69). As a consequence, this adjustment must be accompanied by flexibility in how distance is conceived.

A conceptualization and operationalization of distance beyond its geographic meaning form the bases on which this study will model international tourist flows to the Caribbean. First, it seeks to account for the difference in preferences between two countries, based on Linder's (1961) conjecture within the context of tourism; that is, the intensity of tourism flows between two countries depends on the similarities in their preferences. Second, the study also considers the difference in climate between countries as a factor of tourism demand. Understanding tourists' response to the impact of climate is essential to explaining the possible geographical and seasonal changes in tourism demand, among other things (Gössling et al. 2012). Third, the research employs the gravity framework for modeling international tourism demand for the Caribbean. The gravity model with its basis in physics—gravitation is the physical force that increases with mass and decreases with distance—emphasizes geographic and demographic factors of tourism demand, in addition to the traditional economic factors such as income and price, and can be appropriately augmented with other factors.

The current study thus contributes to the literature in three key respects. First, it moves beyond the narrow confines of neoclassical theory to incorporate other key factors of tourism demand. Second, it conceptualizes tourism demand within the concept of distance. Third, it introduces the construct of "climatic distance" to tourism.

Literature Review

Modeling International Tourism Demand

In its simplest form the gravity equation, an economic variant of the Newtonian gravity equation, states that bilateral flows between two countries/regions are proportional to the product of their GDPs. Linnemann (1966) introduced a gravity equation that has become the basic form for most gravity studies:

$$X_{ij} = \delta_0 Y_i^{\delta_1} N_i^{-\delta_2} Y_j^{\delta_3} N_j^{-\delta_4} D_{ij}^{-\delta_5} P_{ij}^{\delta_6} \qquad (1)$$

where X_{ij} is the relevant flow between country *i* and country *j*; Y_i and Y_j are gross national production/income in *i* and *j*; N_i and N_j are the populations in *i* and *j*; *D* is geographical distance between *i* and *j*; P_{ij} is a factor which facilitates the flows between *i* and *j*; and the exponents are the gravitational forces (parameters) to be estimated. Wide applications of the gravity model stem from its solid foundations (see Anderson 1979; Bergstrand 1985, 1989; Evenett and Keller 2002) and flexible form which allows for augmentation.

A number of tourism gravity studies have appeared in the recent literature. Gil-Pareja et al. (2007a) estimate the effect of embassies and consulates on tourist flows to 156 countries from the G7. They find a positive and significant effect, which is larger for developing countries. In another study, Gil-Pareja et al. (2007b) assess the influence of the Euro on tourism demand within the European Monetary Union from 1995 to 2002. The authors find that population size and source market income are the primary drivers of demand. Durbarry (2008) examines the impact of tourism taxes on demand for the UK. Findings indicate that increases in both real and relative prices have a negative impact on arrivals, while a common language increases arrivals significantly more compared to arrivals from non-native English-speaking countries. Llorca-Vivero's (2008) analysis shows that both domestic and international terrorist attacks cause tourist flows to deviate from their normal trend. Santana-Gallego et al. (2010) analyze the effect of various exchange rate arrangements on international tourism, finding that various exchange rate regimes increase tourist arrivals; however, the less flexible the exchange regime, the greater its impact.

Linder's Hypothesis

Linder's (1961) hypothesis—also known as the income similarity thesis—is stated in terms of preference similarity or similarity in demand structures and demand patterns, which is typically assumed to be associated with a common income level and the more similar are per capita incomes between two countries the greater are bilateral trade flows. Linder's hypothesis predicts a larger volume of flows between developed countries, or between developing countries respectively, than between developed and developing countries. Linder's hypothesis is also argued from a supply perspective. Countries usually develop a comparative advantage in supplying the products that are in high domestic demand. High- (low-) quality products are highly demanded in the domestic markets of high- (low-) income countries, which therefore develop a comparative advantage in producing such high- (low-) quality products. Combined with the demand-side argument of preference similarity, it can be argued that countries of similar income level tend to trade more intensely with each other (Hallak 2010). Linder's Hypothesis has been the focus of much empirical research in international trade for decades, and the empirical tests are often based on gravity models. However the empirical evidence is not always consistent. In more recent studies based on disaggregated, sector-level data and controlling the effects of additional factors, Linder's hypothesis has been well supported in the contexts of international trades of both manufacturing and service products (e.g., Baltagi et al. 2003; Li et al. 2003; Stack 2009).

Despite the economic nature of international tourism (i.e., as a kind of international trade) and therefore the applicability of an international trade theory, Linder's hypothesis has yet to be tested in the context of international tourist flows. Inclusion of a variable in the tourism demand model which measures the degree of similarity in preferences between origin and destination countries, will permit broad inferences to be drawn regarding the preferences of foreign tourists for the products offered by different destinations. In particular, a finding that greater similarity in preferences results in greater tourist flows provides support for Linder's hypothesis. The finding will provide useful implications on tourist behavior in a cross-cultural context and the importance of service quality especially in a developing destination country.

Climate

Climate has a strong influence on tourism and recreation and in some regions constitutes the resource on which the sector is predicated, for example, in the case of beach destinations (Kozak et al. 2008). The importance of climatic attributes for destinations is reflected in advertising (Gómez Martín 2005) and destination image construction (Pike 2002). Agnew (1995) and

Benson (1996) find that tourism spending abroad by UK residents increased following a cold winter. Benson (1996) and Giles and Perry (1998) also note that domestic tourism in the UK increased during and following a warm summer.

Generally, approaches to assessing the impact of climate on tourism demand focus on temperature (Koenig and Abegg 1997; Lisle and Tol 2002). However, an index approach to measuring and evaluating climate is a superior approach to assessing climatic impacts, owing to the complexity in the way weather variables interact to give meaning to climate for tourism (de Freitas et al. 2008). A "good" index would allow tourists to select the best time and place for vacation travel or plan activities suitable to the expected climate (de Freitas et al. 2008, p. 400). Climate indices have also been employed by, among others, Scott et al. (2003) and Amelung and Viner (2006) to assess the impact of climate change on the climate resources of the Mediterranean, and Amelung et al. (2007), the influence of climate change on global tourism flows.

Few tourism demand models include climate as a factor (Amelung and Viner 2006). One possible explanation for this discrepancy may be that climate has long been considered a relatively stable factor (Abegg et al. 1998; Baker and Olsson 1992), with little predictable and structural change from year to year. In all known studies, the climate variable or index of the destination is included directly in the demand specification. None considers the difference in climate between source and destination. Yet, unfavorable climate or weather at home, either in the year of travel or the previous year (Agnew and Palutikof 2006), act as a push factor for tourists to travel to warmer and drier conditions (Lisle and Tol 2002). This suggests that climatic conditions in both origin and destination should be considered in modeling of tourism demand and the difference between each other may have an effect on tourism demand.

Methods and Data

The gravity model in this study takes account of several factors: tourist flows between country *i* and country *j*; economic sizes of *i* and *j*; prices in *i* and *j*, and a measure of transportation costs between *i* and *j* in replacement of geographical distance. A variable to measure Linder's hypothesis is incorporated to determine whether similarity in preferences between two countries or regions can help to explain international tourism flows. Finally, the difference in climatic conditions between two countries or regions is included in the model specification.

To explain tourist flows, the gravity variables population and income are appropriate (Isard et al. 1998; Llorca-Vivero 2008). Broadly speaking, a destination's income and population can be viewed as indicators of potential supply, and the origin's income and population as indicators of potential demand (Linnemann 1966).

For destinations, it is likely that more services will be offered as the country becomes richer. For origin countries, if international tourism is a normal consumption good, demand will increase as income increases. Incomes in the origin and destination are thus both expected to be positively associated with demand. Populous countries are typically well diversified and have less need to undertake transactions with other countries (Brada and Mendez 1983; Linnemann 1966). Conversely, heavily populated countries are usually able to capture economies of scale in production and therefore engage in more economic activities than less populated countries

(Sandberg et al. 2006). Understood within the context of tourism, as the source markets for the Caribbean are much more heavily populated than the destination, tourist flows could be relatively small or large. Thus, the expected sign of the origin population parameter is ambiguous. Caribbean countries have very small populations, implying low potential supply of tourism services compared to countries with large populations. The sign on the destination population parameter is therefore likely to be negative.

Transportation costs (which include actual monetary costs, foregone time, and inconvenience) in gravity studies are typically proxied by the distance between capital cities due to the complexities of the price structure of transportation and the lack of consistent data (Madhavan and Iriyama 2009). Geographic distance is typically measured using the great circle formula giving the shortest distance between two points on a sphere (Mayer and Zignago 2011). A drawback of using geographic distance as a proxy for transportation cost is that it is time invariant. Consequently, this study adopts a different approach. Geographic distance as calculated by the great circle formula is multiplied by the average oil price to estimate transportation costs. The study notes that airfares might be a better measurement for transportation costs; however, wide unavailability of airfare data for the period under study restricts us to considering the best alternative. The direct relevance of oil prices for transportation costs and the effect of oil price movements on tourism demand have been argued by some scholars such as Smeral and Witt (1996) and Yeoman et al. (2007). Oil prices have been used as a travel cost proxy in some recent transport and tourism studies such as Carson et al. (2011), Ledesma-Rodríguez et al. (2010), Moore (2010) and Wang (2009). This variable is expected to have a negative effect on inbound flows.

Two price variables are employed, own price and substitute price. Own price or "effective price of tourism" (Mangion et al. 2005) reflects the cost of touristic activities in each Caribbean country relative to those in the origin country/region. It is calculated as:

$$P_{ijt} = (P_{it} / P_{jt})(e_{it} / e_{jt}) \quad (2)$$

where P_{it} and P_{jt} are prices in destination *i* and source market *j* respectively, e_{it} is the exchange rate between country *i*'s currency and the US dollar (USD), and e_{jt} is the exchange rate between country *j*'s currency and the USD. For Europe, e_{jt} is proxied by the UK/US exchange rate as this market comprises roughly 50% of European arrivals to the Caribbean. To compute e_{jt} for the Caribbean, a trade-weighted real effective exchange rate (REER) is calculated for the Caribbean, which is then divided by the US REER.

The substitute price employed is a weighted average of the prices of selected substitute destinations and the calculation takes the form of Stone's price index as follows:

$$\log P^{*}_{ijt} = \sum_{k=1}^{n} w_{jkt} \log P_{kt} \quad (3)$$

where *n* is the number of substitute destinations and w_{jkt} is the share of international arrivals to country *k* and is calculated as $w_{jkt} = TA_{jkt} / \sum_{k=1}^{n} TA_{jkt}$ where TA_{jkt} is international arrivals to substitute destination *k* from origin country/region *j* at time *t*. In this study, the substitute destinations are the Dominican Republic, the Bahamas and Jamaica, consistently the three largest markets from the sample under study in terms of arrivals. Stone's price index is appropriate for use in tourism demand studies, where logarithm transformation is applied to the demand function, and aggregate price levels for a region tend to be highly correlated (Li et al. 2004).

Both prices should be inversely related to demand; higher prices in the destination relative to those in the origin market, as well as to prices in competing destinations, should reduce flows to the destination market. The consumer price index was used to impute relative prices. While this index may not assign the exact weights to goods which tourists consume, it is employed because of its wide availability, making comparison among countries less problematic; and since one of the largest costs facing tourists is accounted for by airfare, already captured with the transportation variable, the consumer price index may be meaningful as it still captures many of the items associated with tourist spending. Further, domestic prices and tourism prices should be highly correlated (Morley 1994).

Linder's hypothesis is modeled in two ways: the absolute value of the difference between overall GDP per capita, $|Y_{it} - Y_{jt}|$, (McPherson et al. 2001); and the absolute value of the difference as a ratio of the sum of per capita GDP, $|Y_{it} - Y_{jt}|/(Y_{it} + Y_{jt})$, (Choi 2002). Support for Linder's hypothesis would follow from the finding of a negative relationship between the above variables and demand.

To model climate distance this study employs the tourism climatic index (TCI) by Mieczkowski (1985), a composite measure which systematically assesses the climatic elements most relevant to the quality of the experience for the "average" tourist. The TCI, based on theoretical considerations from the bio-meteorological literature related to human comfort, particularly with reference to tourism activities, is a weighted average of seven climatic variables: mean maximum daily temperature, mean daily temperature, minimum daily relative humidity, mean daily relative humidity, total precipitation, total hours of sunshine, and average wind speed.

In the TCI, the highest weight is given to the mean maximum daily temperature and the minimum daily relative humidity (together forming a daytime comfort sub-index) to reflect the fact that tourists are generally most active during the day, and that temperature is a key determinant of climate fitness. Sunshine and precipitation are given the second-highest weights, followed by daily thermal comfort and wind speed. The weights reflect the relative importance of these climate indicators on the quality of the tourism experience (Mieczkowski 1985). Recent applications of the TCI in tourism research can be found in Amelung and Viner (2006), Amelung et al. (2007), and Goh (2012).

A critical issue is the fact that tourists' appreciation of climatic conditions depends on activity levels. Beach holidays, for example, require different climatic conditions from snow boarding or skiing. Different combinations of the underlying variables can result in similar levels of comfort as calculated by the TCI. The TCI ranges from -20 (impossible) to 100 (ideal). A TCI score of 70 or higher is considered attractive to the "average" tourist engaged in relatively light activities (Mieczkowski 1985, p. 231). So the TCI is applicable for multiple climatic environments. In this regard, it is perhaps more of a tourism comfort index, as it is designed to indicate levels of climatic comfort for various types of tourism activities.

The TCI score for the Caribbean, considered arid by the Köppen-Geiger climate classification, is calculated by averaging the TCIs for the Caribbean countries under study. According to the Köppen-Geiger map, Europe has four climate types (cold, arid, temperate and polar) (Peel et al. 2007). Thus its TCI score is calculated as a population-weighted average of the TCIs for EU-15 countries, which gives a higher weight to more populous countries and thus better reflects the average climate exposure for the region. The TCI scores for Canada and the USA are calculated similarly.

Climate distance is modeled in two ways: the absolute value of the difference between the TCI score in the destination and origin, $|TCI_{it} - TCI_{jt}|$, and the absolute value of the difference as a ratio of the sum of destination and origin TCI scores, $|TCI_{it} - TCI_{jt}|/(TCI_{it} + TCI_{jt})$. These formulations thus account for both the push (climate of origin) and pull (climate of destination) dimensions of climate on tourism demand. It is expected that the greater the difference in climatic comfort between source and destination country or region, the greater will be the tourist flows from the source to the destination. For example, individuals who seek climatic attributes that give greater tourism comfort than those that exist in their country will be more inclined to travel to a destination with those attributes. Therefore, the greater the gap between tourism comfort levels in the destination relative to tourism comfort in their home country, that is, a large climate distance, the greater the volume of tourist flows. In contrast, a country with climatic attributes similar to those of the home country—that is, a small climate distance—will hold less appeal on the basis of climate, leading to a smaller volume of tourist flows. A positive relationship between climate distance and tourism demand is thus expected.

Finally, inbound arrivals are used to proxy international tourism demand. This variable remains the most popular measure of demand (Song and Li 2008). Song et al. (2010) conclude that the choice of the measure should depend on whether the objective of the decision-maker is to maximize arrivals or expenditure, and should be specified in aggregate form. Consideration of expenditure is not considered for empirical purposes here given the wide unavailability of such data for many of the countries. Arrivals are also likely to be persistent and likely to return to a destination (Lyssiotou 2000) if they are sufficiently satisfied with their experience, unless a major shock influences their perceptions of the destination (Naudé and Saayman 2005).

Dynamic demand models have been found to be empirically superior to their static analogues (Anderson and Blundell 1982; Browning 1991; Weissenberger 1986). Consequently, a lag of arrivals is included as another determinant in the gravity equation. This variable is expected to have a positive effect on tourism demand.

The final specification in log-linear form is:

$$\begin{aligned} \ln Tour_{ijt} &= \alpha + \beta_1 \ln Tour_{ij(t-1)} + \beta_2 \ln Y_{it} + \beta_3 \ln Y_{jt} \\ &+ \beta_4 \ln Pop_{it} + \beta_5 \ln Pop_{jt} + \beta_6 \ln Trans_{ijt} + \beta_7 \ln P_{ijt} + \beta_8 \ln P^*_{ijt} \\ &+ \beta_9 \ln Lind_{ijt} + \beta_{10} \ln Clm_{ijt} + \varepsilon_{ijt} \end{aligned} \tag{5}$$

where $Tour_{ijt}$ is the number of international arrivals to destination *i* from origin *j* at time *t*; $Tour_{ij(t-1)}$ is the number of arrivals lagged once to account for habit persistence; Y_{it} and Y_{jt} are per capita incomes in *i* and *j*; Pop_{it} and Pop_{jt} are the populations in *i* and *j*; $Trans_{ijt}$ is the cost of transportation between *i* and *j*; P_{ijt} and P^*_{ijt} are tourism own-price and substitute price; $Lind_{ijt}$ is a similarity index between *i* and *j*; Clm_{ijt} is the climate distance between *i* and *j*; and ε_{ijt} is a composite error term such that $\varepsilon_{ijt} = u_{ijt} + \eta_{ij}$, where ε_{ijt} is white noise and η_{ij} is time-specific unobserved heterogeneity.

Equation 5 assumes elasticities are the same across countries and time. Sanso et al. (1993) show that although the log-linear specification is a special case of the "optimal" form, it is a "fair and ready approximation" of the optimal form (p. 274). Several studies have investigated the time-varying properties of tourism demand (for example, Song, et al. 2011; Wu, et al. 2012); however, the variations in the long-run elasticities are beyond the scope of this study.

Panel Estimation

The model allows for some feedback from the past to the present. Thus, the usual procedures for estimating panel data models are inconsistent in this dynamic setting. Essentially, the problem arises from the fact that the equation's disturbance term, ε_{ijt}, and the lagged dependent variable, $Tour_{ij(t-1)}$, are correlated (Sevestre and Trognon 1985). Consequently, Equation (5) should be estimated using a method which takes into account the possibility of short-run disequilibrium in a particular year.

Generalized method of moments (GMM) methods to address such situations have been developed by Arellano and Bover (1995), and Blundell and Bond (1998), who use moment conditions based on the level of equations along with orthogonality conditions, and maximum likelihood estimation by Hsiao et al. (2002), who use differenced data under assumed normality for the errors. However, these methods are inappropriate for cases when the time span (T) is large. An appropriate method of estimation is the GMM estimator by Han and Phillips (2010). This estimator avoids the weak instrument problem when the coefficient on the lagged dependent variable approaches unity and the inconsistency present in fixed effects estimation of dynamic panel models (Nickell 1981). Another advantage of this estimator is that there are no restrictions on the number of cross-sectional units (n) and the T other than the requirement that $nT\rightarrow\infty$**.** Gaussian asymptotics apply regardless of how the composite sample size $nT\rightarrow\infty$, including both fixed n and fixed T cases..

Data

There are 18 destination countries: Antigua and Barbuda, the Bahamas, Barbados, Bermuda, the British Virgin Islands, the Cayman Islands, Dominica, the Dominican Republic, Grenada, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, and the United States Virgin Islands. These countries were selected based on availability of data for the variables in the demand model. The origins are the 4 main source markets: the USA, Europe, Canada and the Caribbean.

The data are a panel which runs from 1980 to 2008 on an annual basis. For six countries the data run from 1986 to 2008, and for one country, from 1986 to 2002; one country also has missing observations. Observations on arrivals from Europe conclude in 2007. Consequently the panel is unbalanced. This specification allows for all information available to be efficiently used without arbitrarily eliminating observations in order to balance the sample, as employing a balanced panel by restricting the sample would cause a selection bias to be incurred and yield inefficient estimates.

Arrivals are obtained from the Caribbean Tourism Organization; real GDP per capita, exchange rates and population from the United Nations National Accounts Main Aggregates Database; consumer price indices, average oil prices from the International Monetary Fund *International*

Financial Statistics online database; and coordinates of latitude and longitude from the Central Intelligence Agency *World Factbook*. Distance from Europe, to each country, is calculated using the latitudinal and longitudinal coordinates of Brussels, considered the capital of the European Union. Similarly, to calculate the distance from the Caribbean to each Caribbean country, the latitudinal and longitudinal coordinates of the middle of the Caribbean Sea are used. Finally, observations on the climate variables to calculate the TCI and, by extension, climate distance, are obtained from the Tyndall Centre for Climate Change Research and the Climate Research Unit, both at the University of East Anglia.

Results and Analysis

Before model estimation, panel unit root tests are performed. This study employs the Levin et al. (2002) test. The results (available from the authors on request) indicate that most variables are stationary, and a few are I(1). The GMM estimators such as the one used in this study generally have good performance when variables are nonstationary (Hayakawa 2009).

The estimation of alternative gravity models is performed using the statistics package Stata 13. The results are shown in Table 1. There are four specifications since there are two proxies each for Linder's hypothesis and climate distance. Across all the specifications, the new distance variables, Linder's hypothesis and climate distance, always show significant effects. Also noteworthy is the close similarity in estimates across specifications for the baseline gravity variables.

[INSERT TABLE 1 ABOUT HERE]

Habit Persistence. Results for all specifications suggest that arrivals exhibit a high degree of habit persistence. The estimated coefficient on $Tour_{ijt-1}$ suggests that international arrivals adjust to a new equilibrium at a rate of 60% in the year after changes in any of its determinants. The significance of the coefficient implies that there is a relatively high level of repeat visitation to the region. A further implication is that there may be factors which prevent tourists from full contemporaneous adjustment to changes in the determinants of demand. The finding of a high degree of habit persistence should be of extreme significance for destinations since it means that they could increase their share of worldwide arrivals by identifying and improving the characteristics which are responsible for creating a habituated tourist clientele. Finally, it suggests that the full effect of any changes in pricing policies on Caribbean demand should take a reasonably long time to be realized.

Income. Income elasticities for the destination and the origin, proxies for the attraction capacity of the Caribbean and purchasing power or tourist-generating capacity of the source country or region respectively, were both significantly positive in all models. When income in the source country rises by 10%, the total number of international arrivals rises between 2.2-2.9% in the short run and 5.5-7.3% in the long run. This implies that economic conditions existing in the origin countries have a fairly substantial effect, in the near and long terms in the Caribbean market. The income elasticities of the destination are larger than that for the origins. Increases in tourist arrivals vary between 2.7-3.1% in the short run and between 6.8-7.8% in the long run for a 10% rise in destination income, suggesting that tourists' preference is to visit a destination with a high per capita income, since this is likely to translate into higher standards of accommodation and better facilities. This suggests that destination attraction capacity is important in drawing tourists to the Caribbean.

Population. The destination population elasticities are all negative, and significant, while the population elasticities for the source markets are positive and insignificant. The negative estimates imply that the Caribbean is less able to supply tourism services as its population grows. At first blush, the result appears contradictory to that of the destination income elasticity. However, small countries, such as those in the Caribbean, face physical and financial constraints that larger countries do not. As their populations grow, more resources are increasingly diverted from providing tourism services towards other services which directly benefit the population, such as education and health. Thus, there may be a natural limit to the level of tourism services that can be provided by Caribbean countries.

Transportation costs. Estimates for transportation costs are negative and significant. Arrivals fall by approximately 0.5% and 1.3% in the near term and long term respectively for every 10% increase in the cost of transportation. Thus, despite the high rate of persistence, there is still some fallout when the cost of a trip to the Caribbean increases.

Prices. The own price is significantly negative; for every 10% increase in destination prices, arrivals fall by approximately 2.5% in the near term. The substitute price is also significantly negative; short run arrivals to the Caribbean decline by 1% for every 10% increase in the relative price of the destination to its competitors. This relatively high level of substitutability reflects a similarity in tourism offerings in the Caribbean. However, the greater own price elasticities imply that the cost of goods and services which tourists consume in the destination, are of greater importance.

Linder's Hypothesis. Estimates indicate that Linder's hypothesis has a relatively small though significant effect on flows to the region; short-run elasticities average around 2% for a 10% change in income similarity. Thus, the level of flows is inversely related to the differences between per capita consumption (and income) levels in source markets and the region. The implication is that as per capita income levels in source markets and the region converge, tourists become more inclined to go to Caribbean destinations. However, the small impacts observed may be indicative of the fact that average income levels in origin and destination countries are used to model Linder's hypothesis. If the distributions of income are diverging between origin and source countries, even though average income may be converging, the preference structures of origin and source countries would also be diverging. It may also be the case that arrivals from Caribbean countries, which have more similar incomes than the other source markets, are responsible for the significant results observed.

Climate Distance. Results suggest a highly significant effect as a result of the distance in climatic conditions between home and destination countries. Elasticities indicate an increase in arrivals of between 0.1-0.3% for every 10% increase in climate distance in the short run and 0.3-0.8% in the long run. As climate distance was calculated annually due to the general availability of the other variables on an annual basis only, the effect of climate distance is very likely underestimated. The positive and statistically significant coefficient estimate on climate distance has two key implications: first, climatic features have a statistically significant impact on demand in the Caribbean; and second, an adverse change in climatic features relative to competitors could lead to substitution away from the region.

Conclusion

This study uses the gravity model framework to model tourism demand for the Caribbean employing annual data on 18 countries from 1980 to 2008. The basic gravity equation was augmented by Linder's hypothesis which, in this context, conjectures that the level of tourist flows to the region is partly determined by the similarity in preferences between the Caribbean and its main source markets—the USA, Europe, Canada and the Caribbean—and by tourism climate distance. Two different specifications to model both Linder's hypothesis and tourism climate distance are used. The model is estimated using the dynamic panel GMM estimation technique by Han and Phillips (2010).

The results indicate that traditional gravity equation variables are significant in explaining demand for the region; that is, destination and origin income, destination population, tourism own and substitute prices are all key determinants. Habit persistence, is the primary determinant of demand, a result which holds promise for regional policymakers in designing strategies to maintain the level of arrivals at their long-run trend. The existence of habit persistence also indicates the importance of the "word-of-mouth" effects. In the present digital era, the importance and effectiveness of social media marketing should be well recognized by destination management originations and tourism service providers, especially for such developing countries as the Caribbean. Well developed social media campaigns can be very cost effective given the more widespread and powerful "electronic word-of-mouth" effect. The finding of significantly habituated source markets is also important due to evidence which suggests that transportation costs have an adverse effect on the volume of arrivals to the Caribbean. Oil price fluctuations are likely to affect the long-haul markets more significantly. Therefore, short to medium trends of world oil price changes should be taken account of in destination management and marketing plans. The significant effects of both the own- and substitute- prices reveal the competition within the region. More effective competitive strategies should focus on value for money and product differentiation and innovation, instead of price reduction.

The study also unearths evidence that similarity in preferences between the region and its source markets is significant in explaining demand. This suggests that visitors to the Caribbean are attracted to the destination partly because of expectations that it can offer tourism goods and services that are of a quality reasonably similar to what can expect at home. Tourism service providers in the Caribbean, especially those targeting long-haul European and North American markets, should have good understanding of their customers' expectations and delivery quality services and products to meet the expectations. Another important finding is the significance of climate distance in attracting tourists to the Caribbean. While there is little, if anything, that can be done by the region's policy-makers about the fall-off in tourists from main markets who travel for climate reasons, during periods when the climate distance is very small, they should consider targeting other markets whose climate distance is largest during periods when traditional markets are in abeyance and invest additional marketing efforts in these markets.

As the study was limited by the unavailability of relevant airfare data, the use of oil prices as a proxy for transportation costs becomes an inevitable limitation of this study. Alternative proxies will be explored in the future and potential biases of the proxies will be assessed once required data support is available.

Other possible distance concepts that could be investigated within the gravity framework include, for example, socio-psychological dimensions of distance such as cultural distance, cognitive distance or psychic distance, colonial legacies, and language barriers, among others. These will be considered in future research. Another line of research will seek to capture the effect of climate distance on a seasonal basis, which is likely to offer a clearer picture of this factor's true impact.

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Table 1. Gravity Estimates

	(a)	(b)	(c)	(d)
$Tour_{ijt-1}$	0.609*** (0.000)	0.605*** (0.000)	0.608*** (0.000)	0.613*** (0.000)
Y_{it}	0.286*** (0.000)	0.306*** (0.000)	0.286*** (0.000)	0.271*** (0.000)
Y_{jt}	0.249*** (0.000)	0.219*** (0.000)	0.248*** (0.000)	0.286*** (0.000)
Pop_{it}	-0.373*** (0.000)	-0.322*** (0.004)	-0.373** (0.011)	-0.405*** (0.000)
Pop_{jt}	0.271*** (0.000)	0.268** (0.037)	0.292*** (0.009)	0.283*** (0.006)
$Trans_{ijt}$	-0.046*** (0.000)	-0.047*** (0.008)	-0.046*** (0.001)	-0.046*** (0.000)
P_{ijt}	-0.246*** (0.000)	-0.241*** (0.000)	-0.248*** (0.000)	-0.248*** (0.000)
P_{ikt}	-0.101** (0.041)	-0.107** (0.039)	-0.101** (0.040)	-0.097** (0.046)
$Lind_{ijt}\_1$	-0.181*** (0.000)	-0.198*** (0.000)	---	---
$Lind_{ijt}\_2$	---	---	-0.255*** (0.000)	-0.224*** (0.000)
Clm_{ijt}_1	0.012** (0.049)	---	0.012** (0.040)	---
Clm_{ijt}_2	---	0.014** (0.038)	---	0.028** (0.027)
Observations	1612	1612	1612	1612
Sargan	62.503 (0.458)	59.851 (0.589)	63.948 (0.408)	62.036 (0.511)

Notes: $Lind_{ijt}\_1 = |Y_{it} - Y_{jt}|$ and $Lind_{ijt}\_2 = |Y_{it} - Y_{jt}|/(Y_{it} + Y_{jt})$. $Clim_{ijt}\_1 = |TCI_{it} - TCI_{jt}|$ and $Clim_{ijt}\_2 = |TCI_{it} - TCI_{jt}|/(TCI_{it} + TCI_{jt})$. *Sargan* is the Sargan test for over-identifying restrictions. Figures in parentheses are *p*-values. *, ** and *** indicate significance at the 1%, 5% and 10% levels respectively.