THE EFFECT OF TELECOMMUNICATION DEVELOPMENT ON INTERNATIONAL TOURISM IN LATIN AMERICAN AND CARIBBEAN COUNTRIES

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ABSTRACT

Latin American and Caribbean (LAC) countries have experienced a large amount of growth in international tourism arrivals over the time period from 2000 to 2016. At the same time, there has been a great rise in the use of the Internet and other forms of telecommunication. Through this paper I study the effects of infrastructure development, specifically focusing on advances in telecommunication networks, on the overall demand for tourism. By developing an econometric model, I aim to determine the exogenous factors that contribute to this demand for international tourism. Ultimately, this analysis yields statistically significant evidence of a positive relationship between telecommunication infrastructure and international tourism demand, thus providing insights into the general demand relationship.

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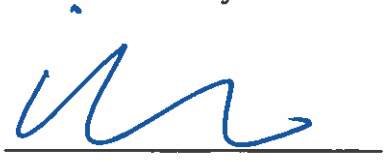

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I. Introduction

Over the past 30 years, increased globalization has led to an increase in international tourism. This is especially true in Latin American and Caribbean (LAC) countries, as North American tourists opt to travel south for international tourism instead of travelling across the Atlantic to visit Europe, Asia, or Africa. Along with the growth in international tourism over this time period, Latin American and Caribbean countries have also experienced economic growth and development. Due to the concurrent growth, it is apparent that there is a correlation between the development of tourism in the LAC region and the development of these countries over the same time period. Because the tourism industry in LAC countries has grown parallel to the countries' development, it is often difficult to determine which growth drives the other. Much of the literature about the tourism industry supports the idea that tourism contributes to economic growth (Eugenio-Martin, Morales & Scarpa, 2004; Lionetti & Gonzalez, 2012). In this paper, I examine and investigate the level of tourism in Latin American and Caribbean countries, specifically focusing on how telecommunication infrastructure development affects the demand for tourism.

Due to the vast differences in countries around the globe, this paper focuses on a common region in order to make comparisons easier. The Latin American and Caribbean region contains many countries that have several common features, and thus serve as a good base for comparisons. In general, LAC countries share the use of Spanish as a common language and a shared history of European Colonization in the fifteenth and sixteenth centuries. For this reason, past research has made it a

standard to study the LAC region as a similar group for visiting tourists. Similarly, because of the large breadth of attractions, common language across nations, and proximity to North America, tourists looking for a travel experience may compare across several LAC countries to pick one that best suits their travel objectives. In addition, international tourists will often visit LAC countries due to their relative inexpensiveness, and compare across the different price points. Ultimately, LAC countries have experienced a large growth in international tourism that is driven by their attractions and affordability.

Despite the recent modernizations in LAC countries, their infrastructure is often underdeveloped. Roads, airports and rail lines are all inconsistent, and a large percentage of roads are still unpaved (Central Intelligence Agency, 2015). For visiting tourists, who often come from regions of higher income, this lack of structure can lead to many problems as they try to navigate a foreign country. Because a successful tourism industry depends on airport and road infrastructure that matches the growth in international tourism, LAC countries with poor air transportation infrastructure, such as Brazil and Argentina, are dramatically hindering their potential in the tourism industry. This was shown in the 2016 Olympics in Rio when Brazil struggled to handle the large infrastructure requirements of hosting such a large-scale international event (Nocera, 2016).

With these shortcomings in road and air travel, Latin American and Caribbean countries also face infrastructure issues with respect to telecommunications. Due to their rapid development and modernization, telecommunications systems are often underdeveloped, sub-optimal or

disorganized. This poor telecommunications infrastructure presents itself through inconsistent electricity, telephone services, and more recently through issues with the Internet. For international tourists, this may present issues as they are separated from amenities that they are accustomed to when they are away from their home countries. Furthermore, there is a history of political turmoil and social unrest within LAC countries that provides even more issues for potential tourists. Due to the rapid turnover of governments, tourists may be deterred from visiting because of perceived risks of terrorism, kidnapping, and violence.

Despite these infrastructure and instability issues, nearly 100 million international tourists visit Latin America and the Caribbean every year (World Tourism Organization, 2016). In this paper, I investigate the root causes of international tourism demand for visits to Latin American and Caribbean countries. I then plan to examine how advances in infrastructure, specifically focusing on telecommunication developments, contribute to a greater demand for tourism. Ultimately, this paper aims to discover the effects on tourist arrivals from developments in telecommunication infrastructure. By investigating this topic I aim to answer the following questions. First, the investigation aims to tell whether and if so, how much, tourists' demand depends on access to amenities and infrastructure that they are used to. Second, this paper hopes to explain the general relationship of demand for tourists that are visiting LAC countries.

In Section II, the Literature Review, I examine relevant works and background information related to economic development, infrastructure, and telecommunications through the lens of tourism. In Section III, I develop the

conceptual and empirical models for this paper and discuss hypotheses that are motivated in Economic theory. In Section IV, I discuss the data and variables used in the econometric model. Section V reports on empirical results from the econometric analysis. I will then connect the econometric conclusions in the context of the research question in Section VI, the conclusion.

II. Literature Review

In order to fully understand the relevant literature related to the research question, focus is separated into three different types of related works. There are very few peer-reviewed articles that cover the intersection of tourism, infrastructure development, and telecommunications networks and so each element must have individual focus. This literature review investigates those three sub-topics in detail, focusing on tourism and economic development literature, tourism and infrastructure literature, and telecommunication network development literature. By investigating related works to these three topics I can ultimately develop an understanding of where this paper's research question fits within current literature, and how my own research contributes.

Tourism and Economic Development

One of the main focuses of tourism and economic development literature is to investigate the affects of tourism on the host country's economy. When studying international tourism in Latin America, growth in tourism is connected and correlated to economic growth for low and middle-income countries (Eugenio-Martin, Morales & Scarpa, 2004; Lionetti & Gonzalez, 2012). While there are many reasons tourism could contribute to the growth of an economy, it has been found

that tourism contributes to a successful and prosperous economy by generating production, creating employment opportunities, and increasing international balance of payments (Lionetti & Gonzalez, 2012). Despite these positive effects of tourism growth, others question whether a tourism boom could ultimately hurt economies in the long run as the growth generates a large inflow of foreign currency, and could create a Dutch Disease effect (Holzner, 2011). Despite fears of negative effects caused by tourism growth, Holzner (2011) found that "countries with higher shares of tourism income in GDP grow faster than others after controlling for traditional growth-explaining variables [and that] countries with higher income from tourism tend not only to have higher economic growth rates but also higher levels of investment and secondary school enrolment" (p. 929). This further suggests the connection between growth in tourism and economic development for Latin American and Caribbean countries. Moving forward in analysis, it is important to take into consideration how tourism has positive effects on the economies of the Latin American and Caribbean countries.

Tourism and economic development papers also aim to identify the determinants of demand for tourists. Eugenio-Martin, Morales, and Scarpa (2004) identify that tourists demand for the following goods and services when they visit a location: accommodation, food, transport, and entertainment. It is also common to consider political risk in tourist destinations as a deterrent of demand for tourists (Eilat & Einav, 2004). These political risks include but are not limited to: terrorism, protests and strikes, kidnapping and abduction, and general unrest. Since LAC countries, in general, have a more recent history of turbulent political situations,

especially in comparison to North American countries, this is an important factor to consider when modeling tourists' demand (Strizzi & Meis, 2001). This suggests that the analysis should consider the different factors that attract and deter tourists through the development of the model.

When considering determinants of tourists' demand, it is also important to note that Latin American and Caribbean countries attract certain types of tourists. Sarigollu and Huang (2005) investigate this question by considering how the tourist market is segmented with LAC countries. They find that LAC tourists are of four varieties: adventure-seekers, fun and relaxation seekers, urban travelers, and multifarious travelers, and then use this information to generalize the types of travelers visiting the LAC region (Sarigollu & Huang, 2005). By segmenting the types of tourists visiting LAC countries, it is easier to see what attracts tourists, and ultimately better understand the tourists' demand. Sarigollu and Huang (2005) found that the largest segment was the multifarious travelers; these are travelers that represent a typical tourist family and most importantly, "expect the highest levels of service and infrastructure" (p. 291). This finding helps motivate the idea that tourists to Latin America and Caribbean countries have high expectations for the infrastructure and service in their travels.

Tourism and Infrastructure

As discussed in Sarigollu and Huang (2005), the success of tourism within LAC countries strongly depends on the amenities and infrastructure available in that country. In order for tourism to be successful in developing nations, such as many of the LAC developing nations, countries must have developed their soft-infrastructure

and their hard-infrastructure to some degree (Thapa, 2011). Here, soft-infrastructure represents "human resource developments [that] support the tourism sector, " and hard-infrastructure represents "facilities, utilities, [and] transportation networks" (p. 1705). Ultimately, the quality of a tourist's experience based off of tourist-oriented infrastructure can be simplified down and evaluated by "the four A's: availability, affordability, accessibility, and accountability" (p. 1706). In studying the affects of infrastructure on tourism, evaluating facilities using this criteria shows how important it is to have adequate soft- and hard-infrastructure in order to be prosperous.

While Thapa (2011) pointed out the necessity of good hard and soft infrastructure for a successful tourism industry, inadequate infrastructure in Latin America and the Caribbean "undermines the regions growth and competitiveness, and hampers the fight against poverty" (Faye & Morrison, 2007, p. 15). Simply put, if the infrastructure is not good enough for the general economy, it is implied that it is also not good enough for the tourism industry, as tourism is a subsection of the economy. Faye and Morrison (2007) discuss how over the past 20 to 25 years, Latin American and Caribbean infrastructure has improved with respect to water, sanitation, and telecommunications, but it has not improved with respect to roads. This discrepancy is important when considering tourists' experiences while traveling, since a major part of traveling involves road transportation. When evaluating tourism in a LAC country, it is essential to consider how advances in infrastructure, or lack thereof, could positively or negatively influence the tourist's experience. This is especially true in the case where North American tourists are

accustomed to a higher level of infrastructure due to the higher standard of living within their home countries.

Telecommunication and Infrastructure

With these improvements of infrastructure for many industries in LAC countries, it suggests the idea that Internet and other telecommunication developments would improve the experience for the tourist. This experience improvement caused by Internet and telecommunications infrastructure likely increases the attractiveness of the prospective destination. In the United States and Canada 89% of people use the Internet, whereas in LAC countries, on average, 59.6% of people use the Internet (International Telecommunication Union, 2016). This difference surely generates some degree of "culture-shock" for visiting tourists. In the analysis section of the paper I investigate how the improvement in Internet use and availability has affected tourism.

Looking from the perspective of the business, it is likely that Internet infrastructure development can affect businesses involved in tourism as well. In Karanasios and Burgess's paper (2008), they discuss how the adoption of Internet for businesses in developing nations has influenced their tourism. They found that Internet infrastructure development improved the prosperity of hotels and other hospitality services, because it enabled the companies to better communicate with potential customers and better manage their bookings systems. Furthermore, they found that the largest hurdles for Internet adoption are poor telecommunications infrastructure, high Internet adoption costs, and lack of relevant knowledge and skills to fully use the Internet (Karanasios & Burgess, 2008). Karanasios and

Burgess (2008) also commented that the "majority of tourism enterprises around the world can be classified as small and medium sized [and that] small tourism enterprises in the developing world are numerically the dominant form" (p. 170). Because small tourism businesses compose a large amount of the tourism industry of the developing nations of LAC, the businesses' relationship with the Internet helps to better understand the general relationship between tourism and Internet adoption.

Finally, it is necessary to address the development of telecommunications in LAC countries. Galperin's (2005) acknowledges that telecommunication development requires a large investment at the outset in order to develop the necessary infrastructure; however, in Latin America and the Caribbean, they adopted the technology much later. By adopting and utilizing the technology later, they were able to take advantage of wireless systems such as mobile phones and Wi-Fi (Galperin, 2005). Because of access to wireless systems, which require a much smaller initial start-up cost, many LAC countries are able to develop a stronger telecommunication network than they would be able to create if they were limited to wired technologies. This Internet and telecommunications development is beneficial to LAC countries because it has been shown that Internet and telecommunication connectivity lead to "increased productivity, better health, education, and government services" (Galperin, 2005, p. 47). These positive effects from internet usage in developing countries, like those in Latin America and the Caribbean, suggest that there are additional positive effects on tourism that were

not initially counted for. In the remainder of this paper I investigate these potential effects on tourism from these telecommunications developments.

III. Conceptual and Empirical Model

The main goal of this paper is to investigate the role of telecommunication infrastructure development on tourism demand. I investigate this question by developing a model for tourism demand that incorporates telecommunication infrastructure and Internet. From this model, I can glean information about different elasticities of demand as well as information about positive and negative correlations between the independent and dependent variables. I model tourism demand as a function of demand determinants and explicitly include the effects of telecommunication in the specification. In this section I use the conceptual and empirical models to explain the hypothesized connections between tourism demand and the independent variables, and finally relate supposed coefficient estimates to their elasticity implications.

Tourism to a country can be difficult to describe because guests and visitors arrive for different motivations, spend their time and money in different ways, and also seek out different attractions while they are visiting. In economic theory, demand is often a function with the dependent variable represented by quantity demanded. In the context of tourism, it is common practice use international arrivals to represent the quantity demanded (Song & Witt, 2000). Using this variable to represent tourism demand shows how many people actually "purchased" a visit to a country and thus displays the total quantity demanded. For the base model of this analysis, I use international arrivals to represent tourism quantity

demanded because it allows for the tracking of growth and changes year-after-year as the number of visitors fluctuates.

When tourism demand is represented by number of arrivals, I generate a model that states tourism demand as a function of various independent inputs. In general microeconomic theory, it is common knowledge that demand for any good or service is determined by the price of the good, the price of related goods, income, and consumer tastes and preferences. This is represented as a function below where Q^D represents the quantity demanded for tourism in a certain LAC destination country.

$$Q^D = D(Prices, Income, Tastes)$$

Empirically, I measure the variables using measures suggested by the previous literature. In *Tourism Demand Modeling and Forecasting,* the authors suggest that they best way to represent price of international travel is to use the consumer price index (CPI) of the destination country (Song & Witt, 2000). While they acknowledge the shortcomings of using CPI – such as the fact that a typical bundle for a resident may be different than a typical bundle for a tourist – they conclude that CPI is still the closest approximation to cost of living or visiting in a foreign country. Song and Witt (2000) further recommend that it may be useful to price-adjust the CPI using exchange rates in order to account for differences in currencies. Income is somewhat complicated as it is difficult to quantify the income of each arriving tourist. Song and Witt (2000) comment that the practice of using GDP to represent visiting country income is common in international tourism demand modeling. Despite this common practice, lack of available information

about arrivals patterns stratified by country makes it difficult to separate the effect of different countries of origin and their respective GDPs on tourism preferences for international arrivals. Because of this, I elect not to use income in the conceptual and empirical models for analysis.

Next, tastes and preferences must be specified as exogenous variables in order to fully develop the conceptual model. As noted in Section II, several variables that contributed to the tastes and preferences of tourists were identified. At a broad level these variables were: infrastructure, political risk and safety, and attractions. This yields the following approximation for tastes, where T represents a function:

$$Tastes\ and\ Preferences = T(infrastructure, safety, attractions).$$

In order to focus onto the research question, I hope to split infrastructure into transportation and telecommunication subsections. By separating them by types of infrastructure, I can ultimately investigate the effects of telecommunication development on quantity demanded of tourism. In the same manner, I can divide the safety variable into health safety and political unrest. By expanding these variables to represent the influencing preferences of travelers, I hope to accurately model the tourists' tastes.

Finally, I must consider expectations as the final variable within the base model. Expectations are also hard to quantify as a real-world variable and so, until later analysis will allow for expectations to be absorbed into the disturbance term as well. Combining all of these specific exogenous variables yields the following theoretical model.

$$Q^D = D(Prices, Infrastructure, Safety, Attractions,)$$

This equation is the basis for my understanding of the inputs and determinants of tourism demand. Moving forward, the next theoretical question that must be addressed is what sort of function would best model this demand function.

Since I am interested in the correlations and relationships between these variables, the simplest way to model them is by generating a linear model. However, Song and Witt (2000) comment that using an exponential model is often a more practical choice because it "implies that the marginal effects of each independent variable are not constant, but depend on the value of the variable [and] on the values of all of the other variables"(p. 10). Exponential models are also easily transformed into a double-log model that can be estimated using Ordinary Least Squares. This is well suited to modeling the real-world tourism demand relationship because it is likely that there is a lot of interaction between the variables, and this type of model accounts for that. Because of this, I plan to compare a strictly linear model with a double-log model in order to represent this relationship. In addition, the coefficients of a power model can be interpreted as demand elasticities. Interpreting the coefficients as elasticities is important to this analysis as it easily tells the effect of telecommunication infrastructure on tourism demand.

The empirical model follows as

$$Q^D = K \cdot P^{\alpha_1} \cdot I^{\alpha_2} \cdot S^{\alpha_3} \cdot A^{\alpha_4} \cdot u$$

In this model K represents the intercept constant, P represents prices, I represents infrastructure (both for transportation and for telecommunications), S represents safety (for health and political unrest), A represents attractions, and u represents the disturbance term.

This model can be transformed into a linear model by taking the natural log of both sides. This yields the following:

$$\ln Q^D = \alpha_0 + \alpha_1 \ln P + \alpha_2 \ln I + \alpha_3 \ln S + \alpha_4 \ln A + \varepsilon$$

This will be the starting equation in the econometric regression analysis, where all of the α's represent the demand elasticities. STATA, a statistical software package, can estimate all of these coefficients using OLS and linear regression analysis, after the variables are transformed. In order to align the model with pre-existing economic theory, my base assumption is that the demand function is downward sloping. This means that as price increases, I expect that quantity demanded will decrease. Because of this, I expect and require $\alpha_1 < 0$ in all of the models that I develop. Infrastructure development is expected to have a positive influence. I also hypothesize that health improvements has a positive influence as well. In contrast, I believe that the increase or presence of political unrest and dangerous conditions will hurt tourism, and thus will have a negative sign. Finally, since borders are, for the most part staying constant, attractions will remain constant over time.

IV. Data and Variables

In the analysis of tourism demand in LAC countries I develop a regression using annual panel data of all LAC countries over the time period from 2000 until 2016. In this section I discuss the various sources for the data in this analysis. I also present information about transformations on the data and proxies that were used in order to develop the empirical model. The data for this paper came from three

major sources – the World Bank[1], the International Telecommunications Union[2], and the Central Intelligence Agency[3]. Each of these internationally recognized sources provides the data annually.

The first major source of data used for this analysis is the World Development Indicators (WDI) from the World Bank. The WDI is a compilation of officially recognized sources for international development data. It covers information from general economic indicators, such as GDP or CPI, to infrastructure and health indicators. Since the majority of LAC countries are still developing, this data set allows for the judgment of their development. It also provides information about total international arrivals for tourism per year to every country, as well as total international expenditures for tourism. Both of these variables could serve to represent international tourism demand; however, as Song and Witt (2000) recommended, I construct my base model using arrivals. The expenditures variable can be used to supplement any findings by showing differences in spending behavior of tourists. Moreover, data from the WDI is useful in the context of the model because it provides a lot of information about the variables of interest: arrivals, prices, and infrastructure and health among others.

In this analysis I use CPI to represent the price of international tourism to LAC countries, and potentially use exchange-rate adjusted CPI, as discussed in the theoretical section of the paper. In order to develop this variable, I utilized the

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[1] The World Bank, World Development Indicators (2016) http://data.worldbank.org/

[2] International Telecommunication Union (2016) http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx

[3] Central Intelligence Agency, Political Instability Task Force (2017) http://eventdata.parusanalytics.com/data.dir/atrocities.html

annual CPI data from the World Bank WDI data set. They use 2010 as a base year across all countries. I also take the exchange rates from local currency units into US dollars for all of the LAC countries. These exchange rates are also stored within the WDI data set. In order to make the CPI exchange rate adjusted, simply add the two values together, as was presented in the Martin and Witt (1987) analysis of the optimal representation of tourism price.

Finally, the WDI data set contains a multitude of variables pertaining to infrastructure and health. One of these is a Logistical Performance Index that evaluates the quality of transport and trade infrastructure. This index continuously ranges from 1 to 5 in evaluation of differing countries transport infrastructure. For reference, the Syrian Arab Republic has the lowest LPI ranking of 1.24, while Germany has the highest LPI of 4.44 (World Bank, 2016). The average LPI of LAC countries from the period 2000 to 2016 is 2.48. The median LPI of the LAC countries that is evaluated under this criterion is a 2.44 in Colombia (World Bank, 2016). For comparison purposes, this country has a network of 204,855 km of roads and 121 paved airports (Central Intelligence Agency, 2015). Using this variable allows for a better understanding of the general level of transport infrastructure in that country. This variables also shows how infrastructure development changes over the desired time period because it changes year to year with infrastructure development. Unfortunately, this LPI variable is not updated annually or on a regular basis. Because of this lack of regularity, it was difficult to extrapolate using averages and so I filled in the blanks in the data by keeping the previous LPI value for years that

were un-reported until a new observation was made. This helped to make the data set more complete.

In addition to this infrastructure variable, the WDI data set has health variables, such as access to sanitation, access to safe water and disease prevalence represented as percentages of total population, urban population and rural population. All of these variables are suitable in representing the health aspect of the model that was described in the theoretical section of the paper. I ultimately chose to use access to sanitation as the variable that best represents health because it is the most complete variable across all of the countries and years. Using this variable to represent health provided the most information to the modeling data set.

Another source of data is from the International Telecommunications Union (ITU). The ITU collects their own data from national telecommunication organizations and regulatory organizations as well as household data from individual countries' national statistics offices. The ITU provides annual data by country about total Internet users as a percentage of the population. It also gives annual data for mobile cell phone subscribers, as either a total or a percentage, and data for broadband subscribers, also as a total or percentage. In this analysis, since this paper investigates the effect of Internet infrastructure on tourism, it makes sense to use the total number of broadband subscriptions as a measure of the Internet infrastructure development. It is better to use Broadband subscriptions over a total Internet users percentage as the explanatory variable because, Internet users percentage only explains how many people access the Internet rather than how many businesses or citizens have access to Broadband, and thus Internet.

Because of this, I use broadband subscription totals as the independent and explanatory variable for Internet infrastructure. Investigating broadband is comparable to investigating Internet as both of those variables describe different ways to quantify Internet use – one through total subscriptions and the other through actual use.

This analysis also uses a dummy variable that is sourced from the Political Instability Task Force Worldwide Atrocities Data Set (PITF). This data set is compiled and created by the Central Intelligence Agency of the United States. It records whether or not there was a political instability incident in a given year and country from the years 1995 to 2017. I use this variable as a way to represent perceived political unrest and safety issues for incoming tourists in my model. The purpose of this dummy variable is to potentially capture the negative affects on tourism that occur when there is violent political instability and unrest in a country.

It is difficult to develop a variable that represents the true tourism "attractiveness" of any LAC country because the only real way to tell how popular a country is to potential visitors is by how many people come to visit. This would obviously cause a high level of multicollinearity within the model and so it is not an ideal choice. From another angle, it is hard to categorically quantify what makes a country desirable. For example, in Peru there is the great cultural attraction of Incan ruins and Machu Picchu, the beaches, and the Amazon. In contrast, in the much smaller country of Costa Rica, the main tourist attractions are outdoor activities on their beaches and in their jungles. It is difficult to quantify these differences across

countries. Because of this, I believe it is best to absorb these attractiveness differences into the disturbance term of the model.

Using all of the variables together, I now have a new, more specific interpretation of the inputs into the empirical model. The variables that will be used in this analysis are presented in the table below.

Variable Name	Interpretation
Arrivals	International tourism arrivals from the WDI
Expenditures	International tourism expenditures from the WDI
CPI	CPI or exchange rate adjusted CPI from the WDI
LPI	Infrastructure Logistics Performance Index from the WDI
Broadband	Broadband subscribers count from ITU
Health	Health quality indicator from the WDI
PITF	The political turbulence/unrest indicator from the PITF

Table 1: Variable Names and Interpretations

V. Analysis and Results

In this section, I first summarize the international tourism arrivals patterns that are present in LAC countries. I then examine infrastructure development patterns and the matrix of variation to see how these variables interact. Using this information, I develop the empirical model and check to see whether the log-log model truly is a good fit. From there, I test for heteroscedasticity in the data. Next, I attempt to improve the model by using the exchange rate adjusted CPI as recommended by Morgan and Witt (1987). I then test for omitted variable bias, examine the Variance Inflation Factors of the model, and examine the residuals. I also generate a similar model using expenditures to represent tourism demand and compare it to the original model.

In the empirical section of this paper, I discussed the goal of modeling international demand for tourism in LAC countries. In general international arrivals, and thus tourism demand, have increased for LAC countries over the period from 2000 until 2016. This growth and variation is shown in the following four graphs, excluding Mexico because it is an upper tail outlier. The four graphs are the upper quartile, the 50th-75th percentile, the 25th to 50th percentile, and the lower quartile; they are shown on the following pages in Figures 1-4. In all of these charts, the growth trend of international arrivals is very apparent. By examining these graphs, it is apparent that there is ample variation in international arrivals over time. Furthermore, I can see in all a general growth pattern in international tourism arrivals over the period from 2000 until 2016. This suggests that there was growth across all of the tourism markets in LAC countries over this time period.

Figure 1

Upper Quartile Arrivals over time

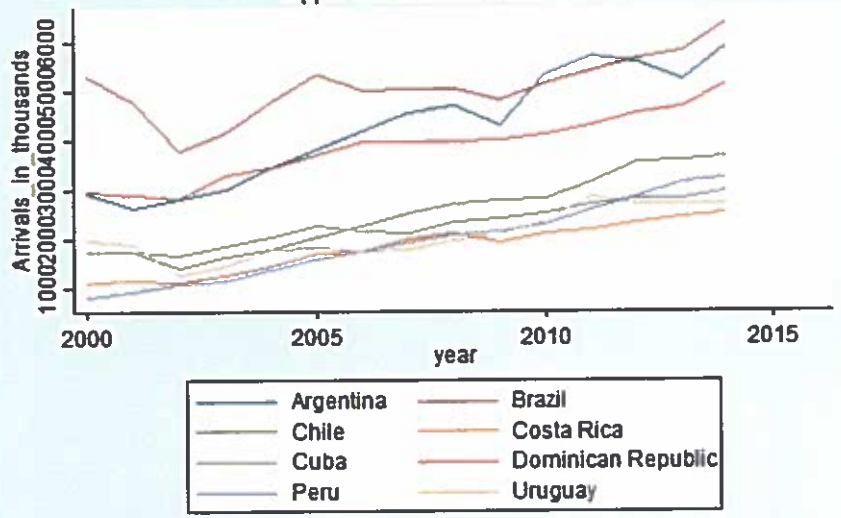


Figure 2

50-75th Percentile Arrivals over time

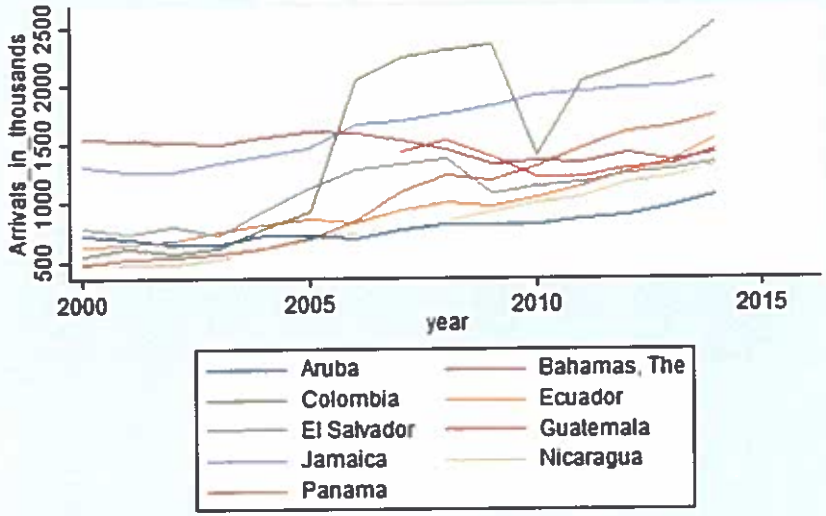


Figure 3

25-50th Percentile Arrivals over time

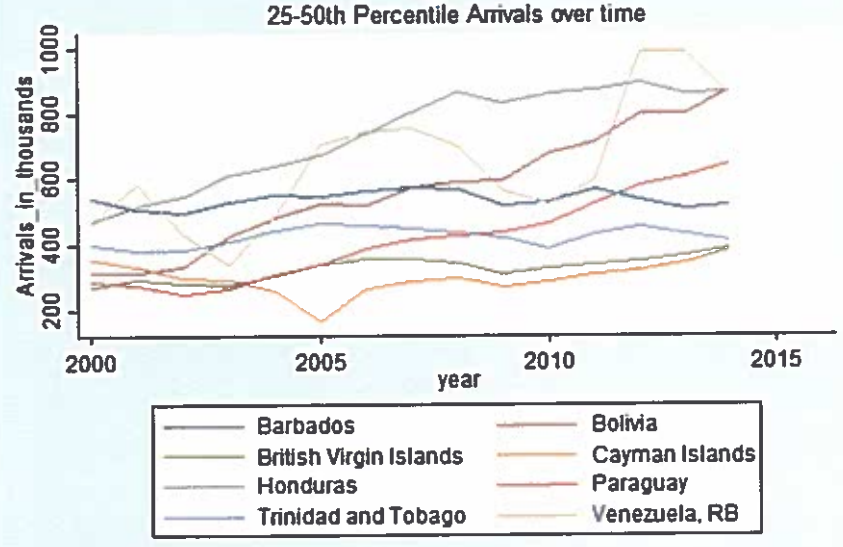
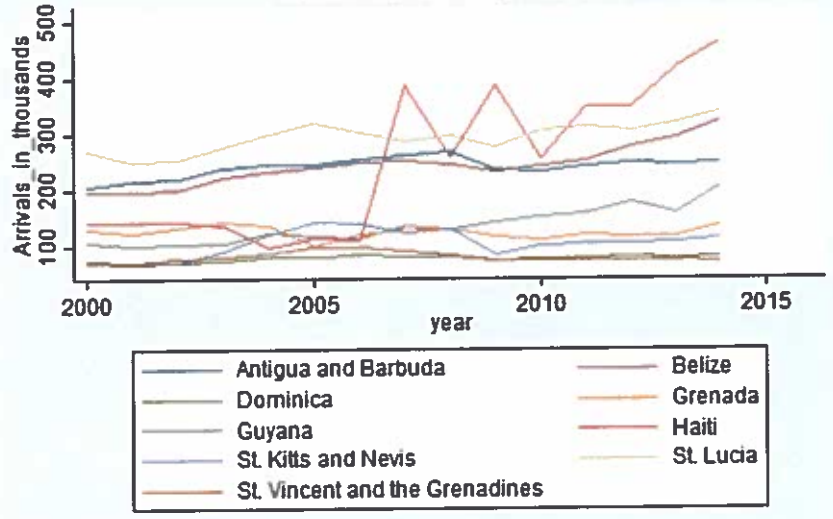


Figure 4

Bottom Quartile Arrivals over time



The focus of this paper is on the relationship between tourism, as shown by international arrivals, and infrastructure variables. In Figure 5, I provide descriptive figures of the relationship.

Figure 5
Matrix of Variation

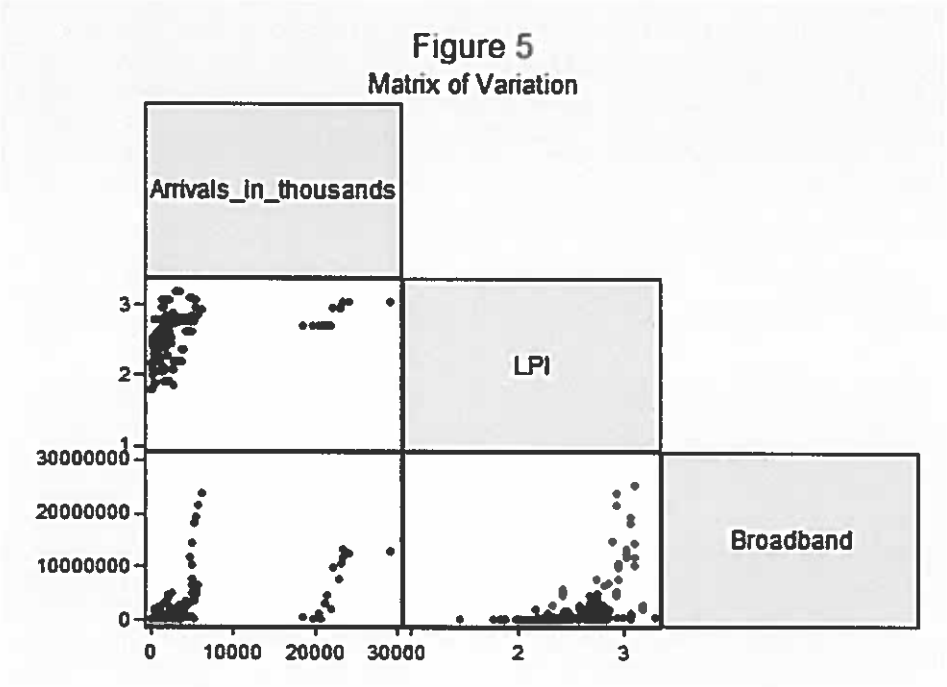


Figure 5 shows the interaction between any two variables and allows for the observation of any readily apparent correlations between the variables. Looking at the upper left quadrant, it appears as if there is a positive relationship between the LPI and Arrivals, with a few high arrivals outliers that are tied to a high LPI-level. The outliers are shown as the cluster of dots in the upper corner of the scatter plot. In the bottom left quadrant of the graph, there is the interaction between Broadband and Arrivals. Again, there is an apparent positive relationship between the two variables. In the bottom right quadrant, the graph displays the interaction between the LPI and Broadband. Unfortunately, the shape of this graph is indicative of multicollinearity because it appears that there is some level of correlation

between the variables. This is to be expected since both of these variables describe infrastructure and can be expected to move together, at least somewhat. After examining these plots, I expect to see positive coefficients on the independent variables LPI and Broadband in subsequent regression analysis. I will need to be wary of any multicollinearity between these variables that could reduce the strength or significance of the model.

Table 2 contains the estimates for the linear and double log model specifications that were estimated using Ordinary Least squares. Note that the PITF variable is not logged because it is a dummy variable. Logging this dummy variable would make the variable undefined because the natural log of 0, the case where there is no political violence, does not exist.

Variables	(1) Arrivals	(2) lnArrivals
CPI	-29,195***	
	(9,688)	
LPI	5.203e+06***	
	(1.091e+06)	
Broadband	0.426***	
	(0.0931)	
Health	14,246	
	(21,224)	
PITF	2.752e+06***	0.233**
	(598,239)	(0.103)
lnCPI		-1.414***
		(0.195)
lnLPI		2.503***
		(0.471)
lnBroadband		0.305***
		(0.0285)
lnHealth		0.157
		(0.256)
Constant	-9.773e+06***	13.92***
	(2.679e+06)	(1.266)

Observations	252	251
R-squared	0.371	0.610

Table 2: Linear versus Double-Log Specification Regression Estimates

Looking first at the strictly linear model, the coefficient on CPI is negative and statistically significant at the 99% confidence level. Additionally, the coefficients on Broadband and LPI are both positive and statistically significant, both at 99% confidence levels. This model has an R^2 value of 0.371. In comparison, the log-log model has a much higher R^2 value of 0.610. The log-log model gives similarly significant coefficient estimates on the logged values of CPI, LPI, and Broadband. The infrastructure and price coefficient estimates support the original hypotheses with respect to the signs of the coefficients—either positive or negative. In order to provide further evidence in support of the double log specification, I perform the Box and Cox (1964) method to scale the dependent variables of the linear and logarithmic models so that I can better compare the R^2's. The Box and Cox method provides $R^2 = 0.371$ for the linear model and $R^2 = 0.610$ for the double log model when the models are run the new scaled dependent variables. The R^2 is still higher for the double log model, and thus is believed to better fit the data. Based on the results, I use the double log specification as the base model and consider alternative specifications below.

In order to generate reliable OLS results, I assume and evaluate the assumptions of OLS, where applicable. One of the OLS assumptions is that the data is homoscedastic. Homoscedasticity occurs when the variance is constant across all observations. It may be that the variance is not constant and therefore violate the assumption of homoscedasticity. Further, it is common in time series or panel data

sets for the data to be correlated along with time, thus failing the assumption of independence. Since the data used in this analysis is a panel data set, I perform the Breusch-Pagan test for heteroscedasticity in order to check whether the errors are homoscedastic. In this test, the null hypothesis is that there is constant variance across all observations. The Breusch-Pagan Test, performed in STATA, yields the following output.

Chi-Squared = 9.40

P-Value = 0.0022

Interpreting this statistical output suggests that at a 99% significance level there is evidence of heteroscedasticity within the data. I also test for any potential serial correlation within the data, as serial correlation is a common occurrence in panel data sets. After performing a Wooldridge test for autocorrelation in panel data, I found statistically significant evidence of first-order autocorrelation. Autocorrelation effects the efficiency of estimates by underestimating standard errors. This should be considered when assessing the overall strength of the model and should be further analyzed in future analysis of tourism demand.

Moving forward, since there is significant evidence of heteroscedasticity within the data, I use the robust regression as an alternative to the OLS regression. By using the robust method of coefficient estimation, I correct for heteroscedasticity so that there is less bias in the standard errors. The table below presents a comparison of coefficient estimates between the OLS and Robust method. Furthermore, clustering the data by country helps to resolve any issues of autocorrelation that biases the standard errors. This is shown in the third column of

the table below. Despite the change in significance for the logged LPI value, it seems as if the strength of the model is not compromised by the change in regression methods. Because of this, I proceed in analysis using the robust and clustered regression methods, shown in the right-most column, as they best resolve issues of heteroscedasticity and autocorrelation within the standard errors.

Variables	(OLS) lnArrivals	(Robust) lnArrivals	(Robust, Clustered) lnArrivals
lnCPI	-1.414***	-1.414***	-1.414***
	(0.195)	(0.186)	(0.397)
lnLPI	2.503***	2.503***	2.503*
	(0.471)	(0.495)	(1.269)
lnBroadband	0.305***	0.305***	0.305***
	(0.0285)	(0.0332)	(0.0664)
lnHealth	0.157	0.157	0.157
	(0.256)	(0.172)	(0.475)
PITF	0.233**	0.233**	0.233
	(0.103)	(0.113)	(0.265)
Constant	13.92***	13.92***	13.92***
	(1.266)	(0.878)	(2.123)
Observations	251	251	251
R-squared	0.610	0.610	0.610

Table 3: OLS, Robust, and Robust Clustered Regression Estimates

Another comparison worth analyzing is whether it is worthwhile to use the exchange rate adjusted CPI, as recommended by Morgan and Witt (1987). When comparing the model using the normal CPI and the exchange rate adjusted CPI, the coefficient estimate on the price proxy is only significant for the model using the real CPI. Additionally, using the exchange rate adjusted CPI greatly decreases the R^2 value of the model. Because of the negative affects of using exchange rate adjusted CPI, I elect to continue in the analysis using the original model, shown in the left-

hand column, as it better explains the variations in international arrivals, indicated by the higher R^2 value.

Variables	(1) lnArrivals	(2) lnArrivals
lnCPI	-1.414***	
	(0.397)	
lnLPI	2.503*	2.256
	(1.269)	(1.614)
lnBroadband	0.305***	0.199***
	(0.0664)	(0.0434)
lnHealth	0.157	0.367
	(0.475)	(0.686)
PITF	0.233	0.427
	(0.265)	(0.315)
lnCPI_adj		0.0393
		(0.0517)
Constant	13.92***	8.045***
	(2.123)	(2.353)
Observations	251	235
R-squared	0.610	0.537

Table 4: CPI and Exchange Rate Adjusted CPI Regression Output

Interpreting the model as defined in the left-hand side of the above table gives significant information about the effects of the independent variables on the dependent variables. The first coefficient on lnCPI is α_1 and it is estimated as $\hat{a}_1 = -1.414$ with 99% confidence. Since CPI is the proxy for price of tourism, I interpret this coefficient as the price elasticity of demand for tourism. This estimates that the price elasticity of demand is estimated as a number greater than one, thus suggesting that the demand is elastic. It suggests that tourism is very responsive to fluctuations in price. Furthermore, the negative sign supports the long-standing economic concept of the downward sloping demand curve. The next coefficient α_2 is on lnLPI, the indicator proxy for transport infrastructure, which is estimated as $\hat{a}_2 =$

2.503 with 90% significance. This positive coefficient suggests that there is a positive effect on tourism from the development of transport infrastructure. More specifically, it implies that a 1% increase in the LPI index for a country yields a 2.503% increase in total international tourism arrivals to the country. Along the same lines, the coefficient on Broadband is represented by the estimate $\hat{a}_3 = 0.305$ with 99% significance. This positive coefficient tells me that there is a positive correlation between Broadband and International tourism arrivals and implies that a 1% increase in broadband subscribers in a given country, gives a 0.305% increase in international tourism arrivals. The coefficient on Health is not significant, most likely because the data set is much less complete for that variable. In terms of political instability, reflected in the dummy variable PITF, there is not statistically significant evidence of positive or negative effects on tourism demand during times of political instability. The intercept estimate is $\hat{a}_0 = 13.92$ with 99% significance and suggests that there is some positive initial conditions for tourism demand, regardless of the infrastructure, price, and health and safety conditions.

I also examined different measures of the dependent variable. That is, as discussed in the data section, it is possible to use either expenditures or arrivals to model the endogenous variable of tourism demand. In the table below, I compare two empirical models – the first, with the original use of arrivals as the proxy, and the second, with the use of expenditures as the proxy. The right hand side of these two models stays the same. It is of interest to compare these two models because, from the perspective of the destination countries, they may be more concerned with

how much their visitors are spending, rather than purely just interested in how many visitors are arriving.

VARIABLES	(1) lnArrivals	(2) lnExpend
lnCPI	-1.414***	-1.322***
	(0.397)	(0.330)
lnLPI	2.503*	3.542***
	(1.269)	(0.781)
lnBroadband	0.305***	0.384***
	(0.0664)	(0.0432)
lnHealth	0.157	-0.380
	(0.475)	(0.378)
PITF	0.233	0.743***
	(0.265)	(0.160)
Constant	13.92***	20.03***
	(2.123)	(1.977)
Observations	251	249
R-squared	0.610	0.819

Table 5: Logged Arrivals versus Logged Expenditures Dependent Variable Regression Estimates

Through this comparison, I can see that using expenditures to represent tourism demand generates a very strong model. The coefficient estimates on this new model are all statistically significant at the 99% level, except for the coefficient on health which is still insignificant. Furthermore, the R^2 value of this model is very high, with R^2=0.819. Additionally, the signs on the variables for price and infrastructure match the hypothesized connection. Unfortunately the strengths of this alternate model end there, because the coefficient on PITF has the opposite sign than what was expected for the arrivals model. This can most likely be explained by differences in the proxy, because spending habits are not indicative of how many people wanted to go to the country. The key takeaway from this comparison is that

both models provide strong evidence of the positive effects of telecommunication infrastructure on tourism demand, either through arrivals or total dollars spent.

Robustness

In assessing the model, I performed a series of additional analyses. First, I use a RESET test for omitted variable basis. The F-statistic was .86 with 3 degrees of freedom in the numerator and 242 in the denominator. This is not statistically important and suggests that there is no omitted variable bias. I also examined the effects of multicollinearity by examining the variable inflation factor table, and found that the VIFs were relatively small and did not suggest that there was a large degree of correlations among the variables. Finally, I inspected the residuals both for patterns and outliers and did not find any major issues. These test provides further evidence of the strength of the model, despite issues with autocorrelation and heteroscedasticity.

In conclusion of the results and analysis section, I elect to support the original estimated double log model specification developed through the robust and clustered methods. Even though the expenditures model had a higher R^2 value, some of its coefficient estimates went against the hypothesized behavior of a rational tourist.

VI. Conclusion

The main goal of this analysis is to investigate the root cause of international tourism demand for visits to LAC countries. In the previous section I developed a model that explained how international tourism arrivals depended on prices, transport infrastructure, broadband subscriptions, health, and political instability. I

now plan to discuss this model within the context of the original questions that were developed in the introduction. These questions were to tell how much tourism demand depends on Internet infrastructure and to explain the general demand relationship.

As was hypothesized in the empirical and conceptual models section of the paper, the coefficient on CPI was negative and significant at the 99% confidence level. This occurred in the model with international tourism arrivals as the dependent variable as well as in the model with international tourism expenditures as the dependent variable. This negative coefficient implies a downward-sloping demand curve with respect to prices. The coefficients on LPI and Broadband, the two infrastructure variables, are both positive and statistically significant at the 90% and 99% level, respectively. In this case, these positive coefficients seem to suggest that there is a positive effect between infrastructure development and tourism in LAC countries. Specifically, the positive coefficient on Broadband suggests that the development of telecommunication networks, such as Internet and broadband, has positive effects on international tourism arrivals and expenditures.

The coefficient on the PITF variable, the dummy for political instability, was positive but not statistically significant from zero in the arrivals model. However, in the expenditures model it was positive with 99% significance. This positive coefficient on PITF goes against my original hypothesis that political instability would decrease overall tourism demand. I suspect that people may be willing to spend more on a "resort-like" experience in locations with more violence, thus explaining the positive and statistically significant coefficient estimate in the

expenditures model. The coefficient on health was not statistically significant from zero in either the arrivals or the expenditures model. This suggests that neither model provides significant evidence to explain how health factors influence overall tourism demand in LAC countries.

As was discussed in section III, the coefficients in this model can be interpreted as elasticities. Using that information, I can interpret the coefficients as indicators of how relatively elastic or inelastic tourists behavior is with respect to each independent variable. Absolute values of these coefficients explain whether demand is elastic or inelastic, where absolute values less than one suggest inelastic demand, and absolute values greater than one suggest elastic demand. The coefficient on price is $\hat{a}_1 = -1.414$, which suggests that the price elasticity of demand is elastic. This means that tourists demand varies a lot with changes of price. In the same manner, the coefficient on LPI is $\hat{a}_2 = 2.503$. This is indicative of elastic demand as well – suggesting that tourists' demand to visit a country is strongly influenced by the level of infrastructure within a country. In contrast, the coefficients on Broadband and Health are $\hat{a}_3 = 0.305$ and $\hat{a}_4 = 0.157$, respectively. Both of these cases this suggest relatively inelastic demand with respect to telecommunication infrastructure (Broadband) and Health. Using this information, the elasticities suggest that tourists more strongly consider price and transport infrastructure when they are picking their destination, because their demand is more elastic for those exogenous variables. For telecommunications and health, they still account for this information in their destination choice, but it does not play nearly as large of a role.

The implications of the coefficient estimates have the potential to affect LAC government decisions, businesses within the tourism industry, potential investors, and tourists planning to visit LAC countries. This model ultimately shows how different factors affect overall tourism demand. Governments and businesses can utilize this information to encourage investment into their tourism industry – thus growing their economy and aiding in development. As a recommendation, it appears that investment in transport infrastructure may be the easiest way to improve the "attractiveness" of a destination to potential tourists. The next best influencer is the price of the destination – this suggests that governments should work to keep their economies stable in order to remain attractive for tourists. While telecommunication has a positive affect on tourism demand, due to its relative inelasticity, it is something that enhances the experiences rather than something that encourages and draws in new tourists.

While this model provides a great amount of insight into the tourism demand relationship, it still has several opportunities for improvement and betterment. For instance, one issue in the creation of this model was the availability of data for analysis. Since Internet has only recently developed within the past 20 years, the time series data was not as extensive as desired in order to fully analyze time trends within the data. Furthermore, lack of information about many small and still-developing LAC countries make it so that the panel data set was missing observations. This is an issue that will hopefully resolve over time as countries and agencies improve their data reporting and data collection abilities. Another potential source of error within the model are cases of time dependency. Again,

because of the small size of the data set, it was often difficult to fully remove effects of cointegration or time trends within the model. This is shown through the issues with heteroscedasticity and autocorrelation. Despite these issues, given the data that was available, the model created in this analysis seems well suited to modeling the tourism demand relationship for LAC countries, and more specifically seems to explain the positive relationship between telecommunications and the tourism demand.

VII. References

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