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FOR THE CARIBBEAN**

# **Towards a demand model for maritime passenger transportation in the Caribbean**

A regional study of passenger ferry services

Omar Bello  
Willard Phillips  
Delena Indar



UNITED NATIONS

**E C L A C**

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This document has been prepared by Omar Bello, Coordinator, Delena Indar, Individual Contractor, and Willard Phillips, Economic Affairs Officer, of the Sustainable Development and Disaster Unit, Economic Commission for Latin America and the Caribbean (ECLAC).

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## Abstract

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In this paper, the main factors that influence the demand for maritime passenger transportation in the Caribbean were studied. While maritime studies in the Caribbean have focused on infrastructural and operational systems for intensifying trade and movement of goods, there is little information on the movement of persons within the region and its potential to encourage further integration and sustainable development. Data to inform studies and policies in this area are particularly difficult to source. For this study, an unbalanced data set for the 2000-2014 period in 15 destinations with a focus on departing ferry passengers was compiled. Further a demand equation for maritime passenger transportation in the Caribbean using panel data methods was estimated. The results showed that this demand is related to the real fare of the service, international economic activity and the number of passengers arriving in the country by air.



## Introduction

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Caribbean countries face unique development challenges. As part of the global community of small island developing States (SIDS), these challenges have been analyzed in several studies (Grenade, 2007; Sanjay and others, 2005), and highlighted through global initiatives and international fora for SIDS development.<sup>1</sup> These analyses consistently point to the critical importance of stronger regional collaboration in order to overcome barriers which impede regional economic growth and development.

Over time, there have been on-going attempts to strengthen integration of Caribbean markets and economies through increased trade and freer movement of people. These efforts<sup>2</sup> notwithstanding, the promise of significant regional development premised on these initiatives has not been realized. Among the myriad causes has been the difficulty of forging full-fledged, efficient connectivity between Caribbean states in order to facilitate the free-flow of goods and persons across the region. Although served by a number of international air and sea carriers which enable the transfer of tourists and goods into the region, the movement of goods and people among Caribbean islands remains unreliable and costly, both in terms of money and time. Consequently, a major constraint to achieving regional integration continues to be limited intra-regional transportation services.

While the benefits of transportation are many, it consumes vast amounts of raw materials such as energy, and utilizes personal time (Button, 2010). Nevertheless, several studies suggest that transportation is often the most important factor in ensuring the viability of the financial, educational and

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<sup>1</sup> The United Nations declared 2014 as The International Year of Small Island Developing States, designated to focus the world's attention on SIDS as they remain a special case for sustainable development in view of their unique and particular vulnerabilities. In brief, the special development challenges that Caribbean islands face include low availability of resources, vulnerability to natural hazards and environmental change, openness and limited diversification, and a small yet rapidly growing population. These and several related issues formed the core agenda at the United Nations Third International Conference on SIDS, held in Samoa in September, 2014.

<sup>2</sup> These aspirations were first manifested in the establishment of the Caribbean Free Trade Association (CARIFTA) in 1965, as a vehicle to encourage balanced development and unite economies by increasing, diversifying and liberalizing trade. In 1973, CARIFTA further evolved to become the Caribbean Community (CARICOM), with this new entity imbued with the hope of brokering full regional integration among Caribbean countries. The CARICOM Single Market and Economy (CSME) was subsequently launched in 2006, so as to further benefit the region by providing opportunities for production and sale of goods and services thereby resulting in improved standards of living and sustained economic development (CARICOM 2015).

tourism sectors in local economies (Tsekeris, 2009; Cahill, 2010; Rodrigue and Notteboom, 2013). Moreover, transport is a derived demand which reflects the need for travel to various destinations for work, business or leisure, all of which further contribute to the dynamism of local and regional economies.

Within the Caribbean, inter-island passenger transportation has thus far been dominated by air transit. However, air transportation requires substantial investment in infrastructure, and significant regulatory facilitation<sup>3</sup> and represents a less environmentally friendly means of transportation relative to maritime transport (Boon, 2007; Cahill, 2010). All of these are important considerations given the Caribbean's inherently vulnerable economic conditions and its need to promote environmentally sound initiatives as the basis of its mostly tourism-oriented economy. On this basis, and taking into account recent technological improvements in shipping,<sup>4</sup> maritime transport has the potential to be the most environmentally sound mode of transport for the Caribbean.

Maritime passenger transportation also has immense potential for the region given its large maritime space and high ratio of sea to land mass. Further, it provides an additional option for addressing the challenge of limited intra-regional transport, while at the same time promoting a sustainable economy. Reliable year-round sea transportation also has the potential to encourage trade and tourism, and to retard depopulation thereby ensuring that essential economic and social links are maintained. In the specific case of tourism, many visitors to the region already utilize specialized ferry services for the intrinsic pleasure of the journey itself, as well as to enhance their Caribbean vacation experience. Hence, maritime passenger transportation can serve to expand the range of choices, relative to the set of economic and social activities which may exist among various Caribbean destinations.

While maritime transportation studies in the Caribbean have focused on infrastructural and operational systems enhancing the movement of goods, the region lacks studies that focus on the intra-regional movement of persons and its potential to encourage further integration and sustainable development. A key constraint in this regard is the unavailability of data, and parameters which could be useful in informing policy making for the development of the maritime passenger transportation sector. This paper aims to contribute by estimating a demand model for maritime passenger transport in the Caribbean. This estimation was done using a panel data set for the period 2000-2014 which included variables such as number of departing ferry passengers, ferry fares in real terms, Gross Domestic Product (GDP) of the country where the travel was originated, the number of arriving air passengers, the price of jet fuel in real terms, the GDP of United States of America, and the GDP of the United Kingdom. Dummy variables for disasters, and investments in new ferry and ferry technology were also included in the analysis.

The paper is organized as follows: Following the introduction, a review of literature on maritime transportation is presented in Section I. A description of the database and variables utilized in the analysis is presented in Section II, while the model and estimates are presented in section III. Finally, conclusions of the research are presented in section IV.

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<sup>3</sup> This is necessary to meet, safety, security requirements, as well as minimum customer satisfaction standards.

<sup>4</sup> Specific knowledge about the environmental impacts of shipping in the region is not yet widespread, particularly as many ships and vessels operating in the region are older in nature considering that technological changes have been slow.

## I. Review of maritime transportation literature

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According to Pinnock and Ajagunna (2012), the maritime resource has not been fully capitalized upon in the Caribbean, and development of the maritime transport sector has been fragmented. Due to this, Briceño-Garmendia and others (2015) note that Caribbean countries are less likely to connect among themselves as they would outside of the region. Moreover, maritime transportation of people remains mostly limited in terms of routing and scheduling, as it has not developed to the same degree as inter-island air transportation. Therefore, the opportunity exists for the expansion of reliable and cost effective inter-island services such as fast ferries.

The development of these opportunities however requires data and analyses in order to assess the feasibility of this form of passenger transportation. And although there have been much discussions on maritime passenger transportation in the Caribbean, there remains a real paucity of data on intra-regional passenger transport matters. Indeed, UNCTAD (2014) has identified the need for studies relating to transportation in the Caribbean as an important limitation in developing this sector in the region.

Still, the limited research on maritime transportation in the Caribbean to date has focused mostly on trade in goods, connectivity, and prospects and challenges for goods shipment into and within the region. For instance, Briceño-Garmendia and others (2015) found that the air transport networks engaged in unnecessary competition between the islands. In this regard, ferry transportation could encourage coordinated efforts to strengthen the Caribbean economy and elevate the Caribbean tourism product as a whole. They further observed that the most salient issues affecting air transportation were logistics and costs due to custom inefficiencies. Similarly, an examination of the sector by Isik (2012) identified economies of scale, connectivity and port efficiency as the three critical logistical issues limiting maritime transportation in the region.

Considerable effort has also been invested in the study of the sustainability and efficiency of the CARICOM maritime sector, particularly relating to ports. Pinnock and Ajagunna (2012) as well as Sanchez and others (2003) discussed empirical analyses of factors such as distance between ports, infrastructure, regulations, freight rates and connectivity. Sanchez and Wilmsmeier (2009) also developed a model that focused on port efficiency as a determinant of maritime transport cost. Additionally, Boske (2001) presented a comprehensive report on maritime transportation in Latin America and the Caribbean which focused on international trade, liner shipping services, port and port reform, and the Mercosur Atlantic Corridor Consortium.

The literature presents only a few studies with a direct focus on passenger related maritime transportation in the Caribbean. Pinnock and Ajagunna (2012) explored the history of cargo and cruise shipping in the region and offered policy recommendations to help the region achieve sustainability and efficiency.<sup>5</sup> Briceño-Garmendia and others (2015) also described current ferry services among 15 countries and determined that more than half of the Caribbean traffic is concentrated domestically, with the majority coming from Trinidad and Tobago.

Their research also found that 47 per cent of total ferry passenger traffic comprised of small island states residents as compared to those from the larger island states within the region. They further noted that freight maritime connectivity was well structured, although tariffs were high. As such, the opportunity exists for similarly structured passenger transport. This study concluded that the market for ferry services was not fully developed reflected by limited and erratic schedules. This situation was considered to be a good opportunity for joint public- private partnerships in order to fully develop ferry services in the region. Towards this end, it was noted that initial investment costs tended to be high and market penetration low, so that subsidies were likely to be required. Another major challenge observed was in persuading governments to purchase adequate vessels to service the needs of each niche.

A global review of the maritime passenger transportation research showed a focus on feasibility studies,<sup>6</sup> assessment of routes and operations, and the estimation of forecast models of demand (Baird, 2004; Puget Sound Regional Council, 2008). Other global studies contemplated liner shipping design (Brouer and others, 2014; Wang and others, 2015) while several papers also considered the operations and environmental aspects of ferries (Baird and Wilmsmeier, 2011). Discussion of maritime policy and its relation to island regions across the European Union was undertaken by Chlomoudis and others (2007) who argued that liberalization of maritime transport policy should be oriented towards the specific needs of the island regions.

Other studies explored issues relevant to the assessment of maritime passenger demand. For instance, in the Greek islands where passenger shipping forms a large share of the transport economy, Polydoropoulou and Litinas (2007) noted that demand models provide a tool for policy-makers and researchers in terms of effective planning for regional growth, creation of policies based on visitor behavior and regional dynamics, and for ferry companies to understand travelers' behaviors when contemplating investments and expansion. They also observed that in recent decades, the passenger industry had undergone several changes such as the introduction of fast high-technology ships and subsequent growth of passenger movements due to a competitive and dynamic environment.

One branch of the literature has also given focus to the estimation of choice models between maritime transportation and its substitutes (Bhadra and Kee, 2008; Wadud 2011). Based on survey data, Rigas (2009) and Diaz (2011) estimated a multinomial probit model between maritime transportation and alternatives such as rail or air, and found that travel times and costs of the alternative modes play significant roles. Rigas (2009) and Tsekeris (2009) further suggested that air transport is advantageous for time-sensitive and longer-haul passengers, while sea travel is the preference of cost conscious and leisure passengers.

Additional international studies (Kopsch, 2011; Wadud, 2011) have been geared towards air transport demand as compared to maritime transport demand and have considered data on passenger numbers, tariffs and economic factors such as GDP and income. Similar to some maritime studies, Kopsch (2011) used regression analysis to find that leisure passengers were more sensitive to cost than business passengers. Wadud (2011) also noted that building demand models, especially for forecasting purposes, is challenging for areas where data are limited, and suggested the use of national aggregate data with calibration from a small number of passenger surveys.

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<sup>5</sup> These include: an integrated approach when making decisions, a regional port security approach, align labour market regulation to global standards, harmonize maritime transport industry legislation, consider public benefit when investing public funds in maritime infrastructure projects; undertake economic, social and environmental impact studies, implement the landlord model, recognize that transshipment is not always the answer for every port; acknowledge that regional organizations should provide services to member governments.

<sup>6</sup> Studies reviewed included Baird, 2004; Report of the Chairman of the task force, 2011, and Puget Sound Regional Council, 2008.

## II. The database

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This study utilized eight destination pairs<sup>7</sup> based on data availability and accessibility (see map 1). Table 1 further showcases the main characteristics of the eight destination pairs that have been used in this study. The resulting dataset is unique considering that the area of maritime passenger transport in the Caribbean has been understudied.

Although data were sought from all countries in the region, they were obtained for only a few countries owing to availability and proprietary limitations. For a comparative review, all the destinations that are traversed by ferry within the region can be found in the annex.

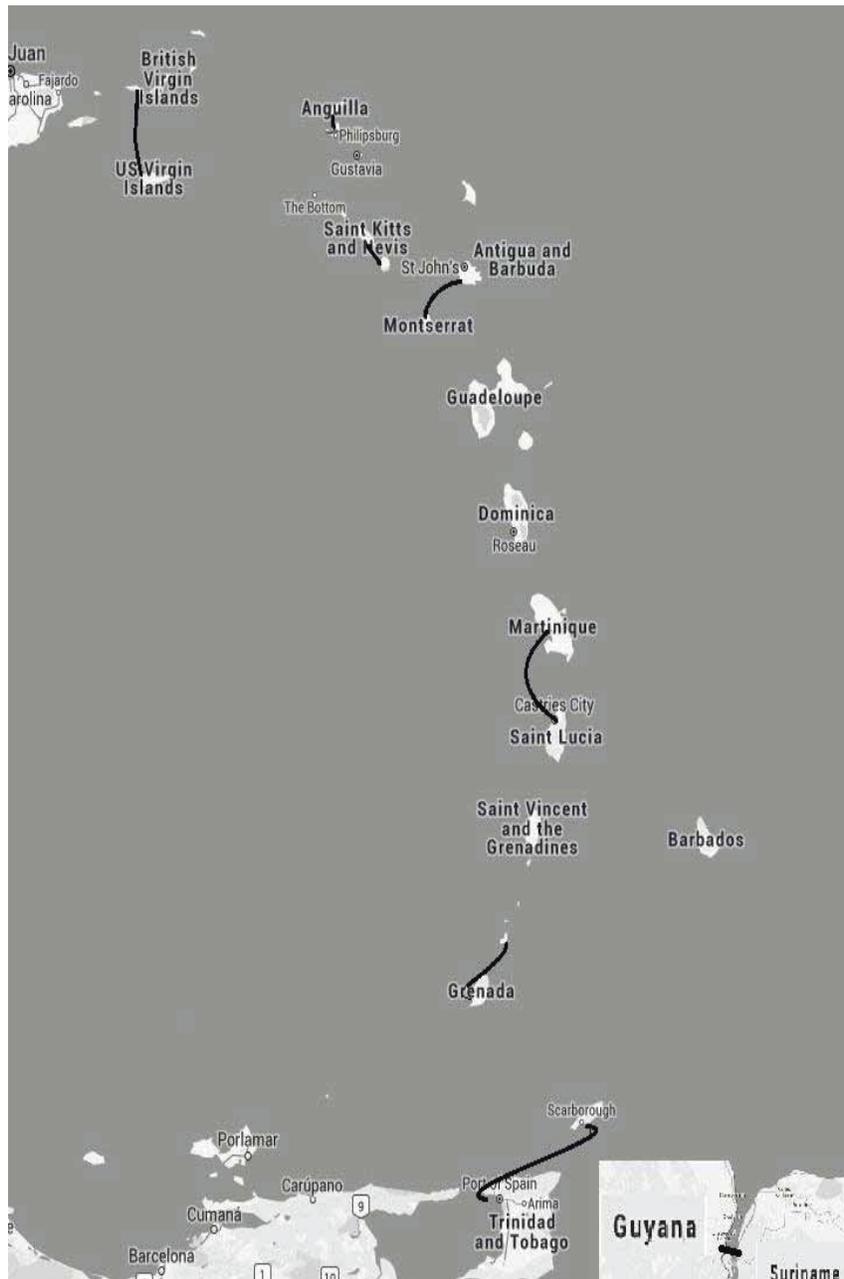
**Table 1**  
**Key characteristics of ferry services assessed in the study**

Origin	Destination	Service type	Ferry ownership	Time frame
Anguilla	Saint Martin/Sint Maarten	Regional	Private	2005-2014
Antigua	Montserrat	Regional	Private	2004, 2005, 2008-2014
British Virgin Islands	United States Virgin Islands	Regional	Private	2001-2014
Grenada	Petit Martinique and Carriacou	Domestic	Private	2000-2014
Guyana	Suriname	Regional	Governmental	2000-2014
Martinique	Saint Lucia	International	Private	2000-2014
Saint Kitts	Nevis	Domestic	Private	2000-2014
Trinidad	Tobago	Domestic	Governmental	2001-2014

Source: Author's compilation.

<sup>7</sup> In this study, destination pairs are utilized as in some cases certain counties that are under the same sovereign jurisdiction can have multiple destination points.

**Map 1**  
**Routes of Caribbean ferry services considered in this study**



Source: Created from Google Maps.

Note: Map is not to scale.

The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

In the Southern Caribbean, ferry services are generally limited to those that operate between islands that are governed under the same sovereign jurisdiction and are referred to as “domestic travel.” Data were captured for three out of seven possible domestic routes in this study. As seen in Table 1, of all the country pairs, Grenada and Carriacou, Saint Kitts and Nevis and Trinidad and Tobago were domestic in nature and began operations prior to the year 2000.

The other five country pairs were within different sovereign jurisdictions. The Anguilla to Saint Martin/Sint Maarten pair was analyzed based on data for nine years, followed by the Antigua and Barbuda and Montserrat pair which had data for eight years. Although data were only available from 2004, the service itself began operation in the 1990s and became particularly popular in 1997 owing to the large volcanic eruption and the subsequent destruction of the W.H. Bramble airport. Operations ceased again in 2006 and 2007 due to volcanic activity, and resumed in 2008.

The British Virgin Islands to United States Virgin Islands data were available for 13 years. The main islands that are serviced in the British Virgin Islands are Tortola, Virgin Gorda, Jost Van Dyke and Anegada. For the United States Virgin Islands, the islands serviced are Saint John, Saint Thomas, Saint Croix, and Water Island. There are several other scheduled and boat charter services that operate between the Virgin Island Archipelago. However, to ensure similarity with the other country pairs, only the data for passengers on scheduled ferry services were taken into account in the study.

While all other ferry routes were coastal and open ocean routes, the Guyana-Suriname route was via an inland waterway across the Corentyne River. This service, which is jointly owned by Guyana and Suriname, is the only legal connection via river and began operation in 1998 with support from the European Union.

The Martinique to Saint Lucia route is one segment of an entire route which also includes Dominica and Guadeloupe. The service has been operational for over 25 years and showcases the success of a multi-destination route within the region, which is operated by a privately owned ferry service. In this instance, as Martinique is an overseas territory of France, it represents an international service type category. Data were available for 15 years on the number of passengers.

Although in many countries maritime passenger vessels are privately owned, the need to ensure connectivity between several islands of a single state has motivated many governments to invest in public inter-island ferry services, as is the case in Trinidad and Tobago and Guyana to Suriname. Other countries such as Saint Kitts and Nevis, and Anguilla do not have publically owned ferry services, but play a regulatory role in the provision of the service. Countries such as Barbados, Haiti and Jamaica are not serviced by scheduled sea transport at all, though they are frequented by private vessels which are available for charter.

Maritime passenger transportation in most countries is monopolized by a single operator (see table 2), while in others, namely Saint Kitts and Nevis, Anguilla, Sint Maarten/Saint Martin, United States Virgin Islands and British Virgin Islands, this service is provided by several operators. The latter is especially the case for countries that comprise numerous peripheral islands. For instance, there are approximately five operators within the United States Virgin Islands and five<sup>8</sup> within the British Virgin Islands. Five operators also serve different islands from the United States Virgin Islands to the British Virgin Islands route.

Naturally, the capacities and types of vessels differ based on their source and destination markets. Many of the vessels were originally cargo vessels that became popular as a mode of transport for passengers. With increased usage of cargo vessels by passengers, operators began to employ fast ferries, usually of the catamaran-type. On average, the capacity of passenger ferries is about 400 persons, and under 100 persons in cargo vessels that offer passenger transportation. The Trinidad and Tobago inter-island ferry has the largest capacity of 900 persons and 200 vehicles, which is followed by the ferry between Martinique and Saint Lucia.

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<sup>8</sup> This does not include at least four private resort ferries such as Marina Cay Ferry, Peter’s Island Ferry, Bitter End (Yacht Club) Ferry, Scrub Island Ferry and Saba Rock Ferry.

**Table 2**  
**Overview of the maritime passenger operations in the study**

Origin	Destination	Distance (nm) <sup>a</sup>	Operator	Travel time (mins)	Tariff (dollars) <sup>b</sup>	Number of vessels	Passenger capacity	Days/week of operation	Vehicle capacity
Anguilla <sup>c</sup>	Saint Martin	6	Several	20	10	10	40–110	7	0
Antigua	Montserrat	23	Government of Montserrat <sup>d</sup>	90	56	12	180	7	0
Grenada	Carriacou	34	Osprey Lines	90	31	2	90, 220	7	0
Carriacou	Petit Martinique	8	Osprey Lines	20	8	2	90, 220	5	0
Guyana	Suriname	2	Canawaima Ferry Service	30	10	1	150	7	20
			F & F Transportation			1	...		0
Saint Kitts	Nevis	11	M & M Transportation	45	9	2	194, ...	7	0
			Wesk Agency			2	74, 197		0, 10
		3	Seabridge	15	28 <sup>e</sup>	1	180	7	35
Saint Lucia	Martinique	36	L'Express de Isles	90	86	2	360, 445	3	10
Trinidad	Tobago	90	Trinidad & Tobago Inter-island Ferry Company	180	8	3	900	7	200
			Speedy's	90	40	4	66, 96 149, 149	3	0
			Smith's /Tortola Fast Ferry	45	35	2	81, 149	7	0
United States Virgin Islands	British Virgin Islands	7-35	Road Town Ferry	50	35	3	49, 149 149	7	0
			Native Son	45–90	35	4	81, 122 149, 149	7	0
			Inter-island Ferry	45	45–70	4	49–81	7	0

Source: Author's compilation, on the basis of several sources.

Note: ... indicates that the figure is unavailable.

<sup>a</sup> The distances have been calculated via maps, as well as have been given by persons of knowledge and are therefore approximate values.

<sup>b</sup> These fares are current 2015 fares; they do not include additional port or additional fees such as first class seating, if available.

<sup>c</sup> There are many semi-private scheduled charters from Sint Maarten to Anguilla; persons can organize pick up from the airport, with varying fares from US\$ 15; 45–75 mins; 8 nm.

<sup>d</sup> The vessels used are privately owned although the service is a public one.

<sup>e</sup> The Seabridge tariff includes a vehicle.

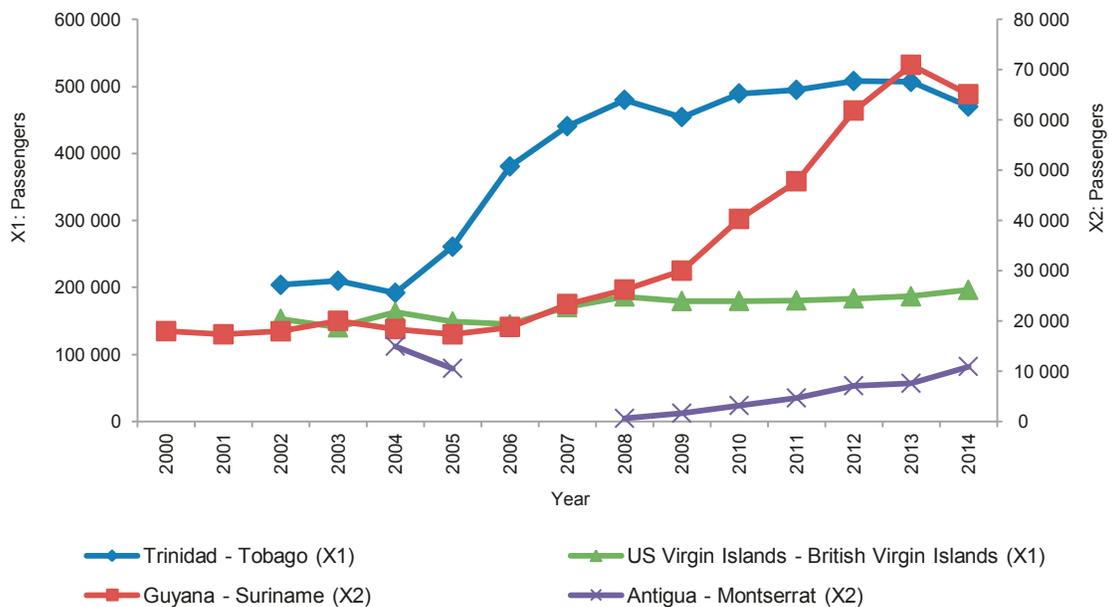
Regarding the general operations of ferry services<sup>9</sup> within the Caribbean,<sup>10</sup> maritime passenger transportation services vary. While the focus of this study is the eight destination pairs, similarities in terms of ownership, vessel type, and technology, among others, can be found between particular ferry services across the region (see annex). Therefore, despite the lack of data, certain broad conclusions may be drawn from such similarities.

The key variable in the dataset is the number of passengers utilizing the ferry service, which is measured by the number of arrivals and/or departures from an origin to a destination point in any given year. These data which were compiled specifically for this study were obtained from several sources in the selected countries, including national central statistics offices, tourism and immigration departments, and national port authorities.

Note that the number of departing visitors per year exhibits a wide range from 1,644 up to a maximum of 523,350 passengers per year over the period. In the case of Montserrat, the ferry service was decommissioned for two years, and consequently there were no scheduled departures. The immediate subsequent years with its ad hoc schedule also showed a low number of ferry departures.

Generally, the ferry passenger data shows two different behaviors for two groups of countries. The first is a steady increase in passenger departures over the years (figure 1). For the routes of Trinidad to Tobago, Guyana to Suriname and the United States Virgin Islands to the British Virgin Islands, the number of passengers utilizing the ferry service increased steadily. In the case of Trinidad and Tobago, the introduction of fast ferries in 2005<sup>7</sup> reduced the travel time from 4 hours to 2.5 hours. The number of ferry passenger then grew significantly between the years of 2004 to 2008, after which it stabilized.

**Figure 1**  
**Ferry passenger departures in select countries showing increasing trends**



Source: Author's compilation.

<sup>9</sup> The overview of current maritime passenger transportation services described in this paper is limited to ferries that traverse areas which are not accessible by car, but by air and sea only.

<sup>10</sup> Arguably, there is no consistent definition of which countries comprise the Caribbean. Often, research focuses on CARICOM member States. For the purposes of this study, all the countries, regardless of sovereign jurisdiction, which sit in the Caribbean Basin are considered.

Investments in comfortable fast ferries combined with relatively low fares were the major contributors to the steadily increasing number of passengers. Moreover, higher frequency schedules along with the opportunity for persons to travel with their vehicles for business and leisure activities at the destination has increased the number of ferry passengers between Trinidad and Tobago.

The data for the Antigua-Montserrat route show a gap since the service was not operational for two years. It was resumed in 2008 on an ad hoc basis and has since increased service to passengers. The service is operated by a large number of private vessels which together provide a schedule frequency that ensures connectivity between the two countries. This service however has one of the higher fares among ferry operations in the region.

Although there is an air route that connects Guyana to Suriname, the journey by inland waterway is quite short and relatively inexpensive. Further, the ferry service allows for vehicles to cross the border so that ease of transportation is maintained for the passengers on both sides. This along with significant marketing has resulted in a larger number of passengers using the service in recent years.

Lastly, the schedule between the United States Virgin Islands and the British Virgin Islands is extremely high in frequency. Increasingly, the knowledge that it is commonly less expensive to utilize air transport to the United States Virgin Islands and then ferry over to the British Virgin Islands than simply flying to the British Virgin Islands, has become more widespread. Additionally, considering the short proximity and travel times between the islands, tourists consider that visits to the different island destinations are worthwhile.

The second major trend observed is mixed and declining passenger departures as shown in figure 2. For example, the domestic route between Grenada and Carriacou has shown a decrease in passenger traffic since 2002. The routes of Saint Kitts to Nevis, Anguilla to Saint Martin/Sint Maarten and Martinique to Saint Lucia also showed an increase in passengers from the start of the period of investigation until 2004 after which passenger traffic declined steadily. This is likely due to the harsh hurricane season in 2004 which resulted in damages to the economies of the countries and discouraged visitors from the region.<sup>11</sup>

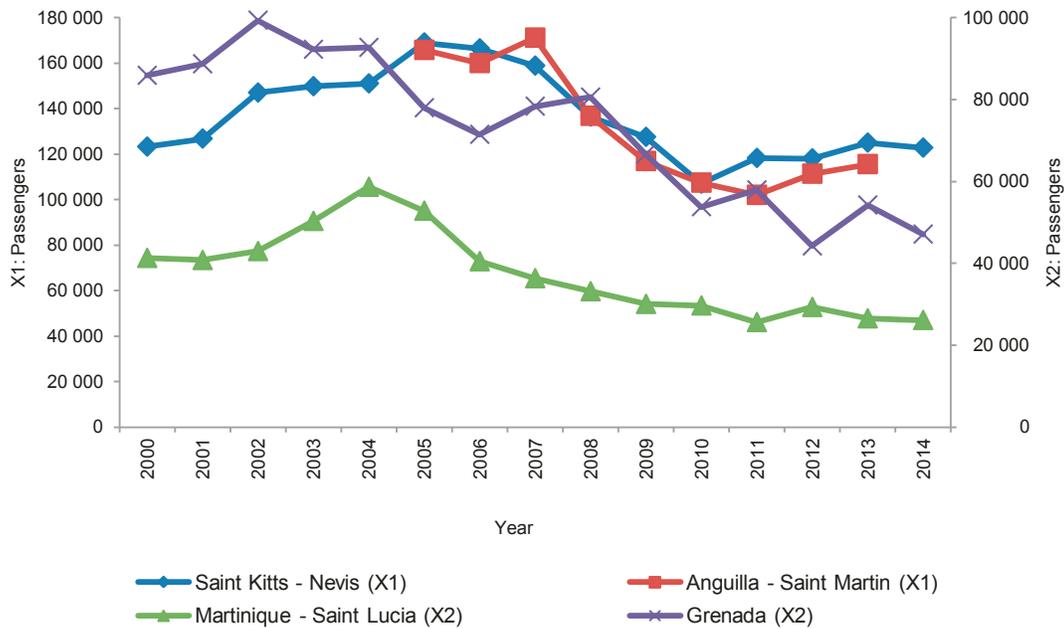
Furthermore, in Saint Kitts and Nevis, the Marriott Vacation Club was commissioned at that time, and encouraged persons to utilize flights as compared to sea transport. In each case, there was an even sharper decline in 2006, which coincided with the global financial crisis. Both the Saint Kitts and Nevis and the Anguilla-Saint Martin/Sint Maarten routes began to witness increases in passenger usage after 2011, while the Martinique-Saint Lucia route remained stable. It should be noted that even though the route assessed was that of Martinique to Saint Lucia, no evaluation could be done on the number of persons who disembarked at Martinique, and therefore the remaining number of passengers who would disembark in Dominica and Guadeloupe.

Considering number of passengers by country, Trinidad and Tobago showed the largest absolute number of passengers, beginning its range at about 200,000 passengers annually. This could be in part due to its larger population relative to other destinations, and air arrivals being larger than that of the other countries. However, when the ratio of ferry departures to the population is compared, the ratio ranges from 0.15 to 0.40 for Trinidad and 3.26 to 8.58 for Tobago. The range for Guyana and Suriname was less at 0.02 to 0.12. For Saint Lucia, the ratio decreased over the years from 0.11 to 0.06 and for Martinique showed fluctuations between 0.36 and 0.14.

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<sup>11</sup> There has been no formal analysis of the effects of the 2004 hurricane season on the shipping sector. However, hurricanes and stormy weather tend to deter persons from utilizing sea services as choppy waters cause passenger discomfort and may be dangerous. Also, visitors tend to stay away from areas of disturbed weather as this is both dangerous and not enjoyable.

**Figure 2**  
**Ferry passenger departures in select countries showing declining trends**



Source: Author's compilation.

Unlike many other Caribbean countries, Trinidad and Guyana are not dependent on tourism, and therefore the ferry was heavily utilized for trade and business, which thrived with the introduction of the fast ferries (Hope, 2008). One of the major advantages that shipping has over air transport is its potential for both cargo and passenger movement. Faster ferries with vehicle capacity would allow persons to be transported with their vehicles in a short time, and technologically advanced models could facilitate low fares since fuel efficiency can be maximized.

In Saint Kitts and Nevis, ferry departures are almost ten times that of Nevis and four times that of the Saint Kitts population. In the cases of Anguilla, the United States Virgin Islands and the British Virgin Islands, the ferry departure numbers were also larger than that of the population. Grenada also showed a ratio of ferry passengers to population that decreased from 1.04 to 0.48. This confirms that for specific destinations, many persons who utilize the ferry may be visitors to the island, and not simply the domestic population. Note however, that in some cases, residents may travel several times on the ferry in a given year for business or recreational purposes. In cases such as in Anguilla, persons working in the neighboring islands utilize the ferry service at least twice per day. Such a captive market also exists for children who attend school in Saint Kitts, even though they may live in Nevis.

The use of ferry service by visitors in some destinations has several implications. Firstly, in many Caribbean countries, tourism plays a large part in the economy. For instance, in 2013, the total contribution of travel tourism to the Caribbean was 14 per cent of GDP, and was forecasted to rise by about 4 per cent in 2014 (WTTC, 2014). As such, decreases in the number of passengers using the ferry service also directly reflect declines in a country's economy.

Secondly, a cost effective, reliable and comfortable ferry service should allow for greater integration and promotion of the Caribbean tourism product as it could allow for easier and more affordable passenger movement between islands. This could ease transportation challenges and improve visitors' experience in the region, and ultimately generate higher revenue in the individual countries.

Regarding other variables in the dataset, while current fares were fairly constant, the real average fare stood at 28.22, exhibiting a range of variation of about US\$ 88.57 throughout the 15-year period. This broad range is largely due to subsidized fares, such as in Trinidad and Tobago, where the current fares have increased only marginally since 2000. Notably, the cost of fares of government-owned services tended to be lower than those of private operators.

The tariffs charged did not always include port taxes. However, in some cases the port taxes were already included in the fare. In the application of demand models, distance can be used as an effective proxy for cost of travel (Lewer and Van den Berg, 2008; Grosche, Rothlauf and Heinzl, 2007; Kimura and Lee, 2004). However, upon examination of distance and current tariffs in the Caribbean, current fares were not found to be proportional to distance.

Economic activity should affect the demand for maritime passenger transportation. In this study real GDP was used as a proxy for it. For this analysis, real GDP for each country was sourced from individual Central Statistical Offices, the Eastern Caribbean Central Bank and CEPAL STAT. The average GDP growth of the countries between 2004 and 2014 was 0.03 per cent. In some cases however, GDP estimates were difficult to obtain or had to be used with care. Note that while models are generally very successful in explaining the choice of a large number of individuals, the choice of any given individual based on a factor such as income may vary greatly from the predicted value.

Population was another key variable in this study, and annual population estimates were obtained from central statistics offices of the studied countries. Larger populations are expected to be associated with more maritime passengers. This variable varies considerably among the countries in the study. Notably, the population of Montserrat is the smallest currently approximating 9,000 persons while Trinidad and Tobago has the largest with roughly 1.3 million persons.

The potential demand for maritime passenger transportation could also be increased by persons coming to the Caribbean by air. For this reason, air passenger arrivals were also included in the demand model. Among the countries studied, Montserrat had the least numbers of air arrivals beginning at 5,395 international passengers.<sup>12</sup> These data were obtained from the Caribbean Tourism Organization, based on individual country sources. A comparison of ferry arrivals to air arrivals was not performed as many of the persons who arrived in the country via air may have used the ferry to visit another island and therefore could be simply returning via the use of the ferry services.

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This excludes arrivals by domestic flights.

### III. Model and estimates

The basic form of the demand equation that was estimated is the following:

$$L(\text{fdep}_{it}) = \beta_0 + \alpha_i + \beta_1 L(\text{rfare}_{it}) + \beta_2 L(\text{rgdp}_{it}) + \beta_3 L(\text{aarr}_{it}) + \varepsilon_{it} \quad (1)$$

where  $L(\text{fdep}_{it})$  is the logarithm of the number of passenger departures from origin  $i$  in year  $t$ ,  $L(\text{rfare}_{it})$  is the logarithm of the real fare for travel from origin  $i$  in year  $t$ ,  $L(\text{rgdp}_{it})$  is the logarithm of real GDP of country  $i$  in year  $t$ ,  $L(\text{aarr}_{it})$  is the number of international arrivals by air transportation to country  $i$ . The demand equation states that the number of ferry passengers depends on the real price of such services, the real income of that country, and the number of international passengers arriving in the country by air. Note that this demand equation is based on aggregate data on passengers, an economic aggregate denoted as GDP, and prices. It is not a model about transportation choice, since such models are based on survey data. Table 3 below summarizes the main variables and their rationale for use in estimating the model.

**Table 3**  
**Variables in the demand model**

Variable	Reason	Source
Number of departing ferry passengers	This measures the total number of persons departing from one point to arrive at another, via the ferry service. Studies generally use this parameter the dependent variable in travel demand studies.	Country tourism boards/statistical offices, port authorities and ferry operators.
Cost of travel	Cost of travel is a deterrence factor, as typically, travel demand decreases with increasing fares.	Ferry operators and websites.
Real GDP (2000 dollars)	GDP is directly related to passenger transport. A higher income in the source market is expected to have a positive impact on demand. As such, large growth rates should be associated with changes in passenger movement.	World Bank's world development indicators and country statistical offices.
Number of arriving air passengers	This measures the total number of arrivals from non-domestic routes arriving into the country via air. The premise is that a higher number of air passengers would increase the base population available for travel.	Caribbean Tourism Organization.

Source: Author's compilation.

Other variables were added in alternative specifications in order to determine whether the sign and the statistical significance of estimated coefficients of the explanatory variables on the basic equation remained the same. These variables are:

- (a) A dummy for disasters,  $d_{disasterit}$ , (1 is a disaster that took place in a year  $t$ , in country  $i$ , 0 otherwise). A negative sign is expected for this variable since the occurrence of a disaster discourages persons from tourism and travel activities due to economy damages. Further, the risk to maritime transport is high owing to rough and dangerous waters.<sup>13</sup>
- (b) A dummy for technological change on the industry,  $d_{techit}$ , (1 is a technological change – purchases of newer, faster, and safer ferries- that took place in country  $i$  starting in year  $t$ , 0 otherwise). A positive sign is expected for this variable since it will imply that ferry services will be more attractive.
- (c) The logarithm of the GDP of the United States of America and the logarithm of the GDP of the United Kingdom. A positive sign is expected for these variables considering that economic growth on those economies should be related to an increase in tourism from those countries to the Caribbean. For example, during the international financial crisis, the total visitor population to the region would have decreased. The simultaneous decrease in ferry passengers would indicate the possibility that a large proportion of the ferry service passengers are visitors to the islands.
- (d) The logarithm of population of country  $i$  in year  $t$ ,  $L(popit)$ . Population determines the pool of available persons likely to undertake travel. The larger the number of persons living in the source destination, the larger the number of potential passengers.<sup>14</sup>
- (e) The logarithm of jet fuel price. Since there are no available data on air fares, the price of a substitute good, air transportation jet fuel price was used as a proxy variable.

Table 4 below shows some statistics of the main variables utilized in the study.

**Table 4**  
**Characteristics of key variables**

Variable	Mean	Standard deviation	Minimum	Maximum
Ferry departures (passengers)	125 030	126 987	313	523 350
Fares (2005 dollars)	28.22	25.96	5.56	94.13
GDP growth	0.03	0.08	-0.23	0.51
Air arrivals (passengers)	234 610	193 783	5 395	737 651
Population (persons)	241 044	341 218	4377	1 300 000

Source: Author's compilation.

Equation (1) was estimated with a panel data set of 15 units<sup>15</sup> and a maximum of 15 time periods. Note that the panel data set is unbalanced, that is, there are no data for some periods. Additionally, note that a database of this size is a limitation to the use of panel data estimation methods because its statistical properties were derived for large samples.

<sup>13</sup> This variable was obtained from EMDAT-CRED. EM-DAT defines (natural) hazards as a disaster if 10 or more people were killed, 100 or more people were affected, a call for international assistance was issued or if there was a declaration of a state of emergency.

<sup>14</sup> This variable was obtained from CEPALSTAT and country statistical offices.

<sup>15</sup> The representation of Grenada's passenger flow is in a different format from the other countries. Whereas the other countries show departures from one point, the graphical representation of Grenada shows departures from all the countries and represents all passenger movement.

Given this limitation seven specifications were estimated using several estimators. Different specifications were used to see how the estimated coefficients of the key explanatory variables ( $L(\text{rfare})$ ,  $L(\text{rgdp})$ ,  $L(\text{aarr})$ ) react to the inclusion of other controls. In each of these estimated models advantage is taken of the panel data structure. In the first two models using a pooled regression and a first-difference pooled regression, advantage is taken of the panel data information to estimate robust errors.

As in the case of the regressions, where the units are countries, for the ferry demand model it is difficult to argue that time-invariant<sup>16</sup> unobserved components are not related to the regressors. For this reason the best panel data model to estimate the equation was the fixed-effects model. The fixed effect is represented by the coefficient  $\alpha_i$  in equation (1). The estimates of the demand for maritime transportation are as follows:

- (a) Pooled data regression with cluster-robust standard errors. This method took into account ferry travel-level heterogeneity in order to estimate the variance and covariance matrix.<sup>17</sup> Table 5 shows the estimates obtained from this method. For all the specifications the estimated coefficient of the log of the real ferry fare was statistically significant and with the expected sign. This elasticity varies from -0.911 per cent to -0.728 per cent. Note that during the period under analysis nominal fares did not experience significant changes. As such, real fares decrease because inflation was positive. In other words, ferry travel becomes relatively cheaper compared with other goods of those economies.
- (b) The log of arriving air passengers was the other variable that was statistically significant and with the expected sign. An increase in one per cent of this variable expands departing ferry passengers by approximately 0.35 per cent. This result points out that tourists coming from abroad are one of the determinants of ferry demand transportation for the routes in the sample. Note that none of the other estimated coefficients associated with the other regressors included in specification (2)-(7) were statistically significant.
- (c) First difference with cluster-robust standard errors. This method was used because the unit root tests on the data set had very low power as the 15-year time span was too short- just 15 years. The estimates using this methodology are in table 6. The coefficients of the estimated ferry real fare were negative and statistically significant. This result proved to be consistent with the outcomes of the previous method. None of other estimated coefficients associated with the other regressors were significant. Note that in table 6, the corresponding regressors has a G in front meaning that is the growth rate of those variables.
- (d) Fixed effects with Druscoll-Kraay robust errors. It is very difficult that  $N \times T$  observations in a panel are independent (Cameron and Triverdi, 2005). The most common case is that they are correlated. Therefore, ignoring the correlation of regression disturbances over time and between units could lead to biased statistical inference. A method that could be used in this situation is the Druscoll-Kraay robust errors. Given that the data set was short, just one lag on the estimation was used. This method estimated robust standard errors both to heteroskedasticity and autocorrelation. In the case of this methodology the expected sign, and statistically significant effects of the real fare, the economic activity, air arriving passengers, foreign economic activity, and jet fuel price on maritime transportation demand was found. Outcomes of this methodology are in table 7.

<sup>16</sup> The variable travel time is considered important in the decision-making process of travelers. However, the travel time was unchanged over the period studied. Travel time for each trip may vary depending on which type of vessel is used for transport, as well as other factors such as sea conditions. While air travel did not provide the same quality aesthetics as marine travel, the travel time of air modes in some instances was quite short compared to the ferry travel time. For instance, flight times were about 120 minutes less than ferry travel in Trinidad and Tobago and 70 minutes less in the case of Antigua to Montserrat. In some cases it was just 15 minutes less, such as in the United States Virgin Islands and British Virgin Islands, Anguilla and Saint Martin/Sint Maarten and Guyana and Suriname.

<sup>17</sup> They are based on the assumption that random disturbances within a travel in different moments of time could be correlated but they are independent between clusters.

As in the previous methods, the real fare elasticity was statistically significant and with the expected sign for all specifications. The range of variation was between -1.17 per cent and -0.91 per cent.

Note that in specifications (1)-(3) the GDP elasticity of maritime transportation demand was statistically significant and with the correct sign. An increase of 1 per cent in economic activity boosts departing ferry passengers between 0.38 per cent and 0.64 per cent.

**Table 5**  
**Demand for transportation: pooling regression, cluster robust errors**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	L(fdep)	L(fdep)	L(fdep)	L(fdep)	L(fdep)	L(fdep)	L(fdep)
L(rfare)	-0.902*** (-5.00)	-0.728** (-3.25)	-0.911*** (-5.09)	-0.881*** (-5.38)	-0.902*** (-5.02)	-0.904*** (-4.97)	-0.903*** (-5.00)
L(rgdp)	0.0113 (0.40)	0.0525 (0.99)	0.0149 (0.50)	-0.00230 (-0.07)	0.0113 (0.39)	0.0112 (0.39)	0.0112 (0.39)
L(aarr)	0.341* (2.21)		0.343* (2.30)	0.351* (2.25)	0.341* (2.20)	0.343* (2.22)	0.342* (2.22)
L(pop)		-0.0617 (-0.35)					
Ddisaster			-0.470 (-2.08)				
Dtech				0.366 (1.04)			
L(usrgdp)					0.0731 (0.06)		
L(ukrgdp)						0.449 (0.38)	
L(jfuel)							0.0266 (0.14)
Constant	9.642*** (6.15)	13.05*** (7.62)	9.623*** (6.41)	9.622*** (6.03)	7.429 (0.21)	-3.179 (-0.09)	9.620*** (6.07)
F-Stat	8.43	7.89	9.02	7.29	6.58	6.54	6.53
N	167	175	167	167	167	167	167

Source: Authors's compilation.

Note: t statistics in parentheses. \* p<0.05, \*\*p<0.01, \*\*\*p<0.001.

**Table 6**  
**Demand for transportation: first differences, cluster robust errors**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	GFdep	GFdep	GFdep	GFdep	GFdep	GFdep	GFdep
Grfare	-0.633*** (-5.39)	-0.604*** (-5.12)	-0.588*** (-5.52)	-0.598** (-4.00)	-0.661*** (-5.61)	-0.648*** (-5.54)	-0.634*** (-5.25)
Ggdp	-0.0804 (-0.47)	-0.0258 (-0.15)	-0.0638 (-0.39)	-0.0322 (-0.21)	-0.172 (-0.90)	-0.222 (-1.12)	-0.0440 (-0.25)
Garr	0.151 (1.78)		0.149 (1.68)	0.0923 (0.98)	0.0772 (0.77)	0.0850 (0.88)	0.162 (1.76)
Gpop		0.158 (0.12)					
Ddisaster			0.0593 (1.41)				
Dtech				-0.0936 (-2.12)			
Gusgdp					1.733 (1.81)		
Gukgdp						1.543 (1.93)	
Gjfuel							-0.0461 (-0.75)
Constant	0.0615* (2.35)	0.0553 (1.99)	0.0538* (2.20)	0.0931* (2.90)	0.0336 (1.22)	0.0410 (1.58)	0.0642* (2.38)
F-Stat	13.78	15.94	12.1	21.25	15.7	13	10.53
N	149	158	149	149	149	149	149

Source: Author's compilation.

Note: t statistics in parentheses. \* p<0.05, \*\*p<0.01, \*\*\*p<0.001.

**Table 7**  
**Demand for transportation: fixed effects, cluster robust errors**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	L(fdep)						
L(rfare)	-0.931*** (-4.73)	-1.173*** (-5.50)	-1.035*** (-5.18)	-0.910*** (-4.89)	-1.071*** (-4.51)	-1.065*** (-4.36)	-1.030*** (-4.39)
L(rgdp)	0.379* (2.95)	0.352 (2.12)	0.388** (3.64)	0.642** (3.49)	-0.0548 (-0.21)	-0.0519 (-0.18)	0.0189 (0.07)
L(aarr)	0.295** (3.33)		0.277** (3.09)	0.259* (2.85)	0.280* (2.93)	0.266* (2.70)	0.289** (3.13)
L(pop)		1.587* (2.44)					
Ddisaster			-0.217 (-2.14)				
Dtech				-0.188* (-2.44)			
L(usrgdp)					1.502* (2.55)		
L(ukrgdp)						1.539* (2.34)	
L(jfuel)							0.197* (2.24)
Constant	2.920 (0.77)	-10.73 (-1.63)	3.285 (0.94)	-1.918 (-0.42)	-33.18* (-2.72)	-31.59* (-2.54)	10.38 (1.63)
F-Stat	76.06	35.41	68.41	59.27	51.13	40.54	56.63
N	167	175	167	167	167	167	167

Source: Author's compilation.

Note: t statistics in parentheses. \* p<0.05, \*\*p<0.01, \*\*\*p<0.001.

The estimates of the arriving air passengers' elasticity are between 0.27 per cent and 0.3 per cent. This result is consistent with the outcomes of the first model. The jet fuel elasticity of maritime transportation demand was 0.2 per cent. Increases in jet fuel could cause increases in air fare, a substitute way of transportation.

In this sample, external economic activity was found to be one of the determinants of demand in the model. The proxy variables on the estimations were the GDP of the United States of America and the GDP of the United Kingdom. Both elasticities were approximately 1.5 per cent. This result points out the sensitivity of the maritime transportation demand in the Caribbean to the world economic activity.

Finally, the estimated coefficient for the addition of new ferries had a statistically significant effect on the demand for maritime transport demand but with a different sign than expected. One factor that could determine the result is that some of the changes in the region occurred at about the same time as the occurrence of the international financial crisis.

## IV. Conclusion

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The main contributions of this paper are: a) the compilation of a data set emphasizing the departing ferry passengers, and b) the estimation of a demand equation for maritime passenger transportation. The results showed that this demand is related to the real fare of the service, international economic activity and the number of passengers arriving in the country by air. The real fare was statistically significant and with the expected sign for all estimation methods and most of the specifications of the demand function. The results also stress the high elasticity of this activity to the international economy.

Given the importance of this issue for the countries of the Caribbean, further empirical research is required. From a methodological stand point, the extension of the sample so that all destinations in the region are covered is a key requirement. Also, the compilation of additional variables, such as the price of air tickets, is recommended.

With respect to policy, the estimation results suggest that real fares for maritime passenger services would be important in influencing passenger use of regional ferry services. Further, there appear to be good prospects for integrating the tourism market into the married passenger services, in order to expand service demand. While the study gave no consideration to technical matters in the provision of regional maritime passenger transportation, it suggests that strong economic performance of regional economies provides a good basis for growth of maritime passenger services in the Caribbean.



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## **Annex**

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**Table A.1**  
**Overview of some domestic maritime passenger operations**

Origin	Destination	Distance (nm) <sup>a</sup>	Operator	Travel time (mins)	Tariff (dollars) <sup>b</sup>	Number of vessels	Capacity	Days/week of operation	
Antigua	Barbuda	28	Barbuda Express	90	48	1	60	5	
Cuba	Isla de la Juventud	54	NCC	160	50	1	237	7	
Saint Vincent	Bequia	8	Jaden Inc.	25	15	1	218	4	
			Bequia Express	90	9	2	400, ...	7	
	Union Island	35	Admiralty Transport	60	...	40, 22, 37	1	360	...
			Jaden	...	...	1	...	...	
			MV Gemstar	180, ..., ...	40, 20, ...	1	...	3	
	Canouan	36	MV Barracuda	..., 160, ...	37, 19, ...	1	...	3	
	Mustique	23	Mustique Ferry Service	120	9	1	200	4	
Les Saintes	25	...	60	28, 12	1	...	...		
Guadeloupe	Martinique	102	Jeans For Freedom	270	85, 43	2	437	3	
	Marie Galante	25	L'express de Iles	60	...	...	...	...	

Source: Author's compilation on the basis of several sources.

Note: Table A.1 shows an overview of domestic maritime passenger operations that currently exist but were not assessed in the study.

... indicates that figure is unavailable.

<sup>a</sup> The distances have been calculated via maps, as well as have been given by persons of knowledge and are therefore approximate values.

<sup>b</sup> The listed tariffs are approximate one way fares as of April 2015; some operators offer a discounted round trip fare.

**Table A.2**  
**Overview of some intra-regional maritime passenger operations**

Origin	Destination	Distance (nm) <sup>a</sup>	Operators	Travel time (mins)	Tariff (dollars) <sup>b</sup>	Number of vessels	Capacity	Days/week of operation
Union Island	Carriacou	5	Lady J-J	45	13	1	30	2
	Martinique	45		120				
Dominica	Saint Lucia	80	L'Express de Isles	270	86	2	360, 445	3
	Guadeloupe	54		135				
Saint Lucia	Guadeloupe	135		435	86			
Sint Maarten	Saint Barths	14	Great Bay Express	45	72	1	130	7
		17	Edge	45	50	1	62	3
Saint Martin (Oyster Pond & Marigot)	Saint Barths	14, 6	The Voyager	40, 60	75	3	117,154,154	7
Saba	Sint Maarten	27	Saba C Transport (The Dawn II)	90	55	1	50	3-5
			Edge	90	55	1	62	3
Puerto Rico	Dominican Republic	158,216	America Cruise Ferry	720	89	1	1200	6 (3 either way)

Source: Author's compilation on the basis of several sources.

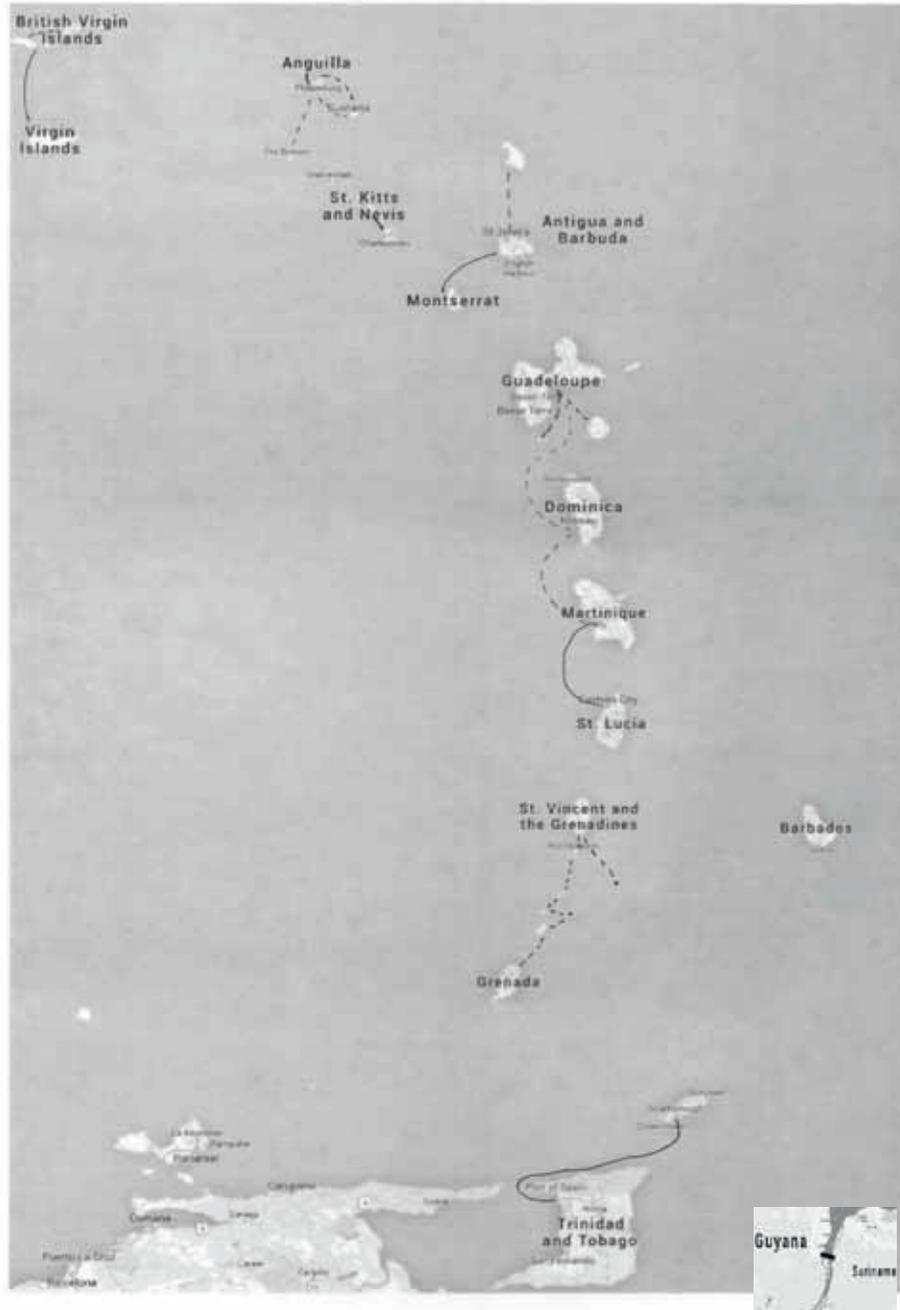
Note: Table A.2 shows an overview of intra-regional and international maritime passenger operations that currently exist but were not assessed in this study.

<sup>a</sup> The distances have been calculated via maps, as well as have been given by persons of knowledge and are therefore approximate values.

<sup>b</sup> The listed tariffs are approximate one way fares as of April 2015; some operators offer a discounted round trip fare.

Map A.1 shows the routes of maritime passenger operations that currently exist in the below displayed area, both those that were assessed in the study as well as those that were not.

**Map A.1**  
**Routes of Caribbean ferry services**



Source: Created from Google Maps.

Note: Dotted lines indicate that the routes were not assessed in this study whereas solid lines indicate that they were assessed in this study.

Map is not to scale.

The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.

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