Faculty of Economics and Administration

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Empirical Project of the course MPE_TREN: Transport Economics

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Topic: Analysis of the demand for railway transport in Costa Rica. The elasticity of the demand for the route San José – Heredia – San José

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Costa Rican Institute of Railways - INCOFER

Statement of the Problem:

Nowadays, Costa Rican Great Metropolitan Area is facing serious problems in terms of transport, the country is small and distances also, but the times for moving from one place to another are increasing constantly. Traffic jams are an everyday issue, this due to some factors like the inefficient infrastructure of the country in terms of highways and roads, the big amount of cars in circulation and the disrespect that drivers take of the road safety rules. During this chaos, the train has always been a good mean of transportation, especially during the peak hours, however, the rail infrastructure is lagging behind the advances discovered, this mainly because the Costa Rican Institute of Railways was closed during 12 years, so this caused that there was no research, investment or any new improvements in the railway system of the country.

Recently, the Costa Rican parliament approved a law for the strengthening of the Costa Rican Institute of Railways, and also the number of trains per day increased, however, the whole problem is not fixed, there's still a lot of traffic jams during the peak hours, for driving small distances, and there are some initiatives and political promises for constructing a tram or a metro for moving into the capital, San Jose, however, this projects are just promises now, and won't be achieved in the short run. The interesting here is that, still, the Costa Rican Institute of Railways needs some additional funding and the tariffs paid for the trains are not so expensive, it would be useful to know the elasticity of the passengers that use the train according to price.

Background

The Republic of Costa Rica is a Central American country that has a boarder with Nicaragua in the north and Panama on the southeast, it has access to both the Pacific Ocean and the Caribbean Sea, it has a presidential and constitutional government. The Gini coefficient per person for 2016 was 0,52, the life expectancy is around 80 years, the unemployment rate for 2016 is 9,70% and the GDP per capita for 2015 was around $10.877,2.

Figure N°1. Map of Costa Rica
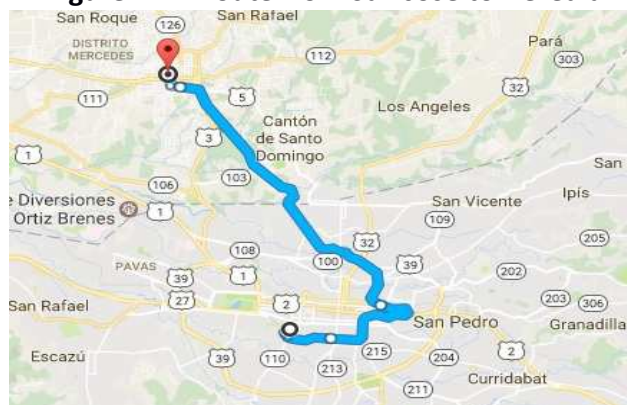

Source: Google Images

To understand the background that surrounds the problem, it is important to know a bit about the history of the Costa Rican Institute of Railways, "was created in 1985 by the Law N°7001, it is a public law institution with administrative autonomy, legal personality and own equity. The law unites the two railways of Atlantic and Pacific and all the branches that have been part of the national railway heritage since 1871. Between 1990 and 1995 the railway activity was plunged into an economic crisis, due to high debts that could not be covered, the government decided to make a technical closure, so the railway services were suspended in the whole national territory on June 28th, 1995." (INCOFER, 2016)

The railway activity in Costa Rica was reactivated on September 1998, due to a presidential decree where it was established that it should work for transport of people and things, starting on the Atlantic region, and then, on other regions where it was considered appropriate. INCOFER is giving public transport services for the population and additionally is giving freight transport by optimizing transport times and decreasing costs, this is the main activity of the Institution and the one that generates revenues for its operation. INCOFER has actually 7 routes in use, detailed as follow:

- San José – Heredia – San José
- III Metropolis – Curridabat – Pavas
- San José – San Antonio de Belén – San José
- Transport of Bananas in La Estrella Valley, Bananito, Estrada and Matina
- Transport of steel from Moín to Leesvile on Guácimo
- Turistic transport to Limón and Siquirres
- Turistic transport to Caldera

The selected route is the one that goes from San José to Heredia and vice versa, this is mainly because these two cities of Costa Rica are very important for the economy of the country, they also possess a big amount of citizens that are flowing among this cities everyday due to reasons of labor or study, the two main and biggest universities of the country are in this cities, also free trade zones, banks and many important institutions that cause big movements of inhabitants from one city to another, in San José lives 1.607.170 inhabitants whereas in Heredia lives 497.805 inhabitants. Also this route was chosen because it helps to reduce the traffic jams in one of the most congested routes of the country, it results interesting that during the peak hours, by bus or by train, it takes more than an hour for people to move between these cities even though when the distance is approximately 13km.

Figure N°2. Route from San José to Heredia

Source: Google maps

Review of Literature

In terms of economic theory, the main concept here is the elasticity of the demand, this is defined by Cowie (2010) as "a formal measure of the rate of change of the quantity demanded in comparison to the rate of change of the price. (…) is a formal mechanism in economics by which price sensitivity is assessed and analyzed. This is measured on a quantitative basis, i.e. a number is derived in order to assess the level of price elasticity". The same author states that there are three basic determinants of price elasticity of demand for transport services:

1. The number and closeness of alternative models of travel (substitutes)

According to the theory established, "the higher the number of alternative modes available and the closer they are in meeting the same basic travel need, the higher will be the price elasticity for a particular transport service" (Cowie, 2010). In this determinant of the demand applied to the Costa Rican case, turns out to be interesting, because, for the train from San José to Heredia, there's only one company of trains in the market, so there's no railway competition, however, it is possible to find some substitutes for the basic travel need, like cars or buses. Nonetheless these means are not perfect substitutes, because there is a big difference on the timing, during the peak hours, the train takes the people from San José to Heredia in 30 minutes, whereas by car or by bus it could take more than an hour, depending on the day and the conditions of the traffic.

2. The proportion (and timing) of disposable income purchased on the mode of travel

The income is usually one of the biggest determinants of the demand, the theory states that "the higher the proportion of disposable income spent on the mode of travel, then the higher the price elasticity of demand, (…) within transport services, the proportion of income spent in most (but not all) instances will be relatively small, although these will add up to significant amounts" (Cowie, 2010). In terms of income, the disposable amount of income dedicated to the transport does not makes a big difference, this mainly because the users of the San José-Heredia route of train, face similar prices on other means of transportation for this city, for example, on the bus lines that go from San José to Heredia, there are some that are a bit cheaper than the train, but also others that are more expensive, also because the main users of the train are people who is forced to make this route for studying or working, hence, the big determinant here is the time, which we will see as follow.

3. The time dimension

The last main determinant of the demand of transport, the literature says that "is an important dimension in determining price elasticity of demand as elasticity can vary between the short and long run. Over a longer period of time, habits can change, thus there will almost always be a difference between long and short run elasticities, with the former almost certainly more elastic (…) An essential journey, such as where commuters have to travel into the center of a city each day for work or business purposes, will have relatively inelastic demand, as there is a little choice but to make the journey at that point time." (Cowie, 2010). As it is stated by the author, there are some journeys named as essentials, they are reducing the elasticity in the demand, and this is the case of the train route from San José to Heredia, which main users are the workers and the students, they need to make this trip many times per week, so the transport is seen as a necessary service. There is a famous

phrase that says that time is money, and taking this into consideration, the train can be seen as a valuable source of money, keeping in mind that the train takes only 30 minutes for going from San Jose to Heredia and the bus or the cars take around 1 hour, this added value that the train has, could be even used as a source for charging more money on the train tariff.

Data and the estimation of the model

The estimation of the Price Elasticity Demand is considered as the change from the first trimester in 2012 until the last of 2013, a 2-year change elasticity is what is about to be examined, the calculation will be done through the following formula:

$$PED = \frac{\Delta Demand}{\Delta Price} = \frac{0,0046}{0,1295} = 0,0377$$

By watching the previous equation, it is possible to observe that the coefficient of the PED is 0,037 which according to the economic theory, since this number is within the range of 0<PED<1 it corresponds to an inelastic or relatively inelastic transport demand. This means that a change in the price of the train tickets, would not imply a significant change in the quantity demanded, hence the number of passengers demanding the service will be relatively the same.

Although the result of the PED is trustworthy, it seems also important to consult the result of an econometric model, and it is even more useful if it contains some other variables that could act as determinants of the elasticity of the demand, this is why the present work, contains another econometric model, created with the help of the software E-VIEWS. To introduce the data of the econometric model, it is important to mention that there is a lack of wide data to accomplish a several model without mistakes, but the statistical department of the institution only could offer data from the year 2012 until the first trimester of 2015, hence these 14 observations would be considered for all the resting variables, which were chosen because they certainly represent some determinants of the demand for the Costa Rican case.

Table N°1. Data used for the model.

Trimester	Passengers	Tariff	Cars	Price of gasoline
I2012	346998	410	1272289	665
II2012	347965	410	1272289	746
III2012	345189	410	1272289	741
IV2012	351472	410	1272289	743
I2013	347296	460	1329053	709
II2013	345873	460	1329053	750
III2013	346129	460	1329053	744
IV2013	348597	460	1329053	704
I2014	375814	460	1399238	689
II2014	381257	460	1399238	776
III2014	387653	460	1399238	801
IV2014	389354	460	1399238	741
I2015	392183	460	1399238	562

Source: Own elaboration with data from INCOFER, RECOPE and media.

The number of passengers and the prices of the train in the San José – Heredia route were given by the INCOFER and they were considered because are the two essential variables interacting when it comes to price elasticity of the demand. The number of cars was chosen because is considered one of the main problems in terms of vial chaos in the country, the amount of cars in circulation keeps increasing disproportionately every year and has been pointed as one of the most severe issues and concerns in the sphere of transport in Costa Rica. Finally, it was also included the price of the liter of gasoline, since this is a determinant on the decision for using or acquiring a car, hence, it can influence on the decision for using public or private means of transport.

The model for estimation under Ordinary Least Squares (OLS) was proposed in the following way:

$$Passengers = \alpha_0 + \alpha_1 Tariff + \alpha_2 Cars + \alpha_3 Literof gasoline$$

And the output obtained from the E-views software is presented in the following table:
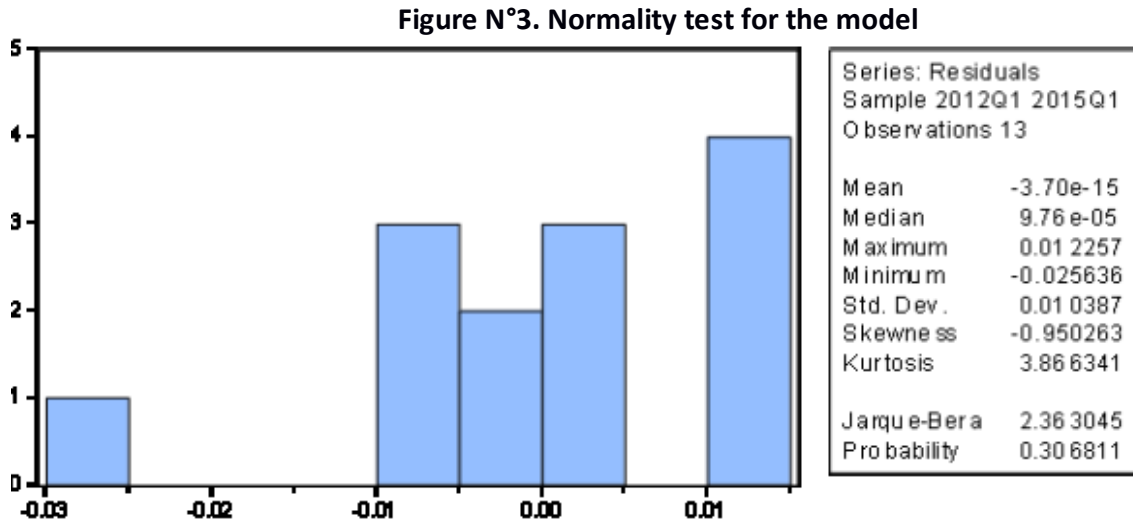
Table N°2. Output of the model.

Dependent Variable: LPSNG
Method: Least Squares
Date: 01/11/17   Time: 22:06
Sample: 2012Q1 2015Q1
Included observations: 13

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.60277	1.719616	-6.165777	0.0002
LRATE	-0.785870	0.116783	-6.729294	0.0001
LCAR	2.014497	0.157541	12.78713	0.0000
LGAS	-0.034341	0.039483	-0.869766	0.4070

R-squared	0.962131	Mean dependent var		12.79803
Adjusted R-squared	0.949508	S.D. dependent var		0.053377
S.E. of regression	0.011994	Akaike info criterion		-5.761172
Sum squared resid	0.001295	Schwarz criterion		-5.587341
Log likelihood	41.44762	Hannan-Quinn criter.		-5.796902
F-statistic	76.22079	Durbin-Watson stat		1.632696
Prob(F-statistic)	0.000001			

Source: Own elaboration with E-views software

As it is possible to appreciate, the coefficients of the parameters present interesting results, first of all, the coefficient of the rate assumes a negative relation, which does not match with the inelastic demand economic theory, this coefficient means that an increase in the tariff would mean a decrease of 0,78 in the number of passengers for the train route, however, this is in contrast with the PED coefficient obtained before through simple arithmetic. The coefficient of the number of cars matched with the theory that the bigger the amount of cars in circulation, the bigger the number of users of the train, this because of the increase in the traffic jams due to the disproportional amount of cars circulating on the streets of the Great Metropolitan Area and finally the liter of gasoline coefficient states that the increase in the price of gasoline would mean a decrease in the amount of passengers, which drives to think that this variable is not really significant or really does not consists as a determinant.

Regardless the normality of the model, in the following image, is possible to appreciate the normality test and the plot of the distribution, according to the probability of the Jarque-Bera statistic (0,30), is possible to affirm that there is presence of normality in the distribution.

Figure N°3. Normality test for the model

Series: Residuals	
Sample 2012Q1 2015Q1	
Observations 13	
Mean	-3.70e-15
Median	9.76e-05
Maximum	0.012257
Minimum	-0.025636
Std. Dev.	0.010387
Skewness	-0.950263
Kurtosis	3.866341
Jarque-Bera	2.363045
Probability	0.306811

Source: Own elaboration with E-views software

Now it is useful to evaluate the heteroskedasticity of the test, by evaluating the probabilities of the White test, since their coefficients are bigger than 0,05, it is possible to affirm, that the model is homoscedastic, as it is stated in the following image:

Table N°3. Heteroskedasticity Test

Heteroskedasticity Test: White

F-statistic	2.400647	Prob. F(5,7)	0.1423
Obs*R-squared	8.211341	Prob. Chi-Square(5)	0.1450
Scaled explained SS	5.640405	Prob. Chi-Square(5)	0.3428

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 01/11/17   Time: 22:08
Sample: 2012Q1 2015Q1
Included observations: 13

Source: Own elaboration with E-views software

Empirical results and conclusions

First of all, it is important to notice that these models were made taking into consideration the statistical patterns of the demand of the train transport, the data was limited and scarce, hence the model would not be perfect and will always face some statistic problems, however, the econometric model could be used as a source of information for observing how the different variables make a reaction, whether they have a relation or not with the amount of passengers that are willing to take the train from San José to Heredia and vice versa. Once said this, there are some conclusions that can be derived from the results obtained in the past section:

- The train in the route from San José to Heredia is an interurban mean of transportation which is mainly used by workers and students from each city that need to move among these cities, especially during the peak hours, hence this mean of transportation is used mainly for essential trips.
- The big amount of cars in circulation is one of the biggest contributors to the traffic jams during the peak hours, and as it could be seen on the model, it is causing an increase in the number of passengers that are taking the train route from San José to Heredia.
- Since this train route is essential and its demand is inelastic, the government should use this argument for two purposes, the first one, to provide a wider supply of trains in this route during the peak hours, and hence, to evaluate an adjust of the tariff in order to collect more money for the strengthening of the INCOFER.
- The train is a solution for the vial chaos that Costa Rica is facing, hence the service should be improved. It is also important to consider that there is no railway culture in the country, more security measures should be provided, and also there should be a spread and communication of the benefits of riding a train instead of the buses and cars.

Possible Extensions and limitations of the study

The present study can be used as a basis to understand that the train is a necessity to which priority should be given, by establishing the fact of this inelastic demand, a set of transport policies could start to be formulated. The transport chaos that we have been living, could be a call of attention for think about new means of transportation in the country, such as the tram or even a metro, this kind of projects certainly won't be accomplished in the short run, but out of doubt, they would solve the traffic jams in a great way.

In terms of further extensions of the model for reasons of transport policies, it is always important to keep in mind that "in order to provide a convincing policy implementation process, it is necessary to put in place mechanisms which will provide assurance of its implementation. For the economist, the market and the market mechanism are the appropriate ways in which, under certain conditions, there exists a process which can provide a conciliation between various divergent interests, bringing competing self-interests towards the realization of a social optimum" (Quinet and Vivkerman, 2004).

The main limitations that the study faced was the scarcity of data, which in fact limited the accuracy of the model, however, it is still used as a point of reference for understanding that this kind of services, has a special consumer behavior that does not match all the times with the economic theory. For further studies, it would be important that the INCOFER creates a specialized data base that contains more accurate and disaggregated data that presents a better output as a model. Also it would be important to have some source of qualitative information, by applying surveys to the passengers, there would be more information about the satisfaction of the passengers with the service, their willingness to pay, some ideas for improving the service and hence, better approximations of the elasticity could be estimated, so as better policies for improving the service and making it more efficient.

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