Demand of Mozambique seaports

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Abstract

This paper presents an Analysis of Mozambique seaports from 2001-2015 using the Anderson, De Palma and Thisse's ideal type demand model. The seaports of Mozambique serve not only Mozambique but also other countries without acess to sea. For example Beira seaport as a specific train line to Zambia.

The ideal type model of Anderson, Palma and Thisse is a model of heterogenous seaports that is estimated in two steps and accounts for endogeneity of the price. The results reveal that the seaport market share increases with income and with the price of container cargo, while decreases with the price of maritime transport services and the price of truck transportation.. The price is endogenous in demand equation and the endogeneity is taken into account in the demand estimation. The price of trucks has a negative coefficient and therefore is a complementary good. Demand elasticities are presented. A robustness test is done estimating also the Berry, Levinsohn, and Pakes approach and comparing the results.

Keywords: Mozambique seaports, Demand analysis; Ideal type demand model.

1. Introduction

Research on seaports demand is common (Coto-Millan, Baños Pino and Castro, 2005; Coto-Millan et al, 2013) with traditional homogenous demand models. However seaports are usually heterogenous justifying heterogeneous models, such the BLP-Berry, Levinsohn, and Pakes (1995) adopted by Barros(2015) for Angola seaports and the Anderson, Palma and Thisse (1992) ideal type demand model adopted in the present paper. The BLP and the ideal type demand model are a family of binary demand models that appear in the economic literature in the nineties. Demand models in this tradition includes the demand model without observed price of Lewbel and Pendakur (2009), the dynamic probit demand model of Orme (2001), Woldridge (2005) and Stewart (2005, 2006). The main characteristics of the new demand models is that they take heterogenosity, and the endogeneity of the price in demand equation is taking into account. Therefore this paper contributes to applied research adopting the ideal type demand model in the seaports of Mozambique.

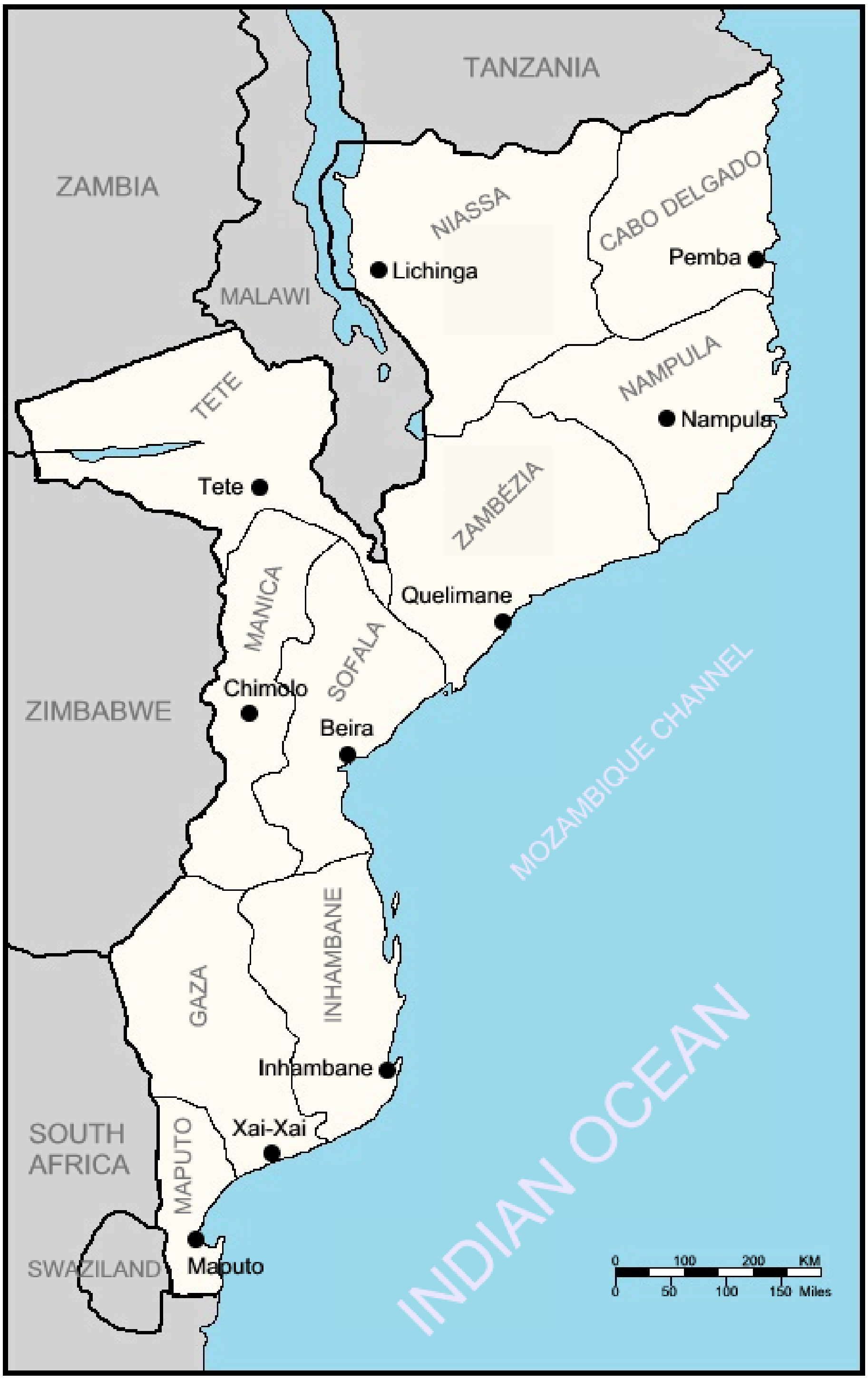
The motivation for the present research is the following. First to estimate the ideal type demand model for seaports innovating in this context. Although the ideal type model is similar relative to the BLP on handling heterogeneity, this model is estimated in two steps and the results in more accurate estimates. Secondly, Mozambique is a country that faces the Mozambique canal and therefore seaports are strategic in the country activity justifying the present research. The transportation of merchandises uses seaports and adjacent roads. Finally this paper estimates the Mozambique seaports demand alone for the first time. This ports were analysed combined with Angola and Nigeria seaports by Barros, Assaf and Ibiowie (2010), Barros (2012) and Barros&Peypoch (2012).

This paper is organized as follows: after this introduction the contextual setting is presented, followed by the literature. Then the methodology is presented, followed by hypothesis. The data section and results section is then presented followed by the last section named conclusion and discussion section.

2. Contextual Setting

Mozambique is an African country located in west coast of Africa above South Africa and below Tanzania. The Mozambique map with seaport location is presented below. The country is the characterized by high growth rate based in the attraction of foreign development investment and open the country resources to these foreign investment. Maputo seaport is nowadays managed by a South African company Port Development Company (MPDC) in association with the UK Company Mersey Docks and Harbor Co. The concession includes the ferry line Nacala-Malawi. The Maputo seaport was allocated to MPDC by 15 year, but In June 2010, the concession period was extended for another 15 years, with an option of an additional ten years of operations after 2033. MPDC holds the rights to finance, rehabilitate, construct, operate, manage, maintain, develop and optimize the entire concession area. The company also holds the powers of a Port Authority, being responsible for maritime operations, piloting towing (tugboats), stevedoring, terminal and warehouse operations, as well as port’s planning development. The seaport of Beira was concession to the private company Cornelder of Mozambique (CdM) and the coal seaport terminal in Beira was concession to the company New Coal Terminal Beira. The other seaports are public.

Map 1 presents the location of Mozambique seaports.



Source: Mozambique Transportation Statistics, Mozambique Institute of Statistics, 2015

3. Literature Survey

Other papers that analyses demand, includes Fung (2001) that analyses Hong Kong and Singapore demand forecast with a VAR- Vector autoregression model. Lin, Wang and Chiang (2001) that analyses manpower supply and demand of ocean deck officers. Yap and Lam (2004) analyses inter-container port relationships from the demand perspective.

At European level, demand analysis in seaports has been concentrated in Spanish seaports, with Coto-Millan, Baños-Pino and Castro (2005) that analyzed imports and exports of Spanish seaports, test the panel data unit roots and test the cointegration among the variables and then estimated an exportation equation and an importation equation. The exportation equation in logs is dependent of world (foreign) income in real terms, the relative export price of the export goods, and from world prices. The Spanish imports price of finished non-energy industrial goods, the log of maritime transport price.

In this paper the price elasticity's of imports and exports are lower than unity. Income elasticity's for maritime imports are higher than the unit, while those from exports are lower than unity.In the same tradition Coto-Milan et al. (2011) analysis the determinants of international demand in Spain estimating several equations, an importation function, where importations are a function of a constant, Spain GDP as a proxy for income an index of containerized general cargo. Second, an export function where exports are function of a constant, world income, merchandise in balance of payments and an index of containerized cargo. Third, import function of containers, where the logarithm of volume imports in containers is regressed in a constant, Spain GDP-gross domestic product, the merchandise in balance of payments and index of container cargo. Other equations are estimated for import containers, export containers, import of dry bulk, and export of dry bulk, import of liquid bulk and export of liquid bulk. The elasticity's for imports and exports are presented for income, price and transport price separated by general cargo, containers, dry bulk and liquid bulk. Coto-Millan et al. (2013) also analyses demand for port traffic in Spain by type of product. They test unit root test, estimate demand equation and the equations for imports and exports. They present demand elasticity's by product.

Anderson, Opaluch and Grigalunas (2009) analyses the Demand for Import Services at US Container Ports. Da Silva and Rocha(2011) analyses demand of southern and southeastern ports in Brazil. Steven and Corsi (2012) analyze containerized imports into the US. Meng, Wang and Wang (2015) analyses the demand of sea fleets. Pelletier and Guy (2014) analyses qualitatively the artic sealift services. Therefore, the new demand models have not yet been adopted in seaports demand.Hence, the present paper innovates in this context focusing on Mozambique seaports and adopting the ideal type model of Anderson, Palma and Thisse (1992).

4. Methodology

The Anderson, De Palma and Thisse (1992), ideal type demand model has the following specification:

$$\log W_{it} = \alpha_{it} + \beta_1 \log(Y_{it} / P_{it}) + \sum_j \beta_{it} \log P_{it} + \varepsilon_{it}$$

With W the budget share of the good in the period of time, P is the price of good and Y the total expenditures per capita, logP is the price index. Consumer theory requires that that the demand equation satisfy the restrictions of homogeneity, symmetry a negativity. The model has the following specification. The model that is adopted in the present paper is the following:

$$\log W_{it} = \alpha_{it} + \beta_1 \log P_{it} + \beta_2 \log PMTS_{it} + \beta_3 \log Pot_{it} + \beta_5 Y_{it} + \varepsilon_{it} \quad [1]$$

Where W is the seaport market share estimated by the import cargo in the total of the year imported cargo by all seaports. Therefore W is a variable in ratio between 0-1 that can be handled by a binary model such as the ideal demand model. In each year the sum of W added to one. Market share is the endogenous variable of all demand models since the Almost Ideal Demand System of Deaton and Mauellbauer (1980) where market shares are linear functions of the logarithm of prices, and real expenditure. The exogenous variables are: P (the price of ton of general cargo), PMT (the price of maritime transport services) and Pot (the price of other transportation services, which in Mozambique is the truck). Thus, the substitution/complementary effect is made with trucks.

5. Data and Results

The data used in the present research relative to Mozambique seaports from 2001-2015 includes 8 seaports, which are the country most important seaports. The data was obtained in Mozambique seaports by request. This data was used before by Barros, Assaf and Ibiowie (2010) and Barros (2011) and was updated based in the Mozambique Transportation Statistics published yearly by the Mozambique Institute of Statistics.

Table 1: Descriptive Statistics – Angola Seaports: 2002-2015

Variables	Definition	Min	Max	Mean	Std. Dev.
W	Logarithm of Seaport market share estimated yearly dividing the tons imported by the total of all seaports	0.017	0.413	0.124	0.133
logP	Logarithm of Price of tons of seaport imports in Meticais (2010=100)	10.326	12.177	11.489	0.466
Log PMTS	Logarithm of price of maritime transport services proxied by the average price	7.674	9.546	8.858	0.437

	of bulk and liquid cargo on Meticais (2010=100)				
Log Pot	Logarithm Price of other transport services proxied by air Transport cargo on Meticais (2010=100)	21.142	25.199	22.924	0.945
Log pcontainer	Logarithm of price of containers on Meticais (2010=100)	8.312	1183.2	57.129	316.21
Log Y	Log of Income in the seaport region in 1000 Meticais (2010=100)	14.118	20.501	18.420	1.889

The results of the estimated equation [1] is presented in table 2. The price is assumed to be correlated with the error term, therefore the Anderson, Palma and Thisse (1992) ideal type demand model is estimated with an xtivprobit model with GMM-General Method of Moments is adopted and estimated in two stages. Results are presented in table 2. The Berry, Levinsohn, and Pakes (1995) is estimated with the random-coefficients logit model.

Table 2: Mozambique Seaports Results (endogenous equation W-seaport market share)

Dependent Variables	Anderson, De Palma and Thisse demand model	Berry, Levinsohn, and Pakes demand BLP model
Constant	-0.566 (0.113)*	-8.927 (2.776)*
LnP	-0.151* (0.010)*	-1.280 (0.071)*
Ln PMTS	-0.012* (0.009)	-0.404* (0.123)*
Ln POT	-0.112	-1.115*

	(0.005)*	(0.025)
Log PContainer	0.005* (0.012)	1.210* (0.005)
Ln Y	0.0023* (0.001)	0.048* (0.009)
SD logp	____________	0.0000*
Sigma u	0.031	
Sigma e	0.066	
rho	0.186	
Wald chi(3)	1666 (0.0000)	
Number of observations	108	108

Standard error in brackets (* indicates that the parameter is significant at the 1% level. ** indicates that the parameter is significant at 5%). SD – Standard Deviation. GMM with 1000 draws. Instrumental variables used in BLP model: tons of imported goods, number of employees, number of cranes, quay length, total area, rail link. Instrumental variables used in Ideal type model: Operational cost in Dollars.

The results reveal that traffic decreases with the price and also decreases with the price of maritime transport services. The POT is positive signifying that it is that price of truck transportation is negative, hence a complementary good. The price of container cargo is positive and thus a substitution good. The income is positive and therefore the positive income elasticity of demand is associated with normal goods; an increase in income will lead to a rise in demand.

6. Robustness test

As a robustness test the BLP model from Berry, Levinsohn, and Pakes (1995) is estimated with the random-coefficients logit model. The results reveal that the signs of the variables are not equal, but the signs are maintained signifying that the results are robust. Furthermore, the statistical significance of the parameters is also maintained reinforcing the robustness of the results. Therefore the BLP model reinforce the Ideal type model results.

7. Seaport elasticities

The estimated elasticities are presented in table 3, namely price elasticity, income elasticity and price of substitute elasticity.

Table 3: Demand elasticities

Seaports	Price elasticity	Price elasticity of maritime transport services	Income elasticity	Price of substitution elasticity
Maputo	-2.013	-1.219	1.112	-1.018
Beira	-2.105	-1.178	1.210	-1.116
Chinde	-1.104	-1.327	1.017	-1.119
Macimboa da Praia	-1.007	-1.184	1.019	-1.114
Mozambique Island	-1.217	-1.138	1.015	-1.125
Nacala	-1.136	-1.126	1.024	-1.117
Pembane	-1.138	-1.101	1.031	-1.131
Quelimane	-1.291	-1.220	1.028	-1.112
Mean	-1.285	-1.186	1.057	-1.106

The estimated elasticities are in line to the values estimated in the literature namely by Barros (2015) for Angola. The values are also in line with Coto-Millan, Baños Pino and Castro (2005), Coto-Millan et al.(2013), but somewhat higher, revealing that in underdeveloping countries the elasticities tend to be higher than in developed countries, thus revealing the higher sensibility of the underdeveloped agents to economic activity.

8. Discussion and Conclusions

This paper presents a demand analysis of Mozambique seaports using the Anderson, De Palma and Thisse (1992), ideal type demand model. As robustness test the BLP model from The Berry, Levinsohn, and Pakes (1995) is also estimated and the results reveal that they are robust to alternative estimation. The results reveal that the seaport market share increases with income and with the price of container cargo, and decreases with the price of maritime transport services and the price of truck transportation. Truck transportation is negative and therefore a complementary of seaport traffic in Mozambique. The price of container cargo is positive, hence a substitution good of seaport traffic in Mozambique. These results are in line to the economic theory and validate previous research in seaport demand (Coto-Millan, Baños Pino and Castro, 2005) and (Coto-Millan et al, 2013). This result also innovates adopting a model not previously adopted in seaport research. The policy implication of these results is that Mozambique seaport traffic tends to grow along the time as the GDP- Gross Domestic Product grows and tends to decrease as the price of seaports increases. Therefore regulation of the seaports price increase should be in the transportation Minister agenda, in order to control its increase. The private exploration of the two Mozambique major seaports may contribute to control the price increases. More research is needed to confirm the present results.

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