



**DEMAND FOR CITY BUS TRANSPORTATION IN MEKELLE, ETHIOPIA  
(HECKMAN SELECTION MODEL)**

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**ABSTRACT**

*Transport system is an essential element in physical, economic and social structure of urban areas .It consists of transport infrastructure and service that permits economic agents to access the activities of the cities. The positive relationship between urbanization and per capita income is one of the most obvious and striking “stylized facts” of the development process. In the main time, the demand for urban transport in many cities of developing world continues to increase with urbanization. Rapid urbanization is taking place in cities of developing world especially Africa where urban population is growing at an unprecedented rate. However, in developing countries, urban transport sector has many problems. In adequate and poor quality infrastructure, mismatching between demand and supply and increase rate of accidents are some of the problems. This study examines the demand for city bus transit service in Mekelle city, Northern Ethiopia. The results presented are based on primary data collected from a random sample of 400 urban public transport. Descriptive statistics and Heckman two steps are employed as analytical techniques. In the Heckman two step, probit method helps to address the preference of commuters to city bus and OLS method addressed the willingness to pay the city bus tariff rate through the socio-economic determinants. Accordingly, more than 96% of respondents strongly demand for the city bus transport service. The recommendation arising from the study is that there is a need to introduce competitive base and end to end city bus transport service.*

**Key Words:** City bus, Heckman,, Mekelle

## **INTRODUCTION**

After the introduction of market-oriented economic policy in 1991 and great crop up of private sectors, Mekelle city becomes more urbanized and plays an enormous part in reducing unemployment as well as urban poverty. Expansion of the city in all dimensions and thriving real estate investment, opening out of industries, watering manufacturing enterprises and service rendering institutions besides; contributing in job creating opportunity, generate a mountainous demand for urban public transport service and this is every increasing.

Although some manufacturing industries and few government institutions provide a transport service to their employees during week days, majority of the civil servants (salary employees) and inhabitants of the city use public transport service. Modern society develops awareness to the value of time and every move is planned efficiently and then drives a demand for contemporary and efficient means of public transportation service. Residents' life in the morning and evening movement is highly subjective and correlated with the provision of public transport service. However, the society is confronted to find the right service at the right time and faced high transaction cost (MTO, 2010). During the peak periods; there is shortage of supply of public transport. On the other hand, outside of the peak periods, the supply is not as such busy; it is almost idle.

Moreover, the departure and destinations of the minibus taxis is between centers of and other corners of the city. There is no public transport service from one end to other end of the city via the center of the city. Even if city administrator addressed the seriousness of the problem i.e., less transport service supply, as a strategy supplying city bus is not given much attention as there are other chronic social and economic problems of the society which demand urgent and prior public intervention. However, the city administrator is obliged to cooperate and encourage for private sectors to participate in this business. This study is unique in its kind since there is no any study conducted concerning this issue at city level.

Demand for transport is a derived demand, and with the rapid economic growth of Mekelle city, this demand increases swiftly. As the existing public transport service; minibus taxi fails to improve in quality and quantity commensurate with the demand, it is reasonable that traveler's take recourse to other modes of transport. Excessively long waiting times as well as long walking distance characterized the current urban public transport situation in Mekelle city and this is more acute in morning and evening hours. The crucial question to ask is what are the challenges, options and opportunities to launch the demand for city bus transit. Partly the demand for city transit may be emanated from the unoptimal utilization of the existing service supply i.e., the imprudent policy measure to tackle the problem. Addressing the demand for city bus transport service would assist in the future planning for urban public transport system of the city. Therefore, conducting this study is timely and sought to answer the following fundamental questions. First, is the existing public transportation service sufficient in Mekelle city? Second, is there a demand for city bus public transport service or not? Third, what city public transport policy should be introduced in order to solve the problem?

## **PREVIOUS WORKS**

Cities are locations having a high level of concentration and **meditation** of economic activities and are complex spatial structures that need to support by well organized and manageable transport system. Rapid growing of urbanization and urban economics of developing countries are suffering of timely and efficient urban public transport service and strongly affect the urban mobility. Urban productivity is highly dependent on the efficiency of the transport system (**Rodriguez, 2010**) and its primary function is to carry people from an origin to a destination within the shortest possible time and least cost. Public transport in developing countries is essential for the urban poor who have to rely on walking; cycling and road based public transport to meet most of their travel needs (Michael, 2010).The relationship between demand and supply in urban public transportation system is an important component of the city economy as it satisfies certain demands and easy to examine efficiency of the system. Increased urbanization and population growth, urban expansion, disposal of amenity lead to have demand for the dependence on motorized transportation service like bus, train, plan and others (Zuidgeest 2005,**Neil et al, 2006**).

Urban transport sector, however, has many problems in most developing countries. Inadequate and poor quality infrastructures, mismatch between demand and supply, and increased rate of accidents are some of the problems. These problems are triggered by interrelated trends such as urban population growth and (rapid, unplanned, and uncoordinated) growth of cities and population density, low income, spatially separated land uses and lack of resources which can transport large numbers of people at low cost.

## **MATERIALS AND METHODS**

### **THE DATA**

**This paper seeks to examine the demand for city bus transportation service in Mekelle city, northern Ethiopia using household survey.** In order to plug the above objectives, the study has designed to gather data and necessary information from various sources. Focus group discussion with the principal agents of public institutions like, City Transport Office, City Municipality, City Administration, and Taxi owner's association are part of information sources. The survey is specifically designed for service users residing far distant from the central city to capture relevant and significant information about the seriousness of the problem and to feed reliable input for decision makers. Primary data is collected through well structured questionnaire from urban public transport users via purposive sampling technique from the entire city. A total of 400 urban public transport service users are involved in the survey.

### **METHODOLOGY**

Following the conceptual frame, the analysis consists of advanced model of two equations. The first equation which is the probability that city resident's choice the city bus transit the so-called choice equation. The independent variables involved are household head income, household size, households' income and other individual attributes of the family member. The model is the outcome of probit analysis, which is commonly employed in transport mode choice situations. Accordingly, it is important to look the decision of individual in demanding this mode of transportation service and socio economic status of the decision maker in affording the tariff

rate. Heckman (1979) selection model is applied to address the decision in demand for city bus transportation service. In order to deal with the problem, the solution is adopted using the method developed by Heckman (1979) and is specified as follow:

$$(1) Y^*_i = \beta' X'_i + U_i \quad (1)$$

Where  $Y_i^*$  is latent or unobserved variable that couldn't captured rather factors that can influence it are observed and  $X'_i$  vectors of independent variables, refers regression parameters and  $U_i$  is the normal disturbance term with zero mean and constant variance. The probability of demanding city bus for public transport by individuals given the explanatory variables is captured by running a probit regression model with value 1 if individual demands city bus transport, 0 otherwise.

*The second equation called the expenditure equation. The dependent variable is the expenditure willingness to pay by the city bus transit users per specified distance or destination. The potential of individual in affording the tariff rate of bus transit with the same distance to the existing minibus taxi but 35 percent lower than the existed taxi tariff rate is taken. Only the individuals which make a decision in demanding city bus as a means of public transport with equal distance nevertheless lower tariff rate (35 percent) to the existed public transport service (taxi or) in its effect on money expenditure is used.*

$$W^* = \begin{cases} 1 & \text{if } W^* \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

$$\ln W = \beta' X'_i + U_i$$

Where (2)

$W$  = In expenditure by individual bus users

$\beta'$  = Parameter estimates for the  $i$  explanatory variable

$X'$  = vector of explanatory variable

$U_i$  = error term

## RESULTS

It is clear that urban commuters in Mekelle city have to devise coping strategies to travel to and from work. On the supply side, the overriding challenge is to provide an efficient, reliable, and demand responsive urbanized public transport service. Though this challenge requires holistic approach with the involvement of all stockholders in private and public sectors, still now neither of these is eager to operate city bus transport service. From the demand side, urban commuters have devised a number of strategies to cope with high transport cost as well as inadequate and unreliable public transport system. The most important coping strategies are people walking long distance from residential area to places of works and from work place to residential although

such practice engenders unnecessary high opportunity cost. In solving the chronic problem, the right way is introducing of city bus transport service and above 96% of respondents reply show strong demand for this type of mode of transportation.

Heckman two step method of estimation is incorporated in order to address the demand for city bus transport system. Part of the surveyed households is not in a position of demanding city bus. Selection of households is occurring in a linear regression model when data on the dependent variable is missing non-randomly conditional on the independent variables. The standard approach in Heckman selection is assume that the error terms of the decision equation in demanding for city bus and the outcome equation in affording of the tariff rate for the new transport mode are non correlated = 0) .

Binary probit method of estimation is applied to address whether individual is in a position of demanding for city bus or not. Once individual becomes voluntary in demanding for city bus as one mode of urban transport, his/her potential in entertaining the bus tariff rate is examined using OLS method. However, the nature of sampling technique is non random, errors term of the two equations(decision and outcome ) are correlated and OLS coefficients are subjected to biased, inefficient, and the regression of decision model on outcome model for the selected sample would not give consistent estimates. Table 1 below illustrates the decision (being choice of the city bus transport service) and outcome models (the potential in affording the tariff rate for the new transport mode) estimation. The affordable price for various prices is set out in comparison to 35 percent lower than the existed minibus tariff rate.

Table 1: Heckman Selection Model (regression results with sample selection) – Robust

Waldchi2(12)= 6459.58    Prob > chi2 =    Log likelihood = - 554.7056 0.0000			
Demand for city bus(Selection model)		(Outcome model)	
Variables	Estimate	lnAffP(Outcome model)	Marginal effects
Family size	-.081* (.0460)	-.0003 (.002)	
HH income	.00008 (.00006)	-2.37e-06 (3.37e-06)	
head income	-.00003 (.00009)	8.02e-06* (4.02e-06)	8.02e-06
Distance home-work	.127*** (.028)	-.007*** (.001)	-.0073
Distance from taxi fermata	.672*** (.118)	-.00 (.005)	
Total travelers/HH	.044 (.033)	-.007 (.005)	
Head secondary	-.210*** (.047)	.004*** (.002)	.0047

Head tertiary	.092*** (.032)	.002** (.001)	.0029
Head privates business	.626*** (.134)	-.004 (.006)	
Head civil servant	.569*** (.134)	-.005 (.004)	
lnExisting taxi/baggage tariff	1.27*** (.121)	.539*** (.005)	.536
Work purpose	.299*** (.011)		
_cons	.824*** (.297)	-.851*** (.014)	

\*\*\* Significant 1%, \*\* significant 5%, \* significant 10% ,Std. error in parenthesis  
Source: Survey 2011.

## DISCUSSION

There are only two mode of urban public transportation in Mekelle city with share of minibus taxi 56.2 percent and share of baggage 43.8 percent and the society is significantly suffering to get right service at the right time and right place due to low potential of the existing service supply. Regression results show that long distance from the center of the city where minibus tax starts business affects the average trip supposed to take care by the service operator negatively.

More than 98.6 percent of respondents are demanding the city bus transportation service. Using Hickman two step method of analysis, it is quite sensible to address the demand for city bus and the capacity in affording new tariff rate which is 35 percent less than the existing minibus taxi rate for those demanding it. In the selection equation, positive coefficients indicated city residents are demanding for city bus transit and while coefficients with negative coefficient not demanding. Being civil servant and personal man household heads, the probability of demand for city bus is positively correlated and significant as 5 percent level of significance. Likewise, residents far distant from working area, the probability of demand for the city bus transport service increases.

Similarly, for an increasing tariff rate for the exiting urban public transport, the probability of demand for city bus significantly increases. This finding confirms the result of McFadden (1974), demand for the alternative mode increases when the tariff rate for the existing mode increases *citrus paribus*. Urban travelers are demanding for the city bus transport service positively and significantly for work purpose than other reasons .Meanwhile, inhabitants of the city residing far distance from the taxi fermata (departure point) and from their working place positively demand for the new mode of transport at 5percent level of significant *citrus paribus*.

Results of the outcome equation interpret like to OLS results. For an increasing the price for the existing mode by one percent keeping others constant, the probability of affording for the new tariff rate (city bus tariff) increases by 53.6 percent at 5 percent level of significance. This result

implies that the existing urban transport tariff rate affects the livelihood of the residents and travelers eager to demand alternative mode of transportation. On the other hand, being secondary and tertiary educated household heads, the probability of affording to the new mode tariff is increased by 0.5 and 0.3 percent respectively as compared to other level of head education like illiterate head.

Far distance residents from work place though they demand for the new mode of transport service, the potential in paying to the new tariff rate decreases by 0.7 percent which obscures that still they are demanding for more lower tariff rate. Furthermore, far distance to the taxi fermata (centered), by one kilometer, significantly increase the demand for city bus with probability of 12.7 percent. Hence, the area which exhibited great demand but are not yet sufficiently covered by the current urban public transport net work, would be prioritized for the introduction of city but transportation service.

## CONCLUSION

This study analyzes the demand for city bus public transportation service in Mekelle city, Ethiopia. A total of 400 service users are involved from the entire city. From the foregoing discussion, in a plain language, there is mismatching between the demands for and supply of the existing urban transport service. As a result, travelers are suffering of getting the service at the right time and right place. Urban transport service operators are individuals and run the service in such way to benefited themselves and practice differently from the normal market environment. The supply side is confined by technical and managerial problems and yet not solved rather aggravated. Hence, the demand for alternative mode especially city bus is significantly increased at 35 percent lower tariff rate than the existing mini bus taxi rate.

## RECOMMENDATIONS

It may safely to recommend that the existing route management system should be revised and administered by the market instead of mentoring by the third part. Increasing the minibus taxi mode of public transportation might be a sound intervention to solve the problem of service supply inequity at different areas of the city during peak time. However, introducing city bus either by the city administration or private sector is an indispensable solution to the supply problem and the new tariff rate should be reasonable and addressed to accommodate the livelihood of the society.

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