Thesis

By

MICHAEL

POKU-BOANSI

Department of Planning,

Kwame Nkrumah University of Science and Technology

THE DETERMINANTS OF URBAN PUBLIC TRANSPORT SERVICE PRICING IN GHANA- A CASE STUDY OF THE KUMASI METROPOLITAN AREA

May,2008

THE DETERMINANTS OF URBAN PUBLIC TRANSPORT SERVICE PRICING IN GHANA - A CASE STUDY OF THE KUMASI METROPOLITAN AREA.

By

MICHAEL POKU-BOANSI, BSc. (Planning)

A Thesis Submitted to the Board of Postgraduate Studies,

Kwame Nkrumah University of Science and Technology

in partial fulfilment of the requirement for the degree

of

DOCTOR OF PHILOSOPHY

Department of Planning,

Faculty of Planning and Land Economy,

College of Architecture and Planning

May, 2008

I hereby declare that this submission is my own work towards the Ph.D. and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any degree of the University, except where due acknowledgement has been made in the text.

MICHAEL POKU-BOANSI/20034888	....	14-05-08
Student Name and ID	Signature	Date

Certified by:

PROF. KWASI KWAFO ADARKWA	....	14-05-08
Supervisor	Signature	Date

Certified by:

DR. K.D. KESSEY	....	14-05-08
Head of Department	Signature	Date

Abstract

The primary function of transportation is to carry people and goods from an origin to a destination within the shortest possible time and at the least cost. Urban mass transport continues to be a high priority social obligation of governments throughout the world. In some jurisdictions, it is the prime responsibility of national governments, while in other localities it is a state or local government responsibility. Mass 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. The primary objective of sustainable public transport should be for pricing to generate sufficient revenues to ensure an adequate, efficient and continuing supply of public transport services. In many urban areas, transport services have been treated as public services or instruments of social policy. In such environments, prices rarely reflected the cost of provision of these services and facilities, as a result of which subsidies have been given, and strict commercial and management accounts have often not been maintained. A clear distinction needs to be made, however, between keeping costs low (and hence allowing prices to be low even where costs are fully covered) and keeping prices lower than costs (the issue of subsidies).

In Ghana, pricing of road transport carrier services especially in the private sector has been a persistent problem for all the stakeholders in the transport sector and characterised by indiscriminate fare increases. This phenomenon keeps reoccurring year after year suggesting that there is no way forward, especially when there are reviews in fuel prices. This indiscriminate pricing system always leads to other problems including high food prices, high inflation as well as instances of very nasty quarrels and violence between commercial drivers, their assistants and passengers at various lorry stations. There is also the problem of persistent strike actions by drivers demanding higher fares, which the government and passengers often resist. The reason has been that, the urban mass transport services serve most people in the urban areas; especially, the low and middle income earners. This group of people consider this form of transport mode as the only affordable means of commuting. This goes a long way to affect productivity since most workers use these means to get to their work places. There ought to be a more rational and objective system of determining the impact of the review of fuel prices on urban transport fares which should serve as a basis for Government to negotiate new fares with

the unions following review of prices of petroleum products. In doing this, research questions such as: what factors affect the cost of operating urban mass transportation services?, What pricing model should be used to price urban mass transport services in Ghana?, And what policy options would enhance sustainable pricing and provision of urban mass transport services in Ghana? were discussed with the aim of finding relevant answers to them.

On the basis of the above research questions, the major objective of the study was to develop a model with which prices of urban transport services can be determined following review of prices of petroleum products. The specific objectives of this study were to identify the factors which affect the cost of operating urban transport services; to investigate how the interests of the various stakeholders in the urban transport industry can be harmonized through pricing; and to identify policy options that may be considered in the pricing of urban mass transportation services. Data for the study were derived from two main categories; Primary and Secondary sources. Primary data were gathered from the field through the use of questionnaires, observations and interviews while secondary data were gathered from secondary sources such as books, newspapers, journals, and Internet; among others.

From the review of literature, it was found that, the factors that affect the demand for urban transport services are transport fares, trip duration, population of the community, income of household/commuters, employment status of the inhabitants, access level and the vehicle kilometres operated. However, from the field data analysis, it was found that, the factors that affect the demand for urban public transport services in Ghana are population size, fare levels, trip duration and employment status. Population is the most significant factor that affects the demand for urban transport services. This is supported by the fact that it contributes about 57.3 percent of the total variation in the demand for urban transport services in Kumasi. Trip duration comes next, contributing about 10 percent to the total variability in demand. This is the time a passenger takes to undertake a journey from an origin to a destination. It involves the time the passenger spends in waiting for a vehicle, boarding time, journey time and walking time, if applicable. Transport fare and employment status contribute 6.1 and 1.6 percent respectively to the overall demand of urban transport services in the study area.

Review of literature further shows that, the factors that affect the cost of providing urban transport services are tyre cost, insurance cost, fuel cost, trip length, overhead cost, hours worked, lubricant cost and cost of spare parts and maintenance. However, from the analysis of field data, it was found that, seven factors affect the cost of providing urban public transport services in Kumasi. They are tyre cost, fuel cost, trip length, overhead cost, hours worked, lubricant cost and cost of spare parts and maintenance excluding insurance cost. Tyre cost is the most significant factor that affects the cost of providing urban transport services in Kumasi and is shown by the fact that, it contributes about 40.4 percent of the total variation in the cost of providing urban transport services in Kumasi. Fuel, the thorniest issue within the industry, contributes about 31.9 percent to the cost of providing urban transport services in Kumasi. Overhead cost comes next, contributing about 14.9 percent to the total variability in the cost function. Trip length contributes about 5.1 percent to the total cost of providing urban transport services in Kumasi. Hours worked, which is the actual number of hours the vehicles are operated, including time spent loading, unloading and refuelling; lubricant cost, spare parts/maintenance cost contributed 0.3 percent, 0.6 percent and 2.0 percent respectively.

The cost model which was derived after the analysis of field data is aimed at estimating the cost of providing urban transport services in Kumasi. This model can be used to estimate the cost to be incurred in providing urban transport services which is critical to the overall supply function in Kumasi and in pricing of transport services. From the analysis, it was revealed that, there was a reasonably strong relationship between number of vehicular trips as a dependent variable and the following independent variables: cost of vehicle, demand for transport services, number of vehicles available and profit level as independent variables. The most dominant factor was the cost of the vehicles used in the provision of the service. From the analysis, it was revealed that, cost of vehicle contributed about 47.7 percent to the overall supply situation within the urban transport industry. This implies that, for prospective investors, the cost of the vehicle was the most important decision criterion. The next factor was the demand for the service. Demand for the service contributed about 17.1 percent to the total variation in the supply of vehicles in the urban transport industry. This was followed by the total number of vehicles operating within the industry, contributing about 16.5 percent. The final factor was profit levels which contributed 2.2 percent to the overall variance in the supply of urban transport services in the study area. Having determined the factors affecting demand, cost and supply of urban transport services, the study also established the factors which influence passengers' willingness to pay for the service. Four variables namely service level, sex of passengers', employment status and household size are the key determinants of passengers' willingness to pay for urban transport services.

Based on the various interest highlighted, it was found that, the main pricing technique needed to harmonize these interests of the stakeholders within the urban transport industry was a combined pricing strategy which uses the cost of providing the service, demand for the service and the competitive factors within the industry as the basis for pricing. It can therefore be argued that, based on the various interests of stakeholders, the appropriate pricing model that should be used in pricing within the urban transport industry in the study area should be a model that considers the cost factors (such as fuel cost, insurance cost, spare parts and maintenance cost, insurance cost, lubricant cost, tyre cost and overhead cost) in providing urban transport services as well as the demand factors (such as population, income of household, employment status, access level and vehicle kilometres operated) that also influence the demand for urban transport services. In addition, the competitive factor that is manifested in the supply level should be factored into the pricing model. By using this approach, the various interests of the stakeholders will be harmonized; hence, reducing the possibilities of conflicts among them.

The study is expected to add to existing knowledge and understanding in the field of urban transport service operations and pricing which is a crucial component of the urban transportation policy. During the course of the study, several areas of research were identified. Some of them include how the use of new vehicles help reduce vehicle operating costs (VOCs) and subsequently make urban transport service affordable and the prospect of empowering District Assemblies (DAs) to license, regulate and monitor vehicle operators under their jurisdiction.

Acknowledgement

For a period of three years, I have accumulated a considerable debt of gratitude to many. My first and biggest debt of gratitude is to my supervisor Professor Kwasi Kwafo Adarkwa, Vice Chancellor, Kwame Nkrumah University of Science and Technology for his guidance, patience, constructive criticisms, contributions and suggestions which have shaped my work and made it what it is.

I enjoyed great support and encouragement from my family and wife. I would like to particularly mention the material, emotional and spiritual support from my wife, Nana, my parents: Anthony Yaw Boansi and Margaret Appiah and my brother Rev. Fr. Raphael Donkor Boansi. I am very grateful to Mr. Daniel Obeng Atuah for the support offered me during my research, particularly in the form of financial and brotherly advice.

I am grateful to CODESRIA for offering me the opportunity to be a laureate of their small grant programme for Ph.D students which gave me the privilege to enjoy some financial support during the period of my research. I am also grateful to the Department of Planning of the College and Architecture and Planning for the opportunity to undertake my Ph.D research. Again, I wish to acknowledge the field advice and support I received from Dr. Daniel Kweku Baah Inkoom, Director of MPhil/Ph.D Programme at the Department of Planning during difficult periods of my research.

I wish to express my profound gratitude to Professor Enos Okoko formerly of the Department of Urban and Regional Planning, School of Environmental Technology, Federal University of Technology, Akure – Ondo State in Nigeria but now with the Department of Planning, KNUST for his contributions in completing this research. His useful comments and suggestions have been much appreciated. I am indeed grateful to Professor E.K.A Tamakloe, Dr. Imoro Braimah, Director of SPRING Programme, Department of Planning, Professor Sam Afrane, Dean of Faculty of Planning and Land Economy, Mr. Ronald Adamptey, Mr. Clifford Amoako, Mr. Sam Adoboe and Mr. Emmanuel Abeka for their interest in ensuring that I completed on schedule.

I have enjoyed the companionship of a number of people during my studies. I would like to mention George Sagoe-Addy, Anaab, Mr Boison, Mrs Ivy Abu, Achaab, Ebo, Yaw Sarpong, Isaac, George Dove, Francis, Nervous, Aba, Kaminta and Abraham Edusei. By acknowledging some people by name, I mean to thank others too, on whom they in turn rely.

Table of Contents

Contents Page

CHAPTER SIX: FINDINGS, CONCLUSION AND RECOMMENDATION

List of Maps

List of Figures

List of Tables

List of Appendices

List of Abbreviations

AC	Average Cost
ADT	Average Daily Traffic
AMA	Accra Metropolitan Assembly
APK	Annual Passenger Kilometres
APR	Annual Passenger Revenue
APT	Annual Number of Passenger Trips
CBD	Central Business District
CEPS	Customs, Excise and Preventive Service
CVM	Contingency Valuation Method
DTC	Delhi Transport Corporation
DUR	Department of Urban Roads
DVLA	Driver and Vehicle Licensing Authority
ERP	Economic Recovery Programme
GCTA	Ghana Co-operative Transport Association
GLSS	Ghana Living Standard Survey
GNP	Gross National Product
GNRTCC	Ghana National Road Transport Coordinating Council
GoG	Government of Ghana
GPRTU	Ghana Private Road Transport Union
HDM	Highway Development and Management
IRS	Internal Revenue Service
KMA	Kumasi Metropolitan Assembly
MC	Marginal Cost
MMTCL	Metro Mass Transport Company Limited
MR	Marginal Revenue

MRT	Ministry of Road Transport
OLS	Ordinal Least Square
OSA	Omnibus Services Authority
PROTOA	Progressive Transport Owners Association
SAP	Structural Adjustment Programme
SAEMA	Shama Ahanta East Metropolitan Assembly
SPSS	Statistical Package for the Social Sciences
TAMA	Tamale Metropolitan Assembly
TMA	Tema Municipal Area
UTO	Urban Transport Overview
UTP	Urban Transport Project
VOC	Vehicle Operating Cost

List of Pictures

CHAPTER ONE
OVERVIEW OF THE STUDY

1.0 Background

The primary function of transportation is to carry people and goods from an origin to a destination within the shortest possible time and at the least cost. The urban sector in most developing nations accounts for at least 50 percent of Gross National Product (GNP) and in some countries over 70 percent. Cities in developing countries often spend 15 percent to 25 percent of their annual expenditure on the transport system. It is common also to find that 5 percent to 10 percent of urban household income in developing countries is spent on urban transportation and in some cases, the figure is 15 percent or more (World Bank, 2004). Urban mass transport continues to be a high priority social obligation of governments throughout the world and in some jurisdictions, it is the prime responsibility of national governments, while in other localities, it is a state or local government responsibility (Hensher, 2002).

Mass 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. Urban mass transport is provided mainly by buses and competition best guarantees the efficient supply of mass transport services. Urban mass transport through franchises and concessions, can mobilize low-cost operations to provide the best quality of service and the best price for any resource capability. The informal sector can also contribute effectively to satisfy demand in competitive markets. Mass transportation contribute both to city efficiency and to the needs of the poor in the larger cities, but can impose heavy fiscal burden, and should only be adopted within an integrated planning and financing structure ensuring effective coordination of modes and affordable provision for the poor (Gwilliam, 2000). The World Bank has estimated that there are 6.5 trillion passenger kilometres per year in 3 million vehicles, of which over 2 million operate in cities (World Bank, 2004).

Urban mass transportation is one of the key priority areas for urban planners. This is because transportation is a very important input for the distribution of goods and services in urban areas. The ultimate objective in providing mass transportation is to best meet the transport requirements of people; and it remains an important and necessary component of the urban transport system. Several studies such as Amos (2004) and Black (1995) have highlighted this important role of urban mass transportation in the urban economy of most countries. All over the world, transportation of people en mass has become an indispensable feature in any urban transport system. The role of the mass transport system is not only to cater for those who cannot afford a personal means of transport, but also to reduce traffic congestion and, most importantly, to economize in the use of road space, which is very expensive to provide especially in developing countries.

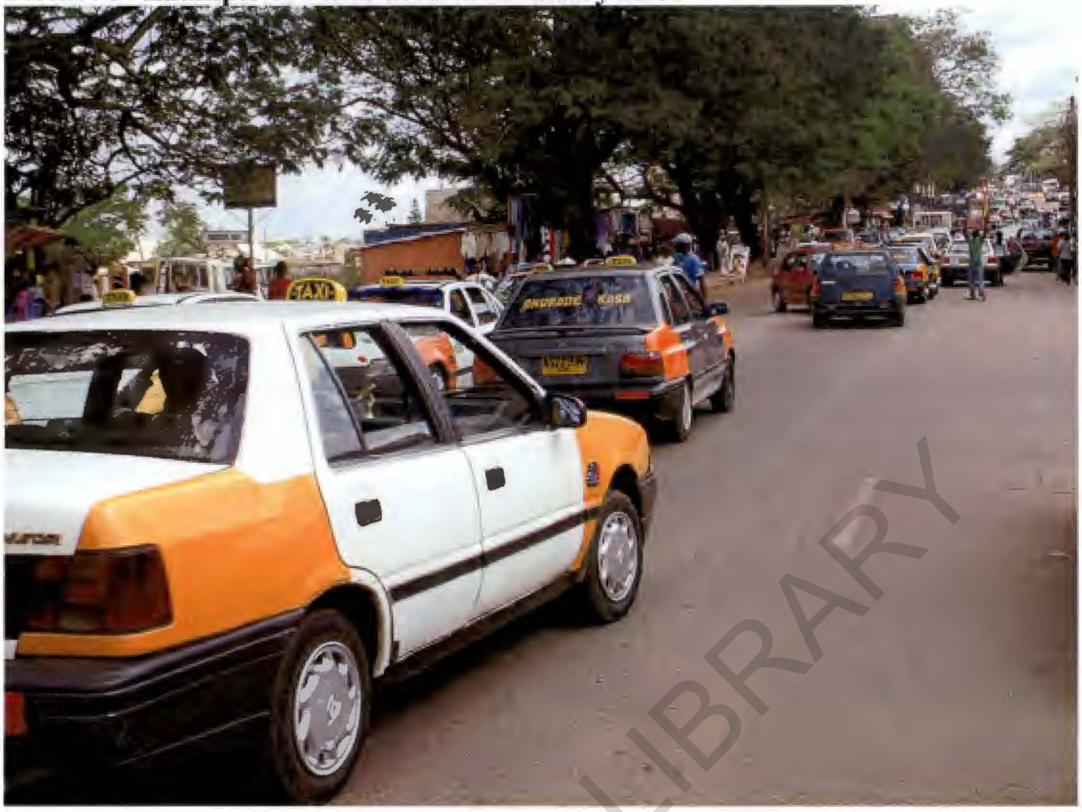
Mass transportation services are provided by both the private and public sectors throughout the developed and developing countries. Again, governments' provision of the services to the public has been found to be disappointing in many countries. In Ghana, the services are provided by both the private sector in the form of Trotro (see Pictures 1 and 2), which is the dominant mode and Taxi (See Picture 3) services and the public sector in the form of Metro Mass Transit (See Pictures 4 and 5). After the demise of the public urban mass transportation system, in the late 1970s, the private sector became the leading provider of the urban transportation services in Ghana providing trotro services. Trotro is defined as an efficient and inexpensive, minibus used for short distance travel. It evolved from the Ga language word "TRO" meaning three pence, that is, the penny coins that were in use in the colonial days of the Gold Coast, now Ghana. Those vehicles charged each passenger three pence per trip; hence it was dubbed "Tro - tro". Though the penny is no longer used, and the fare has been inflated in multiples, the old name still stands, probably as a reminder of the transport service that operated in those good old days when life was simple and easy - going (Ross, 2006).

The trotro system in Ghana operates mainly with small buses with a capacity of 18 passengers including Nissan Urvan and buses with petrol or diesel engine, four 750×16 tyres per vehicle. Ownership and usage of vehicles for personal means of transport have been growing much faster than the nation's ability to provide road space to accommodate the growth in travel demand by means of the private vehicle. Consequently, increases in traffic volumes and road congestion have caused substantial adverse impacts, especially on the large cities (Black, 1995). For example, in Kumasi, about 65 percent of vehicles that had been registered with the Driver and Vehicle Licensing Authority (DVLA) between 2000 and 2002 were taxis and private saloon cars. This has led to traffic congestion and long delays in traveling (Adarkwa and Tamakloe, 2001).

Picture 1: Example of Trotro Buses (33 Seater and 23 Seater Benz Buses)

Picture 2: Example of Vehicles Used as Trotro in the Study Area

Picture 3: Example of Taxis used in the Study Area



Picture 4: Example of a Bus used by Metro Mass Transit Limited

Picture 5: Large Bus and Midi Buses used in the Study Area

A greater percentage of traffic demand is served by the trotro system and Poku-Boansi (2003) has estimated that 75 percent of commuters in the Kumasi Metropolis are conveyed by the trotro service from home to place of work.

With the dominance of the private sector in the urban mass transportation service provision, fares charged have always been a source of controversy due to the objective of the service providers. It is therefore worth investigating into because, a brief interaction with drivers and commuters revealed that there are some reservations on their part regarding the level of prices charged for transport services. Transport operators, especially those in the private sector have always complained of operating at a loss because of the low fares they charge whiles consumers on the other hand have also complained that the fares they pay are too high. These conflicting interests have sometimes led to strike actions by vehicle operators, which ultimately affect productivity, since most people do not have the means of transport to go to work. Often, attempts by government to intervene have not been very successful (Daily Graphic, February, 2005). This is so because there is no mechanism to adjust fares quickly.

The trotros have been the mainstay of Ghana's public transportation system for many years, despite concerted attempts by successive governments to develop and maintain publicly organized state-bus services. Trotros are based on a range of vehicle types but have similarity in their purpose and mode of operations such as level of service provided, travel time and operating along specific route (Fouracre et al, 1994).

In Ghana, various governments have tried to provide an efficient mass transportation system because of its importance to the development of the economy. In 1980, the government made efforts to increase the supply of large buses and other mass transit vehicles including minibuses. As a result, it became government policy to waive import duty on commercial vehicles imported into the country. In addition, the age limit beyond which penalties were imposed on imported vehicles was also waived. This was specifically in respect of commercial vehicles with seating capacity of 10 or more (Adarkwa and Tamakloe, 2001). This policy, however, seems to have been abused since most of the vehicles on our roads are not roadworthy; hence, resulting in frequent breakdowns and pollution to the environment, to the discomfort of the consumer and the public in general. It was found that 92 percent of the vehicles used for the transport services, especially the minibuses, were over 20 years (Poku-Boansi, 2003).

Presently, special efforts are being made by the government to increase the supply of large buses to facilitate the inter and intra-urban transportation system. To this end, the government is currently making efforts to supply a large number of high capacity buses to enhance the public transport system in Accra, Kumasi and other cities (Daily Graphic, February, 2005). This, the government hopes, will make it easier for workers to reach their workplaces early without the hustle and bustle associated with the acute transportation system as well as minimize the quantity of petroleum products consumed in the country.

The primary objective, if public transport is to be sustainable, is for pricing to generate sufficient revenues to ensure an adequate, efficient and continuing supply of public transport services. Here, it may be mentioned that public transport also contributes to the reduction of congestion and environmental impact of road traffic. It is commonly argued that if urban public transport is to satisfy these objectives, it cannot be expected to cover its full costs. Urban mass transport is consequently subsidized in many major cities.

However, many of these cities are no longer in a position to fund such policies, and their mass transport sectors are facing deterioration as a consequence of inadequate funding. This process of decline is compounded by the fact that many governments have attempted to use the public transport industry as an instrument of social policy by simultaneously constraining fare levels and structures.

1.1 Problem Statement

In many urban areas, transport services have been treated as public services or instruments of social policy. In such environments, prices rarely reflected the cost of provision of these services and facilities, as a result of which subsidies have been given, and strict commercial and management accounts have often not been maintained. In consequence, it is being increasingly recognized within the public sector that such pricing practices lead to a number of outcomes which do not promote sustainable development, including:

- economic inefficiency with the resultant waste of resources;
- generation of insufficient funds to develop, operate and maintain transport infrastructure and services;
- creation of distortions in users' choice of mode of transport; and
- externalities in production (such as pollution) as well as externalities in consumption (in the form of congestion).

Divergences between prices and costs not only send the 'wrong signals' to the providers and operators of transport services when considering their investment decisions as well as their operating and maintenance plans, they also send the 'wrong signals' to consumers. For example, where railway prices incorporate infrastructure costs but road prices do not, consumer preferences between these two modes will be distorted. External costs, which are not reflected in prices, are another source of distortion. This is particularly the case with pollution and congestion externalities. One of the consequences of these practices is that insufficient revenue is generated to develop and or maintain transport services. In some sub-sectors, governments have turned to the private sector to assist in the financing, development and operation of these services. However, the maximization of private net benefits by the private sector does not necessarily coincide with the maximization of social benefits of the public sector and, consequently, conflicts arise. It is further recognized that if the private sector is to participate in transport service development, then its private benefits (revenues, including profit) will need to reflect its costs. In cases where insufficient revenues are derived from these sources, or where it is deemed necessary that other social or pragmatic reasons take precedence over commercial pricing principles, alternative policies will need to be developed.

According to Gwilliam (1996), the increasing separation of political decisions from managerial decisions, and increasing involvement of the private sector as suppliers of mass transport in environments subject to competitive pressures, are attempts to keep the costs of mass transport as low as possible. Improving efficiency of supply in such ways is always desirable. Gwilliam (1996), has again stated that, a clear distinction needs to be made, however, between keeping costs low (and hence allowing prices to be low even where costs are fully covered) and keeping prices lower than costs (the issue of subsidies). Pricing of road transport carrier services in Ghana, especially in the private sector, has been a persistent problem for all the stakeholders in the transport sector.

Pricing is a method of resource allocation. In the opinion of Litman (2003), there is no such thing as 'right' price; rather there are various pricing strategies that permit specific aims to be achieved. For example, pricing aimed at profit maximization may differ from that needed to maximize social welfare, facilitate sustainable development or maximize passenger numbers. Pricing normally performs certain functions which include rationing and allocating the use of competing resources; providing a signal on the need for, and viability of investment and helping in generating funds for the development of the related sector. Prices can have significant impacts on travel behaviour. Different types of pricing will cause different types of travel changes, which will provide different types of benefits and costs.

In Ghana, road transport operators always tend to increase fares indiscriminately. This phenomenon keeps reoccurring year after year suggesting that there is no way forward, especially when there are reviews in fuel prices. Another argument being put forward by operators is the persistent increase in prices of spare parts. This indiscriminate pricing system always leads to other problems including high food prices, high inflation as well as instances of very nasty quarrels and violence between commercial drivers, their assistants and passengers at various lorry stations (Daily Graphic, February 17, 2005). There is also the problem of persistent strike actions by drivers demanding higher fares, which the government and passengers often resist. For example, as reported in the February 17th edition of the Daily Graphic, 2005, some commercial drivers in the Kumasi Metropolis had unilaterally increased their fares in anticipation of increase in fuel prices. Taxi drivers were charging ¢5,000 (50GHp) from Kejetia to Tafo instead of ¢1,500 (15GHp) and the trotro drivers were charging either ¢1,000 (10GHp) or ¢2,000 (20GHp) instead of ¢700 (0.70GHp). This action resulted in scuffles and other unpleasant scenes.

The reason has been that, the urban mass transport services serve most people in the urban areas; especially, the low income and middle income earners. This group of people sees this form of transport mode as the most and, in some cases, the only affordable means of commuting. This goes a long way to affect productivity since most workers use these means to get to their work places. With the importance of urban mass transportation to the development of the urban economy, it is prudent that all stakeholders in the industry would have their objectives met through a pricing mechanism that tends to achieve that. This would help streamline activities and ensure sanity in the urban transport industry. On the basis of these problems, there were some emerging issues which need investigating, in order to help bring sanity into the industry as far as the issue of pricing was concerned.

In order words, there ought to be a more rational and objective system of determining the impact of the review of fuel prices on urban transport fares. This should serve as a basis for Government to negotiate new fares with the unions following review of prices of petroleum products.

1.2 Research Issues

From the situation in the industry, the research issues, which have emerged have been explained below.

The first is the various stakeholders or actors in the urban transport industry and the nature of their roles. These various stakeholders in the industry and their roles are shown in Table 1.1.

Table 1.1: Stakeholders in the Urban Transport Industries in Ghana and their Roles

Stakeholders	Category	Key roles
National Road Transport Coordinating Council	Public/Private Sector	Coordinate the activities of all transport unions in the urban transport industry.
Metro Mass Transport Company Limited (MMTCL)	Public/Private Sector	Providers of urban transport services
Ministry of Road Transport (MRT)	Public Sector	Formulate policies that seek to promote the interest of transport operators and passengers in the country
Ghana Private Road Transport Union (GPRTU)	Private Sector	Promote the interest of transport operators under its umbrella as well as provide urban transport services
Ghana Co-operative Transport Association	Private Sector	Promote the interest of transport operators under its umbrella as well as provide urban transport services
Progressive Transport Owners Association (PROTOA)	Private Sector	Promote the interest of transport operators under its umbrella as well as provide urban transport services
Cooperative Union	Private Sector	Promote the interest of transport operators under its umbrella as well as provide urban transport services
Passengers	Private Sector	Users of urban transport services, transport expenditure
Driver / Vehicle Operators	Private Sector	Members of the various transport unions whose interests are represented by their various unions

Source: Author's Construct, 2005.

According to Whyte (1984) and Chamber (1997), for any successful participatory process to be achieved, it is important to identify the stakeholders and empower them to participate in decision making. This was to help bring out all the relevant issues that may be central in achieving the objectives of the study.

The second is the issue of the cost of providing the transport services in urban areas. Different costs require different types of prices (Litman, 2002). It would be inappropriate to simply add up all the estimated external costs of driving and apply them as a fuel tax or fixed annual vehicle fee, since such prices do not accurately reflect economic costs. Of course, a variety of factors must be considered in determining appropriate pricing, including transaction costs, political acceptability and equity objectives. Optimal pricing requires balancing efficiency, equity and convenience. This will help assess the level of fares and also provide a good basis for developing a pricing model. This is critical to the study because, cost recovery is essential for the sustenance of the service or product provider. A comprehensive cost analysis of the operators in the industry is therefore very crucial to the outcome of the study.

The final issue is to examine the various pricing objectives and strategies in a normal economy, assess existing pricing strategies, if any, and then establish a strategy that will promote the development and growth of the industry. A normal economy according to Koutsoyiannis (1979) is an economy within which exist free entries and exits as well as perfect competition among firms. Again, he further argues that the products of the firms are perfect substitutes and that the price-elasticity of the demand curve of individual firms are infinite.

1.3 Specific Research Questions

In order to achieve the research objectives, the following specific questions were addressed:

1. What factors affect the demand for urban transport services in the study area?
2. What factors affect the cost of operating urban mass transportation services? Several factors affect the cost of providing urban transport services. These factors constitute the vehicle operating cost of service providers and they include fuel, insurance, spare parts, tyres and lubricants. What the study seeks to achieve is to establish the contribution of each of these elements to the vehicle operating cost.
3. What factors affect the supply of urban transport services in the study area?
4. What pricing model can be used to estimate prices of urban transport services following review of prices of petroleum products?
5. What policy options would enhance sustainable pricing and provision of urban mass transport services in study area?

1.4 Research Hypothesis

The null hypothesis expresses equality, implying that, the results observed in the study are not different from what might have occurred as a result of the play of chance. On the other hand, the alternate hypothesis expresses non-equality, implying that, the results observed in the study are different from what might occurred as a result of the play of chance. In a generic sense therefore, the null and alternate hypotheses are stated as follow:

$H_0 : \overline{X}_1 = \overline{X}_2$ Null Hypothesis

$H_1 : \overline{X}_1 \neq \overline{X}_2$ or $\overline{X}_1 \geq \overline{X}_2$ or $\overline{X}_1 \leq X_2$ Alternate Hypothesis

From the understanding of the definition of the null and alternate hypotheses, the following study hypotheses were formulated:

- The fares charged by the different categories of urban mass transportation modes are the same;
- The fares charged by the different categories of urban mass transportation modes are dependent on the cost of operations; and
- The fares charged by the different urban transport modes are dependent on impedance factors such as travel time and distance.

1.5 Study Objectives

On the basis of the research problems, the research issues and questions discussed, the major objective of the study is to develop a model with which prices of urban transport services can be determined following review of prices of petroleum products and operating factors.

However, the secondary objectives of this study are:

1. To identify the factors which affect the demand for urban transport services;
2. To identify the factors which affect the cost of operating urban transport services;
3. To identify the factors which affect the supply of urban transport services;

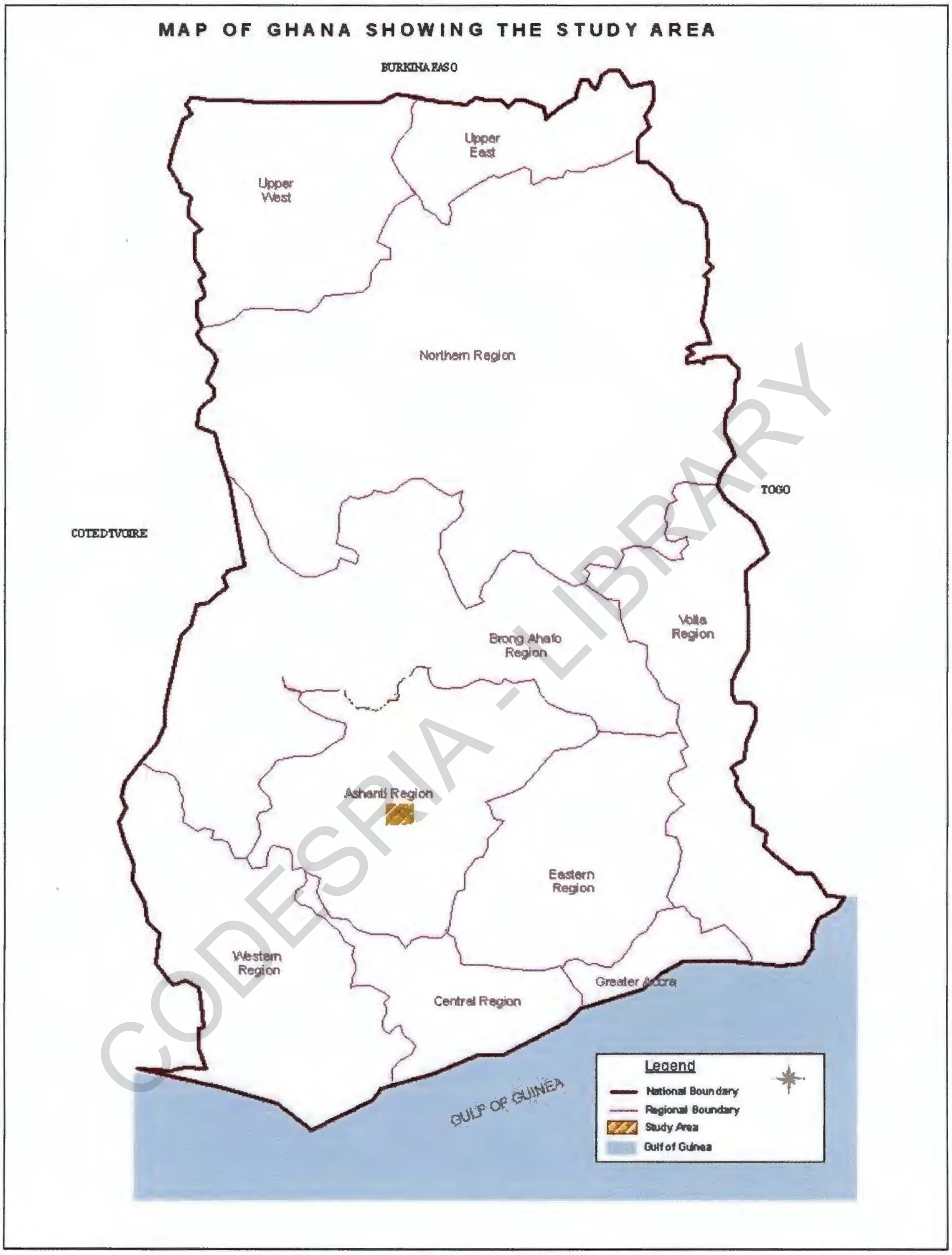
4. To investigate how the interest of the various stakeholders in the urban transport industry can be harmonized through pricing; and
5. To identify policy options that may be considered in the pricing of urban mass transportation services.

1.6 Study Scope

The scope of the study can be seen in two ways. Conceptually, the study was confined to the concept of pricing, pricing objectives and pricing strategies with the aim of using the understanding to investigate pricing of urban mass transport services in Ghana. Again, operations of the trotro services, taxi services and metro transit services were used as the basis for studying vehicle operations and pricing of urban mass transport services in Ghana. The study intends to develop an appropriate model for pricing urban transport services in Ghana.

Geographically, the study was carried out in the Kumasi Metropolitan Area (refer to Map 1). Five major arterial routes in the metropolis were selected for the study. The routes selected were based on high traffic volumes as well as high demand for mass transport services to establish the vehicle operating costs, fares and distances covered.

Map 1: Location of Study Area (Kumasi Metropolitan Area) in Ghana



Source: Kumasi Metropolitan Assembly, 2006

1.7 Study Limitations

The study faced some limitations. The first was the absence of proper record keeping on cost of elements that constitute the vehicle operation cost. This made the estimation of cost of operating urban transport services quite difficult. However, the data collected was validated with the data used for the analysis of the Highway Development and Management IV (HDM 4) for Ghana. The second, was the unwillingness of commuters and drivers to disclose the expenditure and revenue patterns which was to help estimate the ability to pay by commuters and profit margins or otherwise of operators. It must be stated however that, various tactful approaches such as collection and validation of the same data from more than one source and the use of pilot survey to help reveal deficiencies in the sampling frame and design were used. These measures were adopted to minimize the effect of these limitations in order not to affect the outcome of the study.

1.8 Relevance of the Study

This study is very relevant on three grounds. The first is that, it provides insights into the various principles of pricing that are essential to the urban mass transport industry in Ghana. The implications of these principles and lessons learnt for providing options for the industry to enhance efficiency in the service provision cannot be over emphasised. The second is that, it provides an insight into the objectives of all the stakeholders (i.e. operators, government and consumers) in the urban transport industry as well as issues that hinder or promote their interests. The third is that, the emerging issues in the study provide the grounds for further research particularly when it comes to discussing issues related to pricing of urban transport services.

1.9 Organization of the Study

The study is organized under seven main chapters. Chapter One gives an overview of the study which include the problem statement, research questions, study objectives, study scope, study limitation and organization of the study. Chapter Two presents varied literature on pricing strategies, pricing objectives and the role of urban mass transport services to development, among others. Chapter Three is concerned with the study methodology. This chapter details out methods used in data collection and analysis. Chapter Four presents' data gathered from the field surveys. Issues discussed under this chapter include passengers' trip making characteristics, passengers' socio-economic characteristics, vehicle operating characteristics and drivers' characteristics.

Chapter Five presents discussions on the demand and supply of urban transport services. Demand model, supply model and pricing model have been estimated and discussed in this chapter. Passengers' willingness to pay has also been discussed in this chapter. The final Chapter is devoted to the study findings, recommendations and conclusion. This was done under the study research questions and objectives. Recommendations derived from the study analysis have also been presented in this chapter.

CHAPTER TWO

STAKEHOLDER OBJECTIVES AND PRICING OF URBAN MASS TRANSPORT SERVICES

2.0 Introduction

Based on the definition of the research problem, the study objectives and the identified research issues, it is necessary to understand the concept of pricing, the role and importance of urban mass transportation as well as the objectives and interest of the various stakeholders in the urban mass transport industry. Various stakeholders in the industry have different objectives and interests which have a bearing on the performance of the sector. For example, the objective of a passenger or user of urban mass transportation services is to best meet travel needs, taking into consideration the cost he/she is charged. This charge is expected to be affordable and reasonable to the passenger. This objective sometimes conflicts with that of the service provider, especially the private entrepreneur, who aims at profit maximization (Button, 1982).

The obvious questions then are the following:

- What factors affect the cost of operating urban mass transportation services?
- How should the interests of stakeholders be harmonized to reduce conflict?
- What pricing model should be used to fix fares for urban mass transport services in Ghana? and
- What policy options would enhance sustainable pricing of urban mass transport services in Ghana?

These, therefore, provide the basis upon which the detailed survey was undertaken.

This chapter is very essential because, as our understanding of pricing and the role of urban mass transportation deepens and broadens, it was increasingly clear that many issues needed to be considered before prices or fares are determined to serve the interest of all and subsequently promote the growth of the industry. The understanding of the relevant literature is therefore necessary because, it provides lessons on how the complex issue of pricing takes place in other sectors and their impacts on the transportation industry as well as how it can be best used in the industry. Governments, consumers and operators as well as policy makers are therefore increasingly concerned about the role of pricing in the transportation industry. This concern is therefore important to reduce or prevent conflicts and strike actions.

On account of these issues, therefore, it is adequately convincing that the review of relevant literature for this purpose would provide a deeper understanding for the development of relevant models (concepts) for the study. This is important, because various schools of thought have different views on pricing which are significant for the development of the industry. Indeed, all the various schools of thought somehow agree that price is the only element in the marketing mix that produces revenue; all others represent costs. It is also one of the most flexible elements of the marketing mix. The review of literature is therefore intended to understand the varying views in relation to pricing, pricing objectives and pricing strategies which can be adopted for the industry in Ghana. It is from these that the case of the urban mass transportation sector would be analyzed. The objective therefore was to establish which of the strategies can best be used for the urban mass transportation industry in Ghana.

2.1 Urban Mass Transport and Economic Development

Transport is pivotal to economic development. On the one hand, the achievement of economic growth and poverty reduction requires good physical access to resources and markets, whilst on the other; quality of life is generally dependent on the quality of physical access to employment, health services, homes, education and other amenities. Fromm (1965) identified that transport has the following four broad functions in assisting economic development:

1. As an input into the production process permitting goods and people to be transferred between and within production and consumption centers';
2. Transport improvements can shift production possibility functions by altering factor costs and reducing levels of inventory tied-up in the production process;

3. Increasing factor mobility and permitting factors of production, especially labour, to be transferred to places where they may be most productively employed; and
4. Increasing the welfare of individuals by extending accessibility to a range of facilities and providing superior public goods, such as improved social cohesion and security.

Macroeconomic studies have shown that investment in transport promotes growth by increasing the social return to private investment without 'crowding out' other productive investment. Many economists have emphasized the linkage between transport provision and economic development by distinguishing direct from indirect or multiplier effects. The former stem from the cost and time savings resulting from transport improvements, whilst the latter flow from the substantial input of resources needed to construct modern transport infrastructure. Indeed, some argue that efficient transport services are a necessary prerequisite for national economic development, while others argue that economic development is a complex process with transport permitting the exploitation of the natural resources and talents of a country. Transport is thus seen as a necessary, but not sufficient, condition for development (Rostow, 1960).

According to Litman (2002), economic development refers to progress toward a community's economic goals, including increases in economic productivity, employment, business activity and investment. Transportation investments and subsidies are often justified with the claims that they will stimulate economic development (Litman, 2002). Although most economic activities require transportation, not every transport improvement increases economic development. Polices that violate the market principles such as under pricing, distortive taxes and inefficient investments can increase mobility but reduce overall economic development.

Transport policies tend to increase economic development if they:

1. Increase and improve cost-effective transportation options;
2. Result in more cost effective transportation facility and service investments;
3. Increase transport system efficiency (reduce total costs or increase total benefits);

4. Create more efficient pricing by making prices more accurately reflect marginal costs;
5. Create more neutral public policies; and
6. Reduce resource costs, such as the amount of fuel consumed per unit of transport, and the amount of land devoted to transport facilities.

In many cases the perceived economic development that results, consists more of economic transfers (some businesses or areas benefit at the expense of others) than true net economic gains. Inadequate transport is a significant limiting economic factor and transportation investments are the most cost effective way to improve transportation and increase economic development.

Many researchers have studied the roles and adverse effects of transportation on cities. To this end, Blonk (1979) has stated that transport is a catalytic force, both as an agent vital for economic growth and as an agent for economic decline where economic resources and conditions as well as human endeavour are insufficient. In this vein, efficient transportation should be seen as a factor that unifies the entire economy, which facilitates development. Kwakye, Turner and Grieco (1994) have also noted that a well functioning transport system helps to maximize the economic growth or progress of cities.

Mass transportation remains an important and necessary component of the urban transport system. Several studies have highlighted this important role of urban mass transportation in the urban economy of most countries. All over the world, transportation of people en mass has become an indispensable feature in any urban transport system. The role of the mass transport system is not only to cater for those who cannot afford a personal means of transport, but also to economize the use of road space, which is very expensive to provide especially in developing countries (Tamakloe, 1975). Amos (2004) has further argued that transport services that are privately owned and operated are widespread throughout developed and developing countries but government's provision of the services to the public has been found disappointing in many countries.

Since the demise of Ghana's public urban mass transportation system in the late 1970s, the private sector became the leading provider of urban transportation services in Ghana. This scenario, according to Kwakye and Fouracre (1998), was as a result of the Economic Recovery Programme (ERP) and the Structural Adjustment Programme (SAP) pursued by the government. These policies paved the way and laid more emphasis on self-sufficiency and private participation in the national economy of which transportation is crucial. For example, information on vehicle importation from Customs, Excise and Preventive Service (CEPS) revealed that, total vehicle registration in Ghana grew by 22 percent per year during the period 1995-2000 while the number of bus registration increased by 36 percent during the same period. This occurred in spite of the introduction of the 10-year age limit for vehicle imports in 1997 (Benmaamar, 2003).

Tamakloe (1975) again revealed that, the trotro services in Kumasi for instance had a total route length of about 77 kilometres with about 135 stops spaced at an average distance of half a kilometre apart. It was also revealed that the trotro system had about 370 minibuses (refer to Pictures 2 and 3) carrying about 108,000 (88 percent) passengers a day while the Omnibus Services Authority (OSA) had a fleet of 30 buses carrying 13,000 (12 percent) passengers per day. He further argued that the trotro system provided an almost ideal service especially during peak hours when passengers arriving at any trotro station had the equal chance of getting on a vehicle. This shows that the trotro system forms an integral and an indispensable part of the mass transportation system in the major cities in Ghana. However, vehicles providing the trotro services in Ghana were characterized by the following:

- torn seat covers with exposed metal frames;
- being too old;
- being rickety;
- being too dirty; and
- having poor ventilation.

Based on the size and type of vehicles used for the trotro system, it made it less comfortable primarily because of the low level of service they offered. It must be emphasized that even with government's efforts in the re-introduction of public mass transportation services, it is still likely that the private sector will continue to play an important role in urban mass transportation system in Ghana.

2.2 Nature and Problems of Urban Transportation

According to Gwilliam (1996) and Rodrigue (2003), cities are major origins of growth in most developing countries with urban population expanding at a high rate (more than 6 percent annually or doubling in size in less than 12 years). He further states that urbanization has been one of the dominant contemporary paradigms as a growing share of the global population lives in cities. Considering this trend, urban transportation issues are of foremost importance to support the passenger and freight mobility requirements of large urban agglomerations. Transportation in urban areas is highly complex because of the modes involved, the multitude of origins and destinations, and the amount and variety of traffic.

Traditionally, the focus of urban transportation has been on passengers as cities were viewed as locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions and leisure activities. However, cities are also locations of production, consumption and distribution of activities linked to movements of freight. Conceptually, the urban transport system is intricately linked with urban form and spatial structure. Urban transit is an important dimension of urban transportation, notably in high density areas, as viable cities are linked with efficient transit systems.

The World Bank (2004) report on Urban Transport Overview (UTO), categorizes the urban transport sector into the following elements:

- The urban road system;
- Traffic management systems (for increasing the efficiency of available road space);
- Non-motorized transport systems (facilities for pedestrians and people powered vehicles);
- Urban transport institutions (planning, design, finance, implementation, and enforcement); and

- Urban public transport:
    a) On-street systems (for buses, trolley-buses, trams);
    b) Mixed on-street and off-street systems (bus lanes, bus ways and light rail); and
    c) Off-street systems (metros and commuter rail).

The report further states that urban motor vehicle ownership and usage is growing even faster than the urban population. Vehicle ownership growth rates of 15-20 percent per year in developing countries are not uncommon (World Bank, 2004). This has been largely caused by growing per capita incomes in urban areas. Ownership and usage of vehicles is growing much faster than the ability of developing and industrial countries to provide road space and alternative means of coping with the problem. Severe traffic congestion and its adverse side effects on the urban economy, environment, and society are being felt in many cities.

The growing reliance on private vehicles has resulted in a substantial decline in the share of total trips being provided by urban public transport systems in many cities. In some cases there has been an absolute decline in urban public transport patronage and service levels. Similarly, the travel space for pedestrians and people-powered vehicles has rapidly declined. This trend is particularly unfavourable for the urban poor as they are typically captive riders and often dependent on public transit for access to employment (World Bank, 2004).

Rodrigue (2003), further states that cities represent places with a high level of accumulation and concentration of economic activities. They are complex spatial structures to be supported by transport systems. The most important transport problems are often related to urban areas, especially when urban transport systems, for a variety of reasons, cannot satisfy the numerous requirements of urban circulation. Urban productivity is highly dependent on the efficiency of its transport system, notably to move labour, consumers and freight between several origins and destinations. The growing complexity of cities has been accompanied by a wide array of urban transportation problems. These include problems of service provision with its related issues. One of such issues critical to an efficient transport service industry is that of pricing. This is critical because, the continual existence of service providers in the industry can be threatened by poor pricing strategy. The same, however, cannot be said of the consumer, but this may be manifested in conflicts and increasing long queues emanating from people's unwillingness to invest in the provision of the service.

The urban transport system in Ghana is characterized by the congested central areas of the cities, poor quality of services from public transport operators, high exposure to road accidents, and poor environmental standards. This is seen in long commuting times and journey delays, lengthy waiting times for public transport both at and between terminals, high accident rates and localized poor air quality (Kwakye and Fouracre, 1998; Adarkwa and Tamakloe, 2001).

According to the UTO report, the consequent increase in traffic volumes and road congestion has caused substantial adverse impacts, especially in the largest cities of developing countries. These impacts are expressed in several dimensions. They include;

- Economic : -where business efficiency is adversely affected by traffic delays;
- Environment :- where slow moving traffic, combined with an ill-maintained stock of vehicles, is making the megacities in developing countries the most polluted in the world; in some large city centers road traffic accounts for 90-95 percent of health-threatening lead and carbon monoxide in the air and a major share of suspended particulate matter; and
- Social: - where sprawling land-consuming urban structures and deteriorating traffic conditions are making the journey to work, particularly for some of the very poor, excessively long and costly (World Bank, 2004).

Kwakye and Fouracre (1998) also established that the urban transport problems in Ghana, is as a result of the following:

- Poor terminal or lorry-park organization and management, which restricts the optimum use of the available public transport capacity;

- The use of small vehicles for public transportation, which contributes significantly to congestion on the roads;
- The low affordability threshold of the majority of the urban poor, who can only meet low public transport fares;
- Lack of funding (local and foreign) available to operators, who are thus unable to replace their existing vehicle stock with more modern, efficient and comfortable buses;
- The low capacity of the existing road network, and its inefficient use;
- Poor planning and control procedures for land use development, resulting in additional traffic congestion and safety hazards;
- The low standards of road traffic awareness, vehicle maintenance, and driver behaviour, which contribute to the high accident rates, particularly amongst pedestrians and children; and
- The poor upkeep of vehicles which causes excessive vehicular emissions.

Recognizing the inability of the public sector to provide adequate finance for urban transport infrastructure and, in many cases, the relative inefficiency of the public sector in providing urban transport services, the public sector is increasingly relying on the private sector to provide these facilities and services. It is estimated that, at least 80 percent of all urban bus services provided around the world are now privately owned and operated (World Bank, 2004). Increasingly, cities are arranging concessions or other arrangements for the private provision of urban transport infrastructure and services. In short, cities are moving from providers of transport infrastructure and services to facilitators (World Bank, 2004). It must be said that unless prices in the industry are efficient and attractive enough to realize this desire of private sector involvement in the provision of the service, the desire to have them providing the services will not be realized. This therefore calls for the consideration of the interest of all stakeholders within the urban transport industry.

It must be noted that, pricing of urban transport services can be a means of solving most of urban mass transport problems such as congestion, long queues and pollution and also make the service reliable, efficient, safe and sustainable.

2.3 Stakeholders in Urban Mass Transportation Services in Ghana

There are various stakeholders, namely urban mass transport operators, passengers and the government in the urban transportation industry of Ghana. These stakeholders, as have already been stated, have their interest which they hope to achieve in the discharge of their functions. These interests have a great bearing on how transport operators do business in the industry. This section outlines the interests of each of the stakeholders since these will be relevant to the pricing of services provided.

2.3.1 Government

Urban public transport continues to be a high priority social obligation of governments throughout the world. In most jurisdictions, it is the prime responsibility of national governments, while in other localities it is a state or local government responsibility (Hensher, 2002). Governments all over the world have specific objectives they hope to achieve in the provision of mass transportation services. These objectives are often the same irrespective of who provides the services; that is, private or public. It is an objective of the central government to reduce congestion on the road space because of the increase in the use of saloon cars and taxis. Thus the use of mass transportation will economize the use of road space, which is very expensive to provide especially in developing countries. To realize this objective, individuals and firms will have to investment in the provision of urban mass transport services in the industry.

Gwilliam (1996) has again stated that, because of the increasing involvement of the private sector as suppliers of public transport, this could contribute to keeping the costs of public transport as low as possible. Improving efficiency of supply in such ways is always desirable. He however, argued that a clear distinction needs to be made between keeping costs low (and hence allowing prices to be low even where costs are fully covered) and keeping prices lower than costs - the issue of subsidies. Litman (2004) further argued that, failing to charge cost recovery price, under price transportation services relative to other consumer goods, represents a market distortion. Of course, there may be other reasons, he contended, which may result in the under pricing and subsidizing a particular form of transportation. But this is not justified as a general strategy according to Mitric and Prud'homme (2002), since it can be a drain on public finance and a substitute for efficiency.

The rationale and purpose of transportation pricing policies are rarely explicit. However, governments usually seek to maximize the 'public interest' when deciding on the pricing of transportation. Here, 'public interest' embraces a number of objectives; in particular; economic efficiency - where managerial and technology efficiency is combined with the least cost of service provision. It also means that the full cost of transportation is accounted for. This objective, therefore, tries to seek the interest of the consumer and the producer in determining fares. According to Bennathan and Walters (1979), governments in pricing transportation services try to ensure cost recovery on the part of the producers and affordability on the part of the consumer. Another objective of government is to ensure strong political interest such as to reduce deficits from the importation of crude oil which is one of the major inputs in the transport industry. There is also an objective of government to minimize producer profit. It tries to ensure gross trading surplus where total revenue exceeds operating cost of the producer. It also tries to seek environmental sustainability where the consumer benefits from effects of pollution from the provision of the service.

In Ghana, the Urban Transport Project (UTP) outlines government's objectives in the urban transport sector (Kwakye and Fouracre, 1998). These objectives include the following:

- making transport operations safe, efficient and economically viable;
- ensuring that transport services are effective and satisfy the needs of transport users;
- ensuring sustained growth in the transport industry through adequate investment; and
- strengthening the transport linkages with neighbouring countries.

In the urban context, these national transport objectives can be translated into the following specific objectives:

1. Improving the accessibility of the urban community to places of residence, employment, education, leisure, shopping and other important amenities;
2. Enhancing urban travel opportunities at affordable cost for the less mobile, including the urban poor, non-vehicle owners, children, the elderly and the handicapped;
3. Enhancing the quality of travel by ensuring comfort, safety and efficiency in the provision of urban transport services;
4. Minimizing the cost of providing services and facilities through most cost-effective methods; sustaining urban transport development initiatives, and making future development more proactive in respect of urban development, rather than being retro-active; and
5. Minimizing the environmental impact of transport by avoiding emissions and visual intrusion from vehicles.

In achieving the above objectives, the Government of Ghana has provided large capacity buses (see Pictures 4 and 5) to resuscitate the metro mass transportation services. Through this initiative, Government aims at reducing the consumption level of energy used in transportation thereby reducing amount of money used in importing petroleum products as well as reduce the time workers spend in going to and from their workplaces while making the service affordable to them (Daily Graphic, February 2005). Lessons from the above discussions were used to assess how to effectively harmonize the interests of government with those of other stakeholders in the determination of appropriate pricing for the industry.

2.3.2 Transport Operators

In providing transport service, the producer seeks to achieve certain objectives. These include making the service convenient, comfortable, reliable, and efficient, as well as cost effective and, above all, maximize profit. According to Black (1995), the economic rule for price setting in the competitive market is that the price should equal the marginal cost (cost of producing the last or marginal unit).

The first order condition for profit maximization occurs at the point where

$$\frac{d\pi}{dx}=\frac{dR}{dx}-\frac{dC}{dx}=0 \Rightarrow \frac{dR}{dx}=\frac{dC}{dx} \quad \text{.........(1)}$$

Where $\frac{dR}{dx}$ is the slope of the total revenue curve (marginal revenue);

$\frac{dC}{dx}$ is the slope of the total cost curve (marginal cost); and

$\frac{d\pi}{dx}$ is the slope of price.

Thus Marginal Revenue (MR) = Marginal Cost (MC). Given that MC > 0, MR must be positive at equilibrium and since MR = Price (P), the first order condition may be written as MC = P. Price is therefore set at the level at which the demand curve intersects the marginal cost curve as shown in Figure 1.

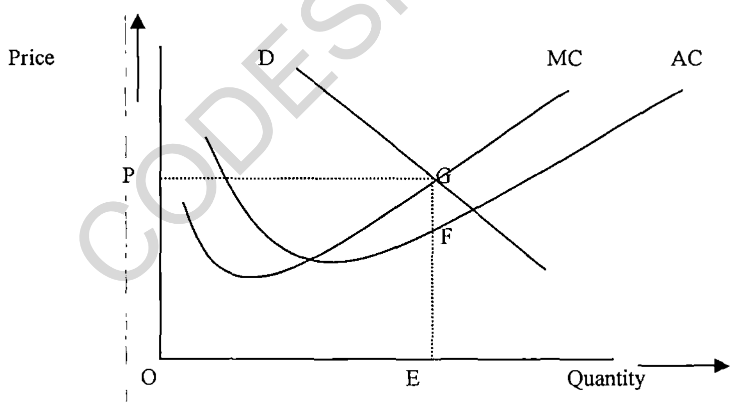


Figure 1: Pricing in a Normal Market.
Source: Black (1995)

From Figure 1, Price and Quantity are determined by the intersection of the demand curve (D) and the marginal cost curve (MC) at point G. At quantity OE, the average cost curve

(AC) is below the marginal cost curve. Average revenue is EG and average cost is EF, so there is a profit of FG on each unit sold. The cost of the marginal unit is just equal to what some purchaser is willing to pay. This yields the most efficient allocation of resources and maximizes social welfare. Black (1995) has again stated that in a normal free market situation, (refer to Figure 1) the demand curve intersects the marginal cost curve at an output where the average cost is increasing, so that the marginal cost is higher than the average cost. If the price is set equal to the marginal cost, then the average revenue will exceed average cost, resulting in total revenue exceeding total cost hence representing profit for the firm.

However, a situation can arise as seen in Figure 2 where the demand curve crosses the marginal cost curve at an output where the average cost is decreasing, and the marginal cost being lower than the average cost. If price is set equal to the marginal cost, average revenue will be less than the average cost and total revenue will be less than total cost resulting in the firm's loss. This is called a decreasing cost industry (refer to Figure 2), and unfortunately, it applies to transit where fixed cost is larger than variable cost. The marginal cost of transit system operates at less than capacity; they could carry more with little increase in cost. This therefore implies that, if price is set equal to the marginal cost, transit operators will lose money.

A possible remedy as stated by Black (1995) is average cost pricing, which many utilities use. Price is set equal to the average cost rather than the marginal cost and since the average cost will be equal to average revenue, total cost will also be equal to total revenue resulting in the firm's break even.

Mathematically, Marginal Cost (MC) $= \frac{d\pi}{dq} = b + 2cq$ ....(2)

Average Cost (AC) $= \frac{\pi}{q} = \frac{a}{q} + b + cq$ ....(3)

Slope of AC = derivative of $\frac{\pi}{q}$

$$\Rightarrow \frac{d}{dq}\left(\frac{\pi}{q}\right) = \frac{1}{q}\left[\frac{d\pi}{dq} - \frac{\pi}{q}\right] = \frac{1}{q}[MC - AC] \qquad (4)$$

If average cost curve is sloping downwards, $\frac{d}{dq}\left(\frac{\pi}{q}\right)$ will be less than 0, implying MC–AC < 0. This will further result in MC < AC and at the lowest point on the AC curve, the slope will be horizontal. That is, $\frac{d}{dq}\left(\frac{\pi}{q}\right) = 0$ and this means, MC–AC = 0. MC = AC at the lowest point. In similar vein, MC > AC when AC curve is rising.

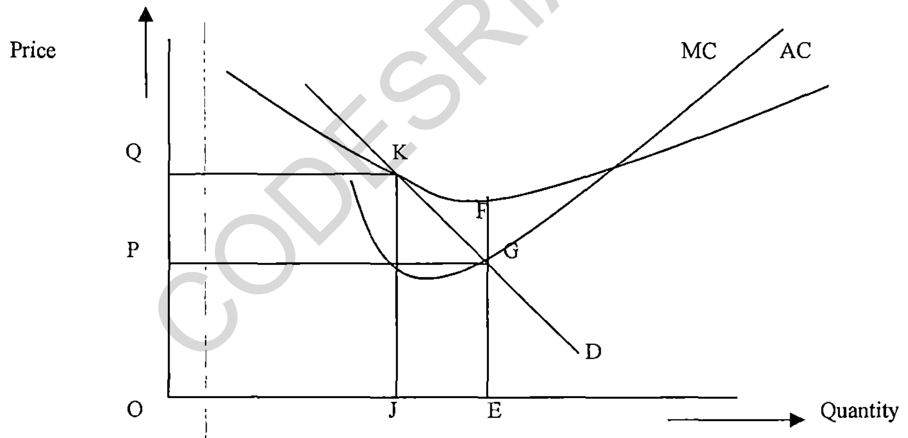


Figure 2: Pricing with a decreasing cost industry.
Source: Black (1995)

From Figure 2, the demand curve and marginal cost curve intersect at point G, which is the economically efficient solution. However, at quantity OE, the average cost of EF is greater than the average revenue of EG, and there is a loss of FG on each unit sold. An alternative is average cost pricing, based on point K, where the demand curve and average cost curve intersect. This is a break-even solution, but it is inefficient because consumers represented by the distance JE are willing to pay more than marginal cost of supplying them.

Profit maximization is the traditional motivation of private enterprise undertakings. The actual price level in this case depends upon the degree of competition in the market (from each mode; trotro, taxis and large buses). Where competition is considerable, then no single supplier has any control over price and must charge the price determined by the interaction of supply and demand in the market as a whole (Button, 1982).

2.3.3 Passengers

Within the urban context, the objective of passengers is to best meet travel needs, taking into account the following:

a) Effectiveness - where there exist an appropriate mix and form of transportation that provide right service to meet people's mobility needs;
b) Efficiency - where what they pay for brings about maximum service;
c) Equity - where similar services in similar areas are provided at the same cost, comfort, safety, minimum travel time; and
d) Affordability - where they can pay for the services they enjoy.

The transportation requirements of consumers include an enormous range of trips made by individuals for a variety of purposes between locations all over the urban area. The last objective happens to be the key expectation of passengers when fares are being determined. Users of transportation services have several yardsticks when measuring the quality of transportation services between two points. They are:

i. Speed;
ii. Accessibility : measured in lapsed time between the decision to use transport and obtaining access to it;
iii. Cost of service;

iv. Level of service offered (travel time, comfort, etc);
v. Reliability; and
vi. Frequency of the user's trip among others.

Passengers in Ghana expect that whatever fares the operators charge should take into consideration their ability to pay since most of them spend about 5.8 percent of their disposable household income on transportation (Ghana Statistical Services, 2000). They also expect that the fares they pay relate to the level of service provided by transport operators. Like the service providers, lessons learnt from the above discussions was used in the determination consumers' ability to pay.

2.4 Concept of Pricing

Pricing refers to fees and financial incentives, including fares, fuel taxes, road tolls, parking fees, vehicle insurance premiums, and other vehicle charges (Litman, 2002) and according to Kotler and Armstrong (1998), price is all around us. It is the amount of money charged for a product or service or the sum of the values that consumers exchange for the benefit of having or using it. It must be said that price goes by many names: **rent** for an apartment, **tuition** for education, **fee** to a physician or dentist, **rate** for utilities, **interest** for money borrowed and **fare** for taxi, bus, and airline or railway services, among others (Schwartz, 1981; Kotler, 2000).

According to Litman (2003), price also refers to perceived, internal, variable costs; that is, the direct incremental costs that an individual consumer trades off in exchange for using a good or service. For example, the price of travel generally includes the fare, vehicle expenses, travel times, risk and discomfort that an individual bears, but not external cost they impose on others (such as congestion delay, crash risk or pollution cost borne by others), or costs a consumer bears individually, such as general taxes used to fund roadways that an individual pays regardless of their travel habits. For the purposes of this study, pricing refers to the amount of money paid for the use of transport services. In order words, it is the cost incurred for the use of transport services, either passenger or freight.

Litman (2002) has argued that a vehicle, route or travel time that imposes lower costs should have a lower fee, and a vehicle, route or travel time that imposes higher costs should have a higher fee. This type of pricing results in economic efficiency. Efficient prices convey information about the costs of producing goods and the value that consumers place on goods. From this perspective, there is no need to charge travelers for sunk or fixed costs, since these are non-marginal, or to structure vehicle fees so they fully recover the costs of facilities and services. Lee (1997) has also stated that others emphasize cost recovery pricing, which can be justified on three grounds.

The first, Lee (1997) contends, is horizontal equity, which implies that users should get what they pay for and pay for what they get. If users pay less than the total cost they impose, somebody else subsidizes their consumption. The second is that cost recovery represents long-run marginal costs, that is, the full costs of providing a facility or service over its lifetime. The third justification is economic neutrality. Since prices in most markets are based on cost recovery, transport services should be priced comparably. Such pricing encourages consumers and managers to use resources efficiently.

Lee (1997) further states that some people emphasize the importance of pricing that reflects vertical equity objectives, that is progressive and includes provisions for people who have special disadvantages, such as discounts for children, elderly and disabled groups. Others emphasize administrative convenience and transaction costs. This tends to favor fixed pricing, with little or no difference between different types of vehicles or travel conditions. Such pricing is sometimes also promoted for the sake of horizontal equity that is, charging all users an equal fee.

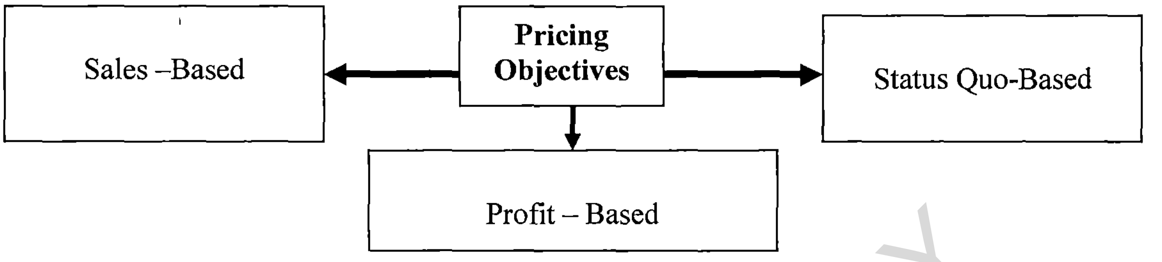
Kotler and Armstrong (1998) have argued that historically, price has been the major factor affecting buyer's choice. This, they say, is still true in poor nations, among poorer groups and with commodity products or services. However, non-price factors, it is said, have become more important in buyer choice behaviour in recent decades. Litman (2003) has again stated that efficient pricing is an important market principle that provides market signals that can result in the optimal use of resources. Efficient prices indicate the full costs of providing a good or service and the value the consumers place on using it. Prices that are too high or too low reduce market productivity, equity and overall consumer benefits. According to Litman (2003) and Kageson (2003) there are calls that transportation should be charged cost recovery prices; that is, with prices set to provide enough recovery to fund the entire operation. Prices can provide many specific transportation benefits, including reduced traffic congestion, increased travel options, consumer savings, environmental protection and more efficient land use, depending on the type of pricing and other factors.

Prices can also have significant impact on travel behaviour. Different types of pricing can cause different types of travel changes, which provide different types of benefits and costs to society. For example, distance-based fares tend to reduce total vehicle trips and trip distances, providing reduction in most external costs as well as causing shifts in modes if travel alternatives are good (Litman, 2003). This section therefore discusses the various pricing objectives and strategies and how relevant they will be to the pricing of urban mass transport services in Ghana.

2.4.1 Pricing Objectives

According to Evans and Berman (1997) as well as Kotler and Armstrong (1998), a pricing strategy should be consistent with and reflect overall goals of the company or service provider. They contend that, there are three general pricing objectives (see Figure 3) from which a firm or service provider may select. They include Sales-Based, Profit-Based and Status Quo-Based.

Figure 3: Pricing Objectives



Source: Evans and Berman (1997).

From Figure 3, sales-based objective in pricing is one of the three main objectives in pricing any service or product. This type of objective orients firms towards high sales volume and expands a company's share of sales relative to competitors (Nagle and Holden, 1995; Evans and Berman, 1997; Kotler, 2000). It sees sales growth as a major step leading to market control and sustained profit. Kotler (2000) has again stated that, such firms, in their effort to gain high sales volume adopt penetrating pricing, where low prices are used to capture the mass market for a good or service. It is a proper approach if consumers are highly sensitive to price changes. Penetrating pricing also recognizes that, a high price may leave a product vulnerable to competition whiles low prices discourage actual and potential competitors (Nagle and Holden, 1995).

It therefore follows that, a transport service provider whose aim is to capture large market shares must place more emphasis on consumers' ability to pay and not the cost of providing the services. Thus, for such an operator, there is the need for subsidies for his operations since prices charged are likely to be lower than the cost of providing the service. This objective however is often sought by state owned or public sector operated transport services providers such as the Metro Transit Company Limited even though it may try to seek some profit.

The next objective in pricing is profit – based. This objective orients a firm's strategy towards some type of profit goals. It ranges from maximization of profit to recovery of cost. With profit maximization goals, high profits are sought. Skimming pricing is employed to attract the market segments that are interested in quality or status. It uses high prices to attract customers concerned with service quality, uniqueness or status rather than price (Evans and Berman, 1997; Kotler, 2000).

From the above discussions, it must be stated that, it is mostly firms operating different modes that may use this objective. This can be explained by the fact that, all transport modes use the same routes while competing for the same consumers. Prices charged by different modes therefore, are guided by issues such as vehicle operating cost, comfort, waiting time, travel time, convenience and level of service. It must be stated that this objective is mostly sought by private firms or individuals providing transport services in the urban industry.

The final objective in pricing is the status quo-based. According to Evans and Berman (1997), this type of objective is sought by firms that are interested in continuing a favourable business climate for their operations or in stability. This form of objective, according to Schwarzt (1981) and Kotler (1999), is used if a firm is faced with intense competition or changing consumer wants. Profit is less important than survival. As long as prices cover the variable cost and some fixed costs, the company stays in business. However, survival is a short-term objective. In the long run, the service provider must learn how to add value or face extinction.

From the foregoing discussions, it is worth noting that this objective is mainly sought by firms that have failed to achieve the sales or profit based objectives as a result of operational problems or market difficulties such as high cost of inputs, inflation, low prices, etc.

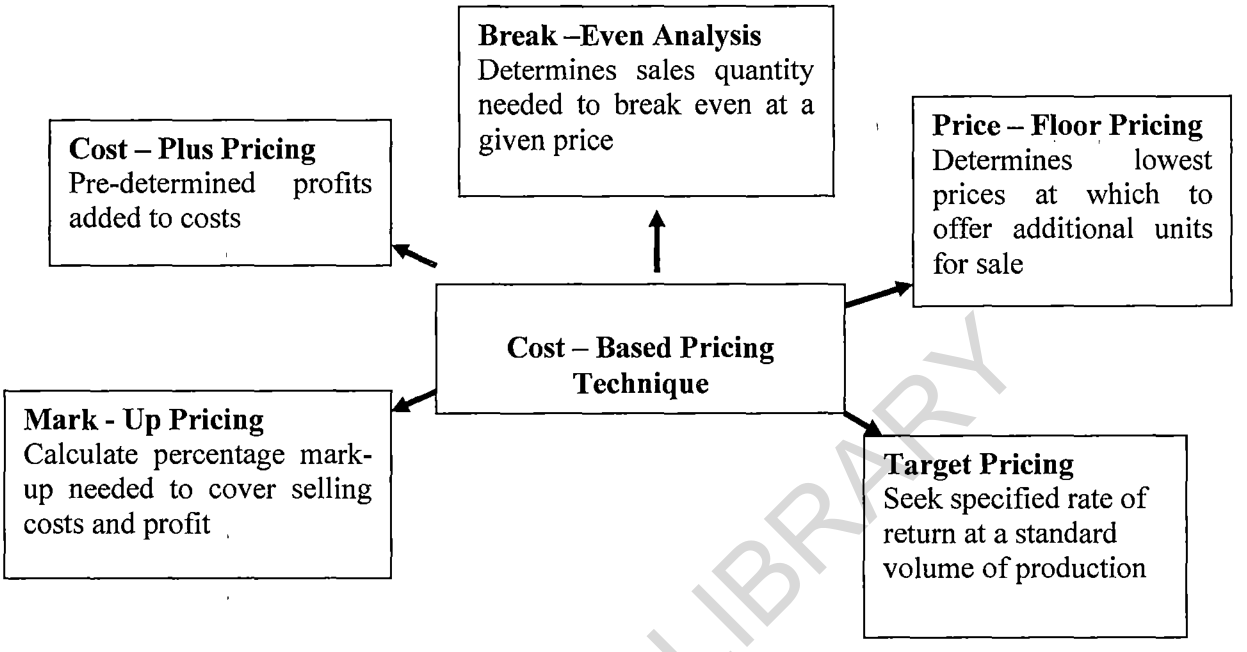
With the understanding of the concept of pricing and using the various pricing objectives which have been discussed by Evans and Berman (1997) as well as Kotler and Armstrong (1998), it was realized that, urban transport service providers adopted the sales based objective. The rationale for this is that the interests of the various stakeholders are somehow served by the pursuance of such an objective. For example, this objective serves the main interest of service providers which is to recover cost and possibly make profit while at the same time meeting that of consumers which is also to place more emphasis on consumers' ability to pay.

2.4.2 Pricing Strategies

Kotler and Armstrong (1998), have stated that the price a company charges for its product or services will be somewhere between one that is too low to produce a profit and one that is too high to attract any demand. According to Evans and Berman (1997), a pricing strategy may be cost, demand or competition based. When the three approaches are integrated, combination pricing is involved. This section discusses the various pricing strategies and establishes how relevant they will be to the pricing of urban mass transport services. This is a crucial step in arriving at an acceptable price to all stakeholders.

The first pricing strategy is cost–based, where a firm sets prices by computing merchandise, service and overhead costs and then adding an amount to cover its profit goal. Cost-based prices are rather easy to derive because there is no need to estimate elasticity of demand or competitive reactions to price changes (Kotler, 2000). There is also greater certainty about costs than demand. Finally, cost-based pricing seeks reasonable profit since it is geared towards covering all types of cost. When used by itself, cost-based pricing does have some significant limitations. It does not consider market conditions, the full effects of excess plant capacity, competitive prices, the product or service phase in its life cycle, market share goals, consumer's ability to pay and other factors (Nagle and Holden, 1995; Evans and Berman, 1997; Kotler, 2000). Examples of cost-based pricing as shown in Figure 4 are Cost-Plus Pricing, Markup Pricing, Price-Floor, Breakeven Analysis and Target Profit Pricing.

Figure 4: Cost –Based Pricing Techniques

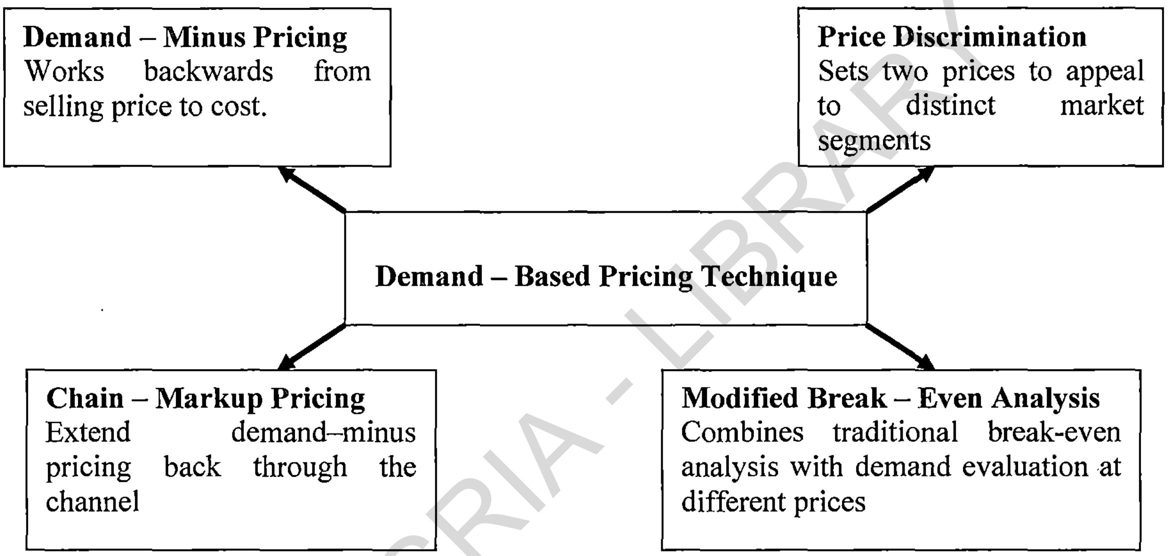


Source: Evans and Berman (1997)

From Figure 4, it can be seen that all the examples of cost-based pricing techniques aim at cost recovery. For example, Mark-Up pricing strategy uses a percentage mark-up needed to cover selling cost as well as make profit. Indeed this pricing technique may be applicable in an industry where the interest of the service provider is paramount. It therefore follows that this pricing strategy serves the interest of transport operators in the urban transport industry. This is so because, transport operators seek to cover their cost of providing transport services as well as make some profit on their operations.

Another pricing technique is demand – based pricing. With this strategy, a firm sets prices after studying consumer desires and then ascertaining the range of prices acceptable to the target market (refer to Figure 5). This approach, according to Evans and Berman (1997) as well as Kotler and Armstrong (1998), is used by companies that believe price is a key factor in consumer decision making. It identifies a price ceiling which is the maximum amount consumers will pay for a given good or service. If the ceiling is exceeded, they contend, will result in consumers making no purchases. Its level depends on the elasticity of demand and consumer objective price regarding the particular good or service (Hanssens et al, 1990). It requires research into quantities that will be purchased at various prices, sensitivity to price changes, the existence of market segments and consumer's ability to pay. Examples of Demand – Based Pricing techniques are Demand – Minus Pricing, Price Discrimination, Chain – Markup Pricing and Modified Break – Even Analysis.

Figure 5: Demand – Based Pricing Technique



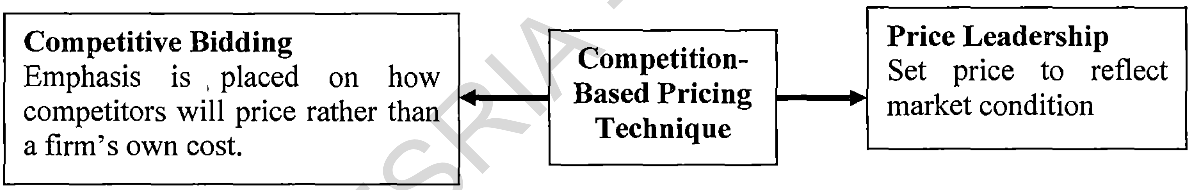
Source: Evans and Berman (1997).

The types of demand-based pricing techniques as shown in Figure 5 lay more emphasis on the consumers' ability to pay for the service or product. For example, the price discrimination technique sets prices for different categories of consumers since it aims at enticing different market segments. Higher prices are offered for inelastic segments whiles lower prices are offered for elastic segments.

It is worth noting that this pricing strategy will best fit the pricing of different transport modes of the urban transport industry, i.e. minibus, taxis and the metro mass transit services. This is so because each mode offers a service with certain characteristics all aimed at attracting certain category of passengers. This means, for example, that passengers who will like to enjoy higher levels of comfort may have to pay much higher than those who will not experience the same level of comfort.

The third pricing strategy is competition – based. In competition-based pricing, a firm uses competitors' prices rather than demand or cost considerations as its primary pricing guideposts. The company may not respond to changes in demand or costs unless they have an effect on competitors' prices. It can set prices below the market price, at the market price, or above the market price, depending on its customers, image, marketing mix, consumer loyalty and other factors. This approach is applied with firms that are similar or sell similar items. Competition-Based Pricing is popular, simple and has no reliance on demand, price elasticity or cost per unit (Evans and Berman, 1997; Kotler and Armstrong, 1998; Kotler, 2000). Examples of Competition-Based Pricing technique are shown in Figure 6. They are Price Leadership and Competitive Bidding.

Figure 6: Competition – Based Pricing Technique

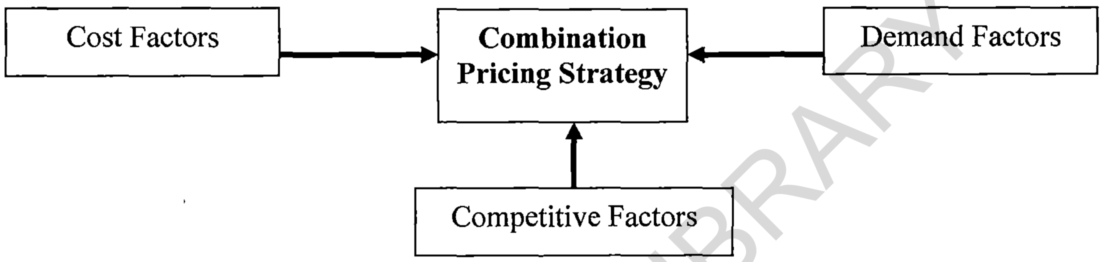


Source: Author's Construct, 2005.

From Figure 6, it can be said that competition – based pricing technique places more emphasis on issues above the market conditions, below the market conditions and at the market conditions. All this is aimed at arriving at a price that reflects the market situation. In the urban transport industry, this strategy may not exist because operators provide different transport services i.e. the minibus, taxi and metro mass transit services.

The final and most realistic pricing strategy is the combination pricing (Nagle and Holden, 1995; Evans and Berman, 1997). Although cost, demand and competition-based pricing methods are useful separately, aspects of all should be integrated when necessary. This is done often in practice. From Figure 7, it can be seen that it is essential that companies and service providers integrate their cost, demand and competitiveness when pricing their products and services (Kotler, 2000). This will help them to price their products or services realistically and efficiently. It must be noted that in the urban transport industry, this pricing strategy may be the best form of pricing since issues (such as costs, demand and competitiveness) reflecting the interest of stakeholders are taken into consideration.

Figure 7: Combination Pricing Technique



Source: Evans and Berman (1997)

With the understanding of the various pricing strategies, the study adopted the combination pricing strategy to assess the existing pricing mechanism and if possible, develop an appropriate pricing model for the pricing of urban mass transport services in Ghana. The rationale for this is that, key issues such as cost, demand and competition which are crucial within the industry are factored into the determination of an appropriate pricing of transport services. Prices then tend to reflect the reality and meet the aspirations of all the stakeholders within the industry.

Having established the technique to adopt for the study, techniques and approaches used in the pricing of transport services in some countries were reviewed. This was to serve as a good basis to compare theory with practice and bridge the gap if necessary.

2.5 Experiences Elsewhere

For the purpose of this study and to obtain best practices for the study, examples of pricing of urban transport services in selected countries have been identified and discussed.

2.5.1 Russian Experience

In Russia, urban public transport forms an integral aspect of the country's transportation system. In the provision of the urban public transport services during the early 2000, passengers' viewed price to mean: $P = \int(f, t, w, c, s, p)$ where P is Price, f is passenger fare, t is travel time, w is waiting time, c is comfort, s is safety and p is punctuality.

This price is what they refer to as generalized price. However, full economic price, according to Mitric (2002), refers to the generalized price, external effects like noise, air pollution and accidents whiles that of passenger fare is the only financial reflection of the real price of travel. In arriving at the right price (fare) for urban transport services, certain important issues were considered. These included the impact of the fares on passengers' choices between alternative modes (price elasticity of demand), the operators' financial results and the operators' decisions to expand or reduce services (Litman, 2003).

Two main key pricing principles were adopted. The first, according to Mitric (2002), was to make price reflect costs (cost – based pricing). This principle is also shared by Litman (2003). They both state that cost must be defined to encompass full cost of service provision. In the analysis of the operating costs of the operators', two types of cost were estimated. They are Direct Operating Costs; made up of wages, fuel and energy, parts and suppliers as well as purchased services and reflection of Capital Costs; also made up of depreciation and financial costs (interest). These two costs were added to obtain the cost (generalized cost) of operating transport services in Russia. It must be noted that, the cost of transport services is subsidized since it is common to find urban public transport fares lower than the required full cost recovery (break-even). These include Russia, most eastern European countries and Central Asian countries (Mitric, 2002).

After the costs estimation, fares were then considered and set. During the fare consideration, it was however found that, if fares were lower than costs, the following may occur:

1. Services may be overused;

2. Wrong signals may be sent to prospective operators as regards service expansion through profit maximization;
3. Competing services may be underused (referring to alternative modes);
4. Operators will not cover costs; and
5. Passengers may receive unwarranted benefits.

On the other hand, if fares were too high, socio-political concerns may arise. These concerns include the following:

1. Low-income people would not be able to afford urban transport services;
2. People who required special privileges such as war veterans and handicapped would be priced out; and
3. People will still be using their own private cars since the prices may not affect choice of mode by passengers thereby the desire to keep people in buses or get people out of cars may be defeated.

The fares finally arrived at were lower than the cost of operating the services hence resulting in subsidies. The lessons from the Russian experience are very relevant to the study. It must be stated that the case in Russia was a typical state planning situation where the government had some form of monopoly in the provision of urban transport services. In the Ghanaian situation, until the introduction of the metro mass transit, urban mobility had been in the hands of the private sector. One key lesson from the experience in Russia is the review of possible impact of price increases on the stakeholder in the urban transport industry before its implementation. This lesson will therefore be adopted for the study. This will be done by critically assessing the role and interests of all the stakeholders in the industry since that will help develop an appropriate pricing strategy for the industry.

2.5.2 The New South Wales Experience (Australia)

The urban transport system of New South Wales is composed of Taxis, Private Buses and Ferries. Like any other industry, fare determination became a thorny issue which required attention. The Independent Pricing and Regulatory Tribunal in November 2002 undertook a review of the urban transport service pricing upon request from the Ministry of Transport.

According to the Independent Pricing and Regulatory Tribunal, the determination of fare was based on the assessment of the cost elements of the private bus and ferry operations as well as that of the taxis. During the assessment, certain important issues were considered. These included the following:

- Fuel;
- Drivers' wages;
- Insurance and registration;
- Lubricants;
- Bus capital cost;
- Bus repairs and maintenance;
- Spare parts;
- Tyre; and
- Other costs as well as the impact of the fares on passengers' choices between alternative modes (price elasticity of demand) and the operators' financial results.

The ratio of each of the elements listed above to the total cost of operating in the industry was established. The financial viability of bus operators, key performance indicators and efficiency measures were also reviewed since they were paramount to the prices to be charged and passenger acceptability (Hamilton, 2003).

After the costs estimation, prices were then set considering the cost each of the elements contributes to the total cost of operation. Some of the lessons learnt from the experience in New South Wales include the following:

1. Establishing the elements that constitute the vehicle operation cost of service providers; and

2. Establishing the cost ratio of each element to the cost of operations. This will help price changes to reflect actual cost of operation resulting from the change of the element.

The lessons from the New South Wales are very relevant to the study. For example, in Ghana, when there is an increase, of say 10 percent, in fuel cost, urban transport operators argue for price increases by the same margin. This may be incorrect especially if the increase in fuel cost did not lead to an increase in the total vehicle operating cost by the same margin. These lessons are dominant in the urban transport industry in Ghana. The reason being that, whenever there is a review of petroleum products, vehicle operators tend to increase transport fares by the same margin. Also, the elements considered appear to be the same used by vehicle operators in the provision of transport services. It will therefore be very essential in assessing the phenomenon in the industry which will help develop an appropriate pricing strategy for the industry.

2.5.3. Indian Experience

Public transport in India can be classified into rail and road. Of the total passenger movement in the country, 80 percent is met by road transport while the remaining 20 percent is carried by the railways (Tata Energy Research Institute, 2002). Road transport in India, according to Tata Energy Research Institute (2002), is operated partly by the public sector but largely by the private sector which owns about 28.7 percent and 71.3 percent of rail and road fleet respectively.

Despite the high volumes of traffic, the public transportation system in Delhi is completely road based. Until the late 1980s public bus services were largely operated and managed by the Delhi Transport Corporation (DTC). In 1992, Delhi became one of the first cities in the country to open the road based public transport sector to the private sector. The origins of this action can be traced to a strike by the DTC union in 1988; wherein the public transport authorities permitted private buses to operate under an 'earn and keep' scheme. These buses continued to operate in the city even when the strike was over. In view of mounting losses, a militant union, poor service quality, and the resulting public criticism, the monopoly of DTC in this sector was ended.

Currently, the government fixes the fares for bus services. A compromise is often sought between competing pressures from operators for an enhancement in the fares and pressures from commuters not to effect any increase. Usually, the motivation for seeking increases in the fares is as a result of an increase in the input costs. There is bound to be a time lag between such an increase in the input costs and the increase in fares. Besides, there is neither an agreed formula for the automatic adjustments of fares with increases in the prices of critical inputs such as diesel, nor a periodic assessment of the need for any increase in fares. Therefore, bus fare hikes tend to be infrequent but steep. Thus, the entire system of fixing fares is unscientific and guided more by political rather than economic considerations.

It must be noted that such a situation has resulted in a not too conducive environment for the healthy operation of public transport services by private operators. It is necessary to have a system under which fares are fixed on economic considerations rather than political ones. This would make the decisions more credible and facilitate private investment. Lessons from India include the importance of having a scientific system of pricing rather than relying on political expediency. This will help promote efficiency and reduce price hikes that may be steep. This lesson will help in the study especially, when justifying the importance of charging economic prices.

2.6 Framework for Developing and Applying a Pricing Strategy

Like any planning activity, developing a pricing strategy for urban transport services requires a framework which will guide firms or policy makers as to the best way of achieving an efficient price which is crucial for the development and growth of the industry. Evans and Berman (1997) have a framework for the design and the implementation of a pricing strategy. This framework begins with a clear statement of goals and end with a corrective mechanism. The development of a pricing strategy, according to Evans and Berman (1997) as well as Kotler, (2000), is not a one-time occurrence but has five steps.

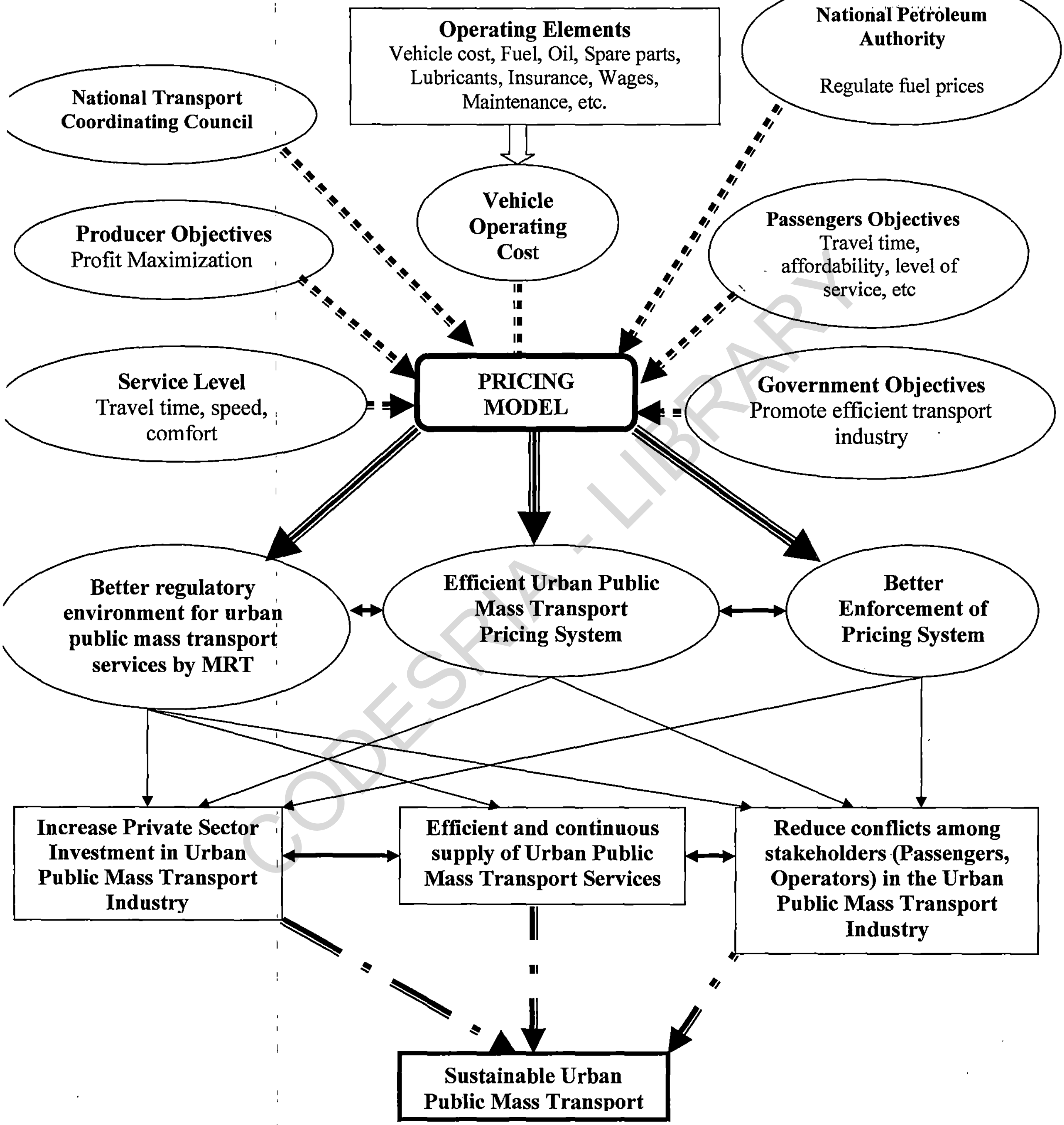
These steps include:

1. The objectives - which should be consistent with the company's overall goal;
2. Broad policy - which sets the overall direction for the firm's pricing efforts while making sure pricing decisions are coordinated with the firm's choices as to a target market, an image and other marketing mix factors;
3. Pricing strategy - which may be either cost-based, demand-based and/or competition based;
4. Implementation - which involves a wide variety of separate but related specific decisions besides the broader concepts such as to use customary pricing (which maintains one price over an extended period) or variable pricing (which allows the firm to change prices as often as cost and demand changes); and
5. Price adjustments - which require continuous fine tuning to reflect changes in costs, competitive decisions and demand.

It must be noted that, each of these five steps has some external factors such as the consumer, costs and government which have a bearing on their outcome. Based on the understanding of this model and the study objectives, the study adopted the conceptual framework depicted by Figure 8 in developing an appropriate strategy for pricing. The goal and importance of urban mass transportation services indicated in Figure 8 have been discussed and established.

Again, the various stakeholders in the urban mass transport industry in Ghana have been identified as well as their objectives in the provision of urban transport services. The next is to identify the instruments that will be used in developing an appropriate pricing model. This will be followed by the formulation of an appropriate pricing model for the urban transport industry. The outcome and conclusion of the developed model is the next stage and it will be done with the support of all the stakeholders identified in the industry. If there is the need for price adjustments, resulting in the change of any of the elements used in the provision of urban transport, then evaluation will be done with the support and involvement of the stakeholders.

Figure 8: Conceptual Framework

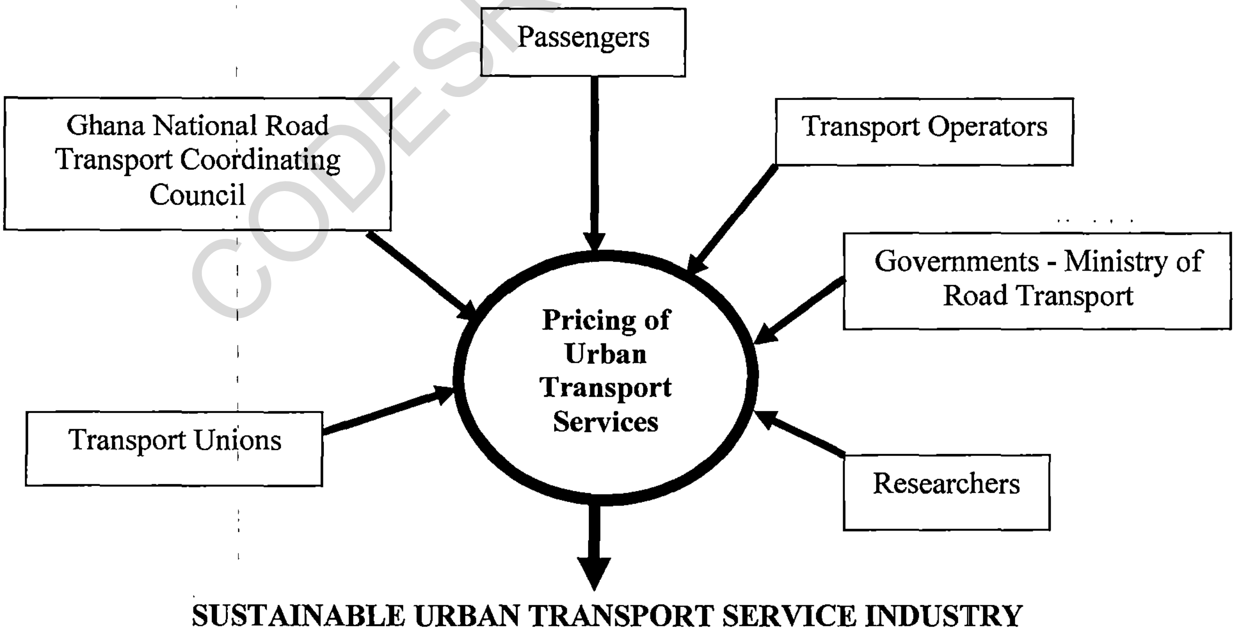


Source: Author's Construct, 2006.

2.7 Summary

The objective of this chapter has been to review the relevant literature and concepts which would provide the basis for the development of the conceptual framework for the study. Key concepts have been discussed with reference to the objective and research issues of the study. The interests and issues needed to be recognized for a successful involvement of the various groups in the study and formulation of an appropriate pricing model for the industry have also been discussed. Some of the critical issues discussed in this chapter include the concept of pricing, types of pricing objectives and the strategies involved. Also, the role and interest of the stakeholders have been discussed as well as factors which affect the operations of service providers. Consequently, the study was undertaken within this theoretical framework, that 'participation of all stakeholders in the urban transport industry will enhance the process of formulating and implementing an effective pricing strategy' (refer to Figure 9). The rationale for this is because, at the action level, the various interests are harmonized by all and not one stakeholder who will most likely be the government.

Figure 9: Pricing of Urban Transport Services in Ghana – Stakeholder Participation



Source: Author's Construct, 2006

Also, when there is inadequate involvement of the relevant stakeholders in the process, there is the possibility that the outcome (an appropriate pricing strategy) will be resisted by those who will be left out. Interestingly, the success or otherwise of any pricing strategy in the industry is highly dependent on the stakeholders in the transport industry. Their level of interest and power and the extent to which their interest are respected are other key determinants to their willingness to participate in the implementation of the outcome of this study. Having obtained this insight, the next stage of the study was to collect and analyze the relevant data from the field drawing lessons from the literature and the various concepts.

CHAPTER THREE
STUDY APPROACH AND METHODOLOGY

3.0 Introduction

This chapter presents the methodology and the relevant models adopted for the study. The chapter also presents the tools used in establishing the extent of the relationship between the various elements that determine transport service pricing (fares) in the study area. It also assess how these elements contribute to the vehicle operating cost (VOC) of urban transport operators as well as the appropriate model that will promote the interest of all stakeholders. The Highway Development and Management (HDM) 4 Model was used to achieve the first objective while Logistic Regression Model was also used to address the second objective. The Stepwise Multiple Regression model was used to achieve the third objective while the Contingent Valuation Method was used to assess the possible policy options likely to arise in the utilization of the pricing model. The specific policy option such as the willingness to pay by consumers was also addressed.

3.1 Research Design

The study was carried out along the lines of deductive reasoning meaning carrying the study along developed knowledge and established theory within the case study method. The case study method is an intensive study of an individual unit or community stressing development factors in relation to the unit's own environment. In this method, the researcher explores a single entity or phenomenon (the case) bounded by time and activity and collects detailed information using a variety of data collection procedures during a sustained period of time (Agyedu et al, 1999). Thus for this study, emphasis was placed on details, actors, structures as well as dialogue among the various stakeholders in the Kumasi Metropolis. The reasons for the adoption of this method stem from the fact that, the study requires multiple sources of evidence and the issue being investigated is a contemporary phenomenon which is ongoing and for which the researcher has little control over.

Kumasi Metropolitan Area was selected after an initial analysis of the problem and the scope of work to be done. As has been stated earlier in this study, it reviewed the activities of public transport services in Ghana. These services are provided by the taxis, minibus and metro transit services. In Ghana, all these three modes of public transport services are found mostly in the Accra Metropolitan Area (AMA), the Kumasi Metropolitan Area (KMA), the Shama Ahanta East Metropolitan Area (SAEMA), the Tamale Metropolitan Area (TAMA) and the Tema Municipal Area (TMA). This situation therefore, prompted the selection of one of these areas, which was the Kumasi Metropolitan Area, out of convenience and to reduce cost of the study.

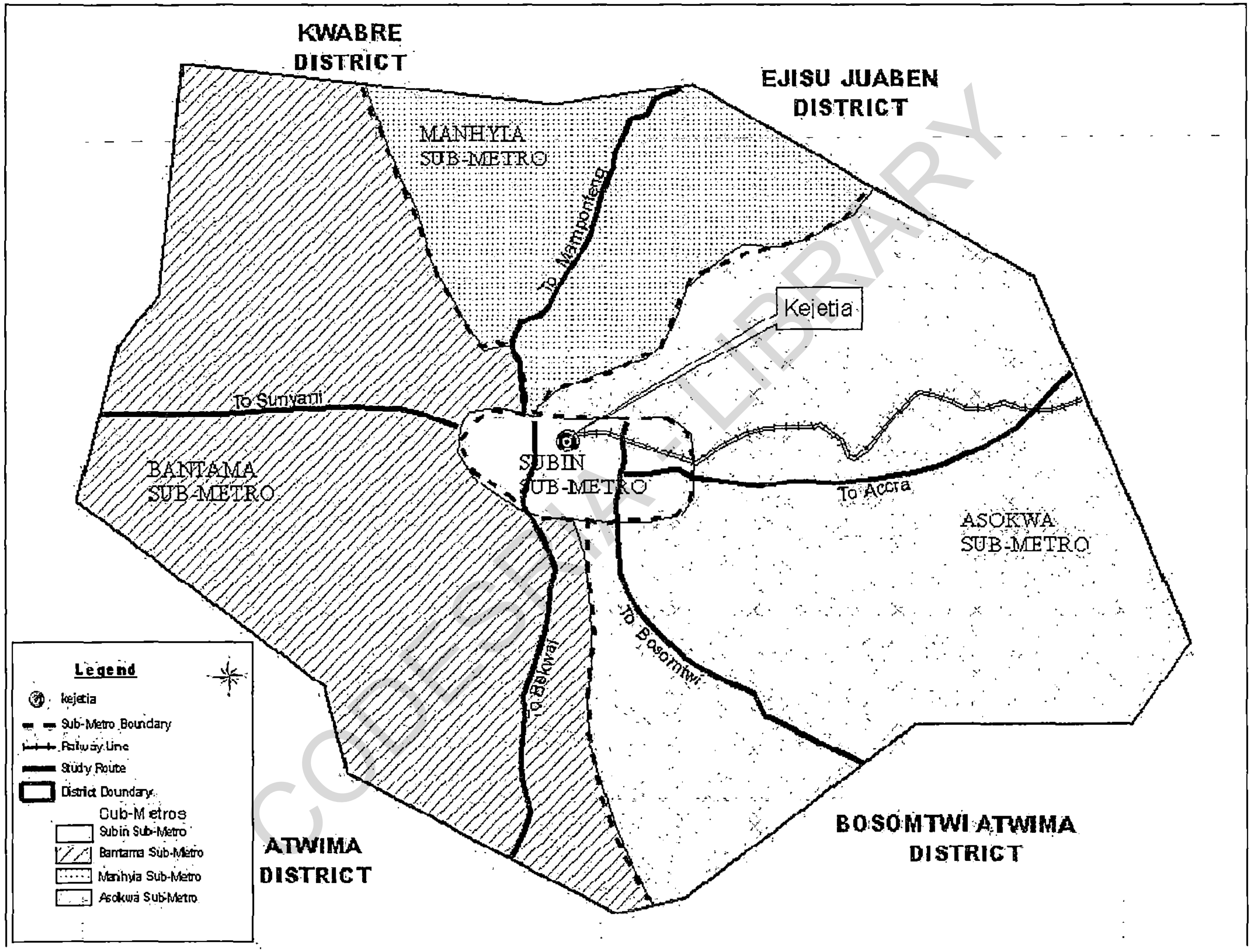
3.2 Selection of Routes for the Study

Five major routes (see Map 2) were selected for the study based on their traffic volumes and the demand for public mass transport services along their corridors. From the Department of Urban Roads (DUR, 2005), the average daily traffic volumes along the roads were:

i. The Accra Road; 36,501 vehicles per day;
ii. The Sunyani Road; 26,425 vehicles per day;
iii. The Bekwai Road; 20,235 vehicles per day;
iv. The Lake Road; 24,454 vehicles per day; and
v. The Mampong Road 20,717 vehicles per day.

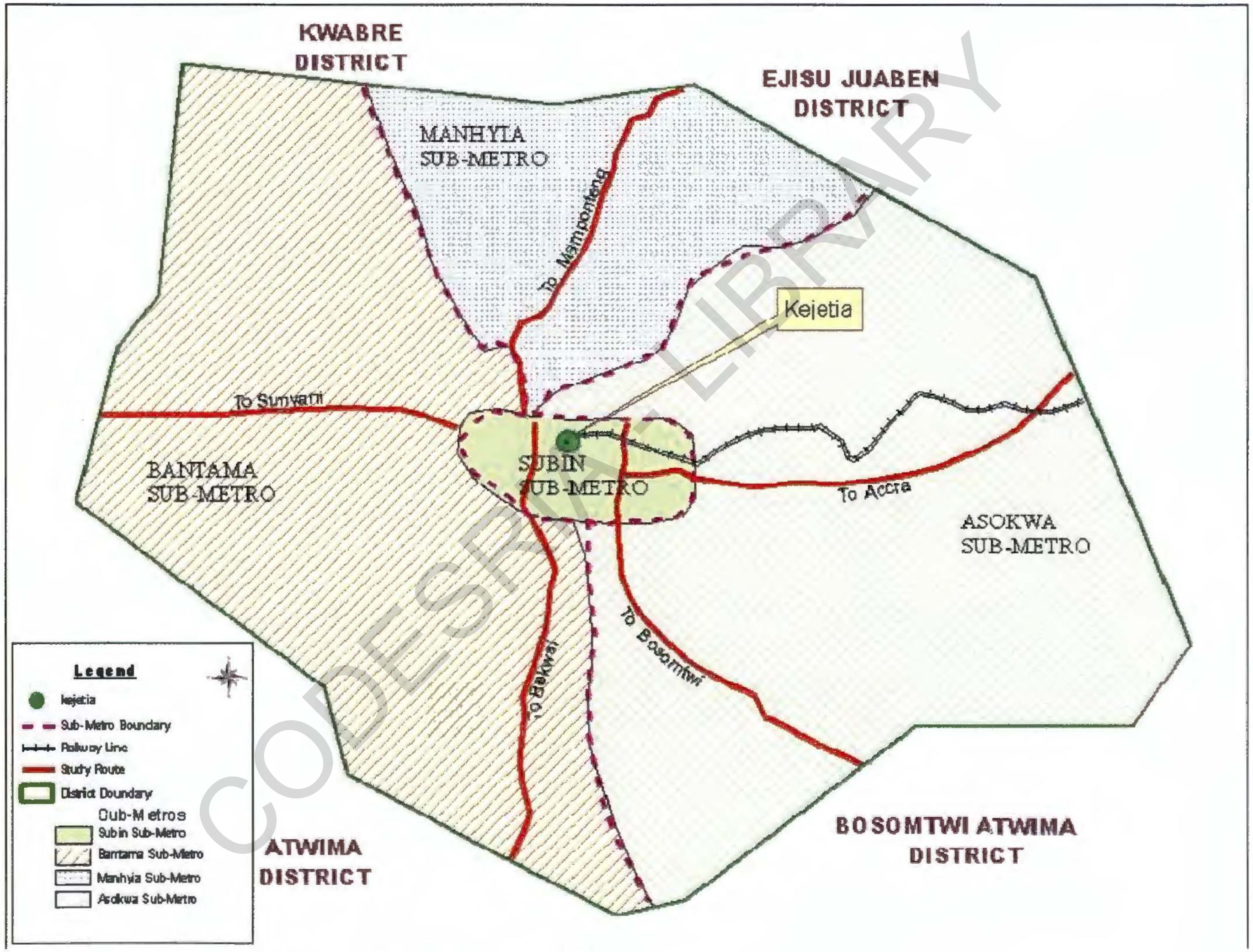
Out of the recorded traffic, mass transport modes dominate, contributing about 55 percent thereby providing a good basis for the study. Drivers of urban mass transportation modes operating on these routes were interviewed to obtained information such as fuel usage, fares charged, number of trips made, and number of passengers carried, among others.

Map 2: Study Routes



Source: Kumasi Metropolitan Assembly, 2004.

Map 2: Study Routes



Source: Kumasi Metropolitan Assembly, 2004.

3.3 Selection of Traffic Zones for the Study

Urban transportation aims at supporting transport demands generated by the diversity of urban activities in an urban context. These urban activities are complex and involve several relationships between the transport system, spatial interaction and land use. Population, housing, employment and workplace serve as generators and receivers of movements. This is because, residential areas serve as sources of commuting while workplace and other auxiliary venues serve as receivers of trips generated. Residential areas provide a wide array of incomes, standards of living, preferences and ethnicity. The dynamics within urban spatial structure provided the basis for selecting samples from the 34 traffic zones within the Kumasi Metropolitan Area. The 34 traffic zones therefore provided the platform to assess the interaction between transport and land use within the study area.

The thirty-four (34) traffic zones in Kumasi which were delineated after a review of the Kumasi Traffic Zones demarcated by the Department of Urban Roads (DUR) for a study of "Landuse Forecast and Traffic Volume Growth Trends in Accra, Tema, Kumasi, Sekondi – Takoradi and Tamale" in 1997 were used (refer to Map 3). These zones were delineated on the basis of homogeneous social and economic characteristics such as income, housing quality, the general culture of the people and the level of economic activities generated in the area. The study focused on population, traffic patterns and socio-economic characteristics within each of the traffic zones. The reason for the selection of these zones is that, they provide a better description of the urban travel characteristics within the metropolis. The traffic zones and their descriptions are shown in Appendix 1.

From these zones, 34 communities were selected for the study: one from each traffic zone. Commuters in the selected communities in each of these zones were interviewed to obtain data on passenger trip making characteristics such as travel time, amount spent on transport, level of service by mode of transport, among others.

3.4 Sample Size Determination

The formula $n = \frac{N}{1+N(\alpha)^2}$ was used in determining the sample size of passengers for the study; where n = sample size, N = total population of the study area, α is the confidence level (which is 95%). From the interpolation, a sample size of 400 was obtained as the sample population for passengers for the study. The passengers were selected from the 34 traffic zones. Again, the Napierian Log was used to verify the reliability and also to validate the sample size obtained. The formula $(1+n^{-1})^n = 2.7183$ where n = sample size was used. In addition, 125 operators of public transport modes selected randomly along the five study routes were also interviewed. The basic assumption in using this formula is that, in order to capture the variations in responses within the stated levels of accuracy, 'n' is the minimum number of respondents to be interviewed.

3.5 Study Variables and Type of data

Based on the objectives, research issues and questions of the study, the following variables and data types listed in Table 3.1 were selected for the study.

Table 3.1: Study Variables and Data Type

Study Variable	Data Type	Source (s)
Vehicle Operating Cost	Insurance cost, Fuel cost, Spare parts cost, tyre cost, Lubricant cost, Wages of drivers and mates, Frequency of tyre and lubricant change, quantity of fuel used per day	Vehicle Operators, vehicle Owners, Transport Unions, Ghana National Road Transport Coordinating Council, Filling Stations, Spare parts dealers
Vehicle Operations	Hours worked per day, number of trips made per day, travel time from an origin to a destination, travel speed from an origin to a destination, number of passengers conveyed per trip, vehicle capacity	Vehicle Operators, Field Observations
Revenue Patterns from Vehicle Operations	Fare charged per distance or trip, daily sales made	Vehicle Operators, vehicle Owners, Transport Unions
Drivers Characteristics	Age, sex, marital status, educational level, occupation type	Vehicle Operators
Passenger Characteristics	Age, sex, marital status, occupation, educational level, income, expenditure patterns	Passengers / Commuters in communities
Passenger Trip Making Characteristics	Vehicle mode use, passenger travel time, waiting time, amount spent on transport, amount willing to spent on transport services	Passengers / Commuters in communities, Field Observation

Source: Author's Construct, 2005.

3.6 Data Collection, Processing and Analysis

Data for the study was from two main categories; Primary and Secondary sources. Primary data here refer to all data that were gathered from the field through the use of questionnaires, observations and interviews while secondary data refer to data that were gathered from secondary sources such as books, newspapers, journals, and internet among others. The type of primary data collected include elements which constitute the vehicle operating cost of service providers such as fuel cost, lubricant cost and insurance cost; socio-economic data from commuters such as income levels and type of occupation; revenue patterns of service providers and trip characteristics of drivers and commuters; among others. Examples of secondary data collected include pricing objectives, pricing strategies, and stakeholder objectives, among others.

Two main surveys were undertaken during the primary data collection. The first survey, span for a period of three weeks starting from 10th January, 2006 to 30th January, 2006. The second survey lasted for a period of two weeks starting from the 10th of June to 23rd of June. The second survey was to gather additional data as well as mop up all the gaps identified during the first survey.

The means of collecting the above data included several methods. First, a reconnaissance survey was carried out to observe critical features about the operations of service providers, establish contacts with stakeholders such as the Ministry of Road Transport (MRT), the Ghana National Road Transport Coordinating Council (GNRTCC), the Ghana Private Road Transport Union (GPRTU), the Progressive Transport Owners Association (PROTOA), garages, non unionized transport operators and the Cooperative Union. Second, interviews were conducted with the stakeholders listed above to obtain relevant data such as their interest and objectives. This was to help address the research question; stakeholder interests in pricing and was in a more discursive manner than the extractive type of interview where respondents just provide answers to structured questionnaires. This approach provided an in-depth understanding of relevant issues. Finally, questionnaires were used to obtain socio-economic data from commuters and the elements constituting the vehicle operating cost from drivers.

The sampling technique that was used to collect the passenger and driver data was multi-stage using both stratified and the simple random sampling methods. The commuters were grouped into strata or categories which exhibit definite characteristics such as income levels and trip making characteristics and simple random sampling was used to select commuters from each strata. The reason for the use of the simple random sampling method is that every element or stakeholder has an equal chance of being selected from the population. However, the method has some disadvantages which include the selected items not being very representative. On the other hand, the use of the stratified random sampling method ensured a representative sample since it guaranteed that every important category would have elements in the final sample and also ensures precision. This method has some form of difficulty since it requires prior knowledge of each individual in the population. The objective for using these methods therefore is to minimize error associated with using just one.

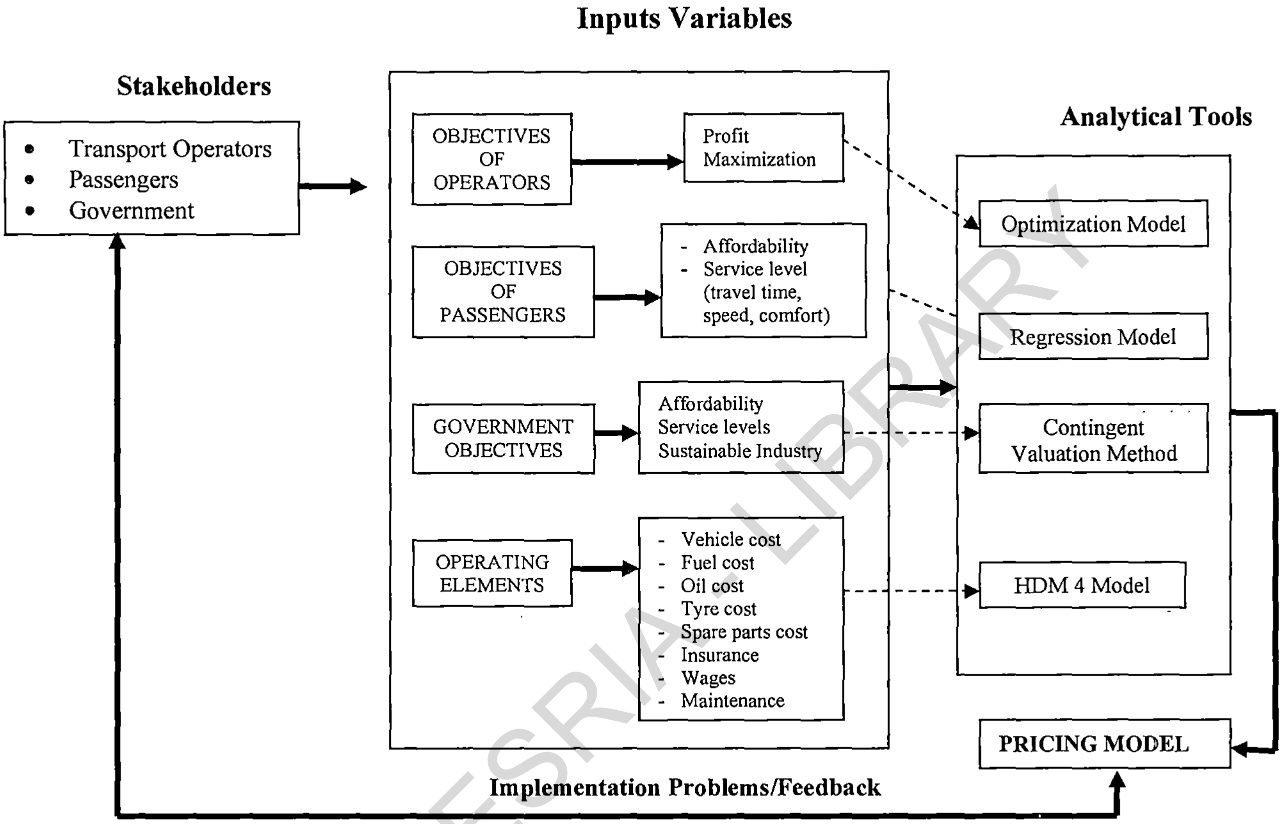
In terms of data processing, a number of techniques were used. Data obtained was edited, coded and then tabulated. Editing was done with the aim of detecting and eliminating error to ensure clean and reliable data. Coding was done by classifying questions into meaningful categories in order to bring out essential patterns like vehicle cost, payload characteristics, trip frequencies, and income of respondents, among others to inform research question such as the factors affecting the VOC, among others. Data was presented in the form of tables and diagrams, among others to facilitate the analysis.

In terms of data analysis, both the qualitative and quantitative techniques were used. Data disaggregation, cross-tabulation and statistical application techniques were used in analyzing responses. The reason for the combination of techniques is to ensure that the generalization was based on credible and reliable means of analyzing data from the field. The SPSS software was used in analyzing the data obtained from the field.

3.7 Analytical Framework

The analytical framework provides the framework within which the study analysis was undertaken. From Figure 10, it can be seen that, data was gathered from the various stakeholders, and these data were inputted into models such as the HDM 4. The expected output, vehicle operating cost, is to be used by the stakeholders from whom data were gathered.

Figure 10: Analytical Framework



Source: Authors Construct, 2006.

3.8 Analytical Tools

3.8.1 Elements of Vehicle Operating Cost (VOC)

In order to investigate the strength of the relationship between the criterion variable (VOC) and the predictor variables (fuel, insurance, tyre cost, spare part cost, overheads, etc), the multiple correlation coefficients (*R*), which can take any value from 0 to 1, was used and the higher the correlation coefficient (*R*) value, the stronger the relation. It was calibrated for any independent variables using the following equation:

$$Ry.x_1x_2 = \frac{\sqrt{ryx_1^2} + ryx_2^2 - 2(ryx_1 . ryx_2 .rx_1x_2)}{1 - rx_1x_2^2} \qquad (5)$$

Again, the proportion of the variance of the criterion variable that is accounted for by the variance of all the predictor variables (element constituting VOC) was assessed using the coefficient of multiple determination (R^2). The equation below was used to determine R^2.

$$\sum R^2 = \frac{a\sum y + b_1\sum x_1y + b_2\sum x_2y - \frac{(\sum y)^2}{n}}{\sum y^2 - \frac{(\sum y)^2}{n}} \qquad ..(6)$$

In determining the strength of the multiple R, i.e. if it is significant or not, the Snedecor's F-Test (Analysis of Variance – ANOVA) was used. The equation is shown below.

$$F = \frac{R^2/k}{(1-R^2)/(n-k-1)} \qquad .(7),$$

where k = number of predictor variables (elements). Data obtained from vehicle operators was used as inputs in the calibration with the view of picking out the independent variables.

3.8.2 Vehicle Operating Cost of Urban Transport Services

After identifying the various elements that contribute to the vehicle operating cost, the HDM 4 model was used to calibrate the VOC of urban transport services by the various vehicle categories. This was done after comparing the results with the field data used in estimating the VOC.

3.8.3 Regression Analysis

The multiple regression model aims at encapsulating n (n ≥ 2) number of predictor variables in a single model and then predicting variations in Y variable , in this case transport fares as the former variables vary. The multiple linear regression models are usually stated as:

$$Y = a + \sum_{i=1}^{n} biXi + e \qquad ..(8)$$

where Y = the VOC

a = the slope intercept value on the regression hyperplane

b_1 - b_n = the partial regression coefficients

X_1 - X_n = fuel, insurance, tyre, spare parts, overheads, etc

e = the error term of prediction

3.8.4 Contingent Valuation Method (CVM)

According to Single et al (2001), the willingness to pay (WTP) approach is based on 'value theory' which assumes that individuals value their own consumption and rationally seek to maximize the value of consumption as best as possible subject to constraints including income and price. Based on this assumption, it is expected that, rational households will be willing to pay a price for a service, in this case, transport, that will improve their wellbeing. As a concept of value is subjective, it means that, commuters' willingness to pay for transport services, will be subject to several factors including the level of service, distance, travel time, comfort, safety and more importantly, income levels.

In order to assess this, the study adopted the Contingent Valuation Method (CVM). The method basically asks people what they are willing to pay for a benefit, in this case, transport services. Respondents were asked what proportion of their income they would be willing to spend on transport services as well as the fares they would be willing to pay from an origin to a destination. This was done through the passenger surveys.

Like any method, the CVM is subject to errors in its use. This comes about due to the hypothetical context within which households value gains associated with an intervention.

For this study however, the intervention being assessed is not hypothetical but rather households undertaking several travel activities.

Since the normal logit and probit regressions are not able to fully analyze ordinal response, the logistic regression method was used to analyze responses from the survey. The method is based on the following specification:

$$y_i^* = \beta^1 + e_i \quad .. (9),$$

$$\text{where } y_i = \begin{cases} 0 & \text{if } y = U_1 \\ 1 & \text{if } y = U_2 \\ 2 & \text{if } y = U_3 \\ . & \\ J & \text{if } y = U_{j+1} \end{cases}$$

The relevance of this survey was to assess the willingness to pay for transport services. The respondents express a preference with the above sort of ordinal ranking. This is due to the fact that, the 'U's are free parameters and therefore have no unit distance between the set of values of y, they merely serve as ranks. The estimates are obtained by maximum likelihoods. The probabilities that enter the Log Likelihood functions are: Prob $[y_i = j]$ = Prob $[y_i^*$ is the jth observation$]$. In this study, the model was estimated with individual data y_i = 0, 1, 3, n. Data collected was analyzed with the SPSS software. This software allows for the derivation of marginal effects. The willingness to pay for transport services (see Appendix 4) was modeled as:

D_{Pass} = f(HhN, Gpass, Slev, MHI) . (10)

where:

D_{Pass}	= Amount household is willing to pay for transport services;
HhN	= Average household size;
Gpass	= Gender of Passengers;
Slev	= Service level; and
MHI	= Household Income.

CHAPTER FOUR
PRESENTATION AND ANALYSIS OF FIELD DATA

4.0 Introduction

Chapters 2 and 3 of the study have outlined the theoretical basis and the framework for undertaking the study. This chapter presents and discusses data on passengers, drivers, vehicle operations and vehicle operating cost. On the passenger front, data gathered and presented include social characteristics of passengers, including, sex and marital status, educational level, number of trips made and purpose of those trips, travel time and mode of travel. In relation to drivers and vehicle operators, data presented include marital status, educational level, transport unions and the type of training drivers have undergone. Data on vehicle operation include vehicle capacity and number of passengers carried, age of vehicles, hours work in a day, number of trips in a day, travel time and travel speed. The chapter also presents data on the consumption of fuel, lubricant, spare parts and tyre as well as maintenance costs.

The data presented were gathered using questionnaires and focus group discussions. In all, 400 passengers and 150 vehicle operators were interviewed. In addition, transport unions were engaged in discussions to validate some of the data obtained from drivers. The data on drivers and vehicle operations were gathered at the various stations at the Kejetia bus terminal and along the study routes while those on passengers were gathered from both the household level and from commuters at the various vehicle terminals.

A major challenge encountered during the data gathering stage of the study was the inability of some drivers to give accurate account, especially on the operations of their vehicles. The effect of this on the entire study was however reduced by gathering data from multiple sources including transport unions and the national transport coordinating council. This chapter therefore presents data gathered from the field surveys which served as the inputs for the analysis, conclusion and recommendations.

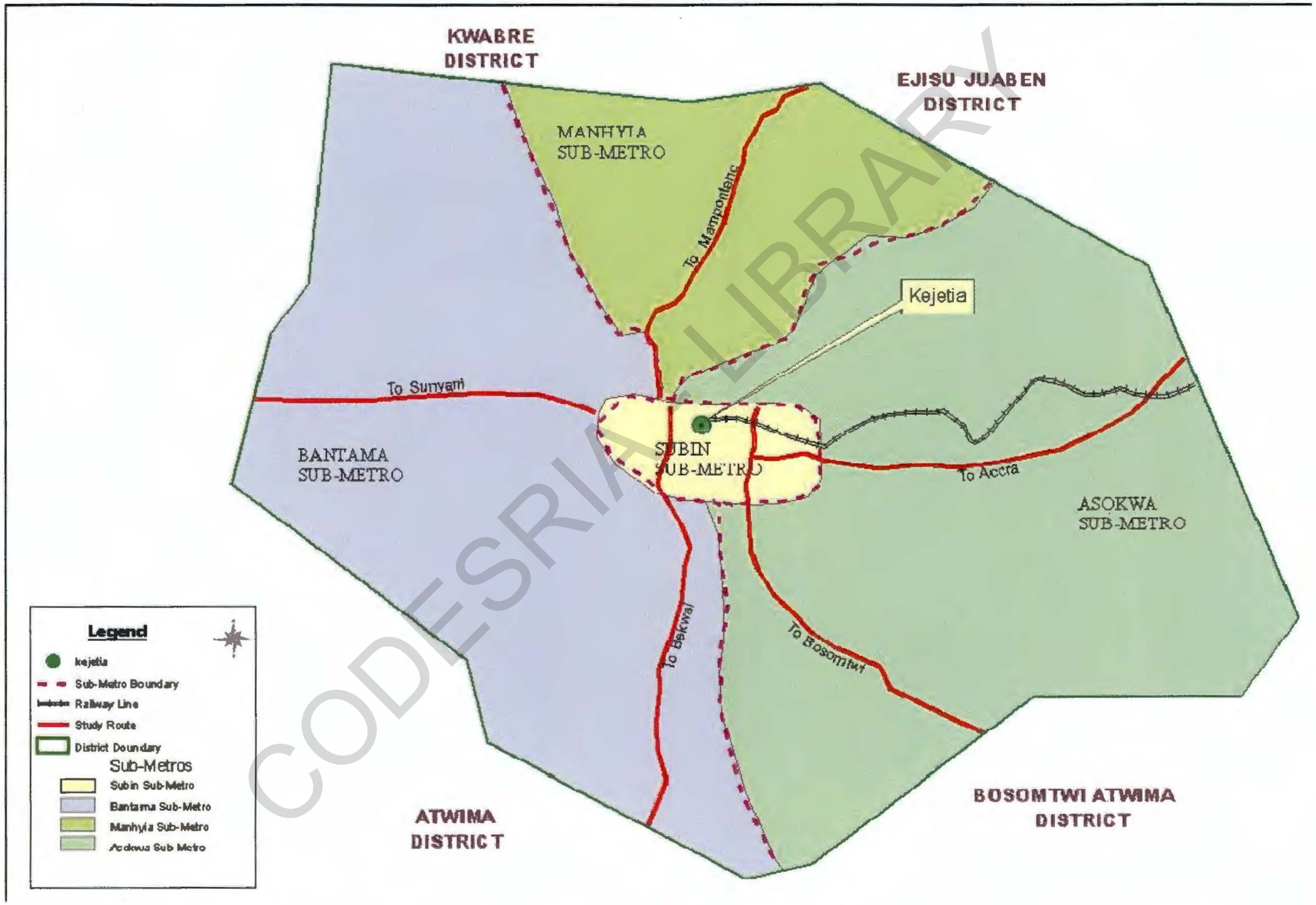
4.1 Overview of the Kumasi Metropolitan Area

Kumasi, as can be seen in Map 1, is located approximately in the central part of Ghana and all the transportation systems both on and above ground converge in the city. Spatially, Kumasi is subdivided into four sub-metros (refer to Map 4) and is not particularly segregated but there are areas that are easily distinguished as low income (e.g. Anloga, Asawasi, Moshi Zongo) or high income (e.g. Ridge, Nhyiaeso). The overwhelming majority of neighbourhoods (e.g. Asafo, Fante New Town, and Dichemso) are noticeably, mixed in terms of residents incomes (Adarkwa and Tamakloe, 2001).

In terms of its ethnic composition, Kumasi is now quite cosmopolitan. Sinai (1998) found that over 60 percent of household heads are either lifetime or first-generation migrants. However, evidence from a poverty profile by Korboe (1996) suggests that, inflow of migrants has slowed considerably in recent years. In spite of the role that the urban economy has played in encouraging nucleation and independence, lifestyles have retained strong traditional values.

The economy of Kumasi is predominantly led by the informal sector (Adarkwa and Post, 2001). In 2001 for example, the sector employed about 70 percent of the labour force in the metropolis with self-employment accounting for about 65 percent of total employment. The informal sector contributes a great deal to the acquisition of skills through the apprenticeship system of training. An example is the Suame Magazine; a vehicle service centre, which is highly noted for this form of skill diffusion.

Map 4: The Sub-Metros of Kumasi Metropolitan Area



Source: Kumasi Metropolitan Assembly, 2004.

According to Adarkwa and Tamakloe (2001), the land use pattern in Kumasi is characterized by the following:

- The sudden upsurge of suburban development in Kumasi, which could be a reaction to the increased human activities and over concentration of various social, economic and employment opportunities in the Central Business District (CBD), defined as Adum, Bompata and the central market;
- Most of the suburban areas are generally service deficient and as a result some residents still depend on the CBD for various services. About 44.3 percent of all trips in the city have either their origin or destination in the CBD; and
- The problem of over-concentration of commercial and business activities in the central area has been exacerbated by the extent to which traffic congestion in the city centre has become worse partly because of the increase in the number of vehicles and the use of private cars and taxis as a predominant mode of transport.

The city currently has about 430 kilometers of road which is made of both trunk and urban roads. In addition, there is also an extensive network of residential or local roads, one half of which is in "poor" condition. The trunk and urban roads consist of a 40km (9 percent) long asphalt dual carriage, 70km (17 percent) of asphalt single carriage, 230km (53 percent) of surface dressing, 50km (12 percent) of gravel surfacing and 40km (9 percent) of earth surface pavement (KMA, 2004). It is estimated that, as of 2007, about 30 percent of the total urban road network is in "good" condition, 15 percent in "fair" and 55 percent in "poor" conditions.

Five major arterial trunk roads and national highways converge in Kumasi with major transport terminals which serve as interchange points for both passengers and cargo destined for different parts of the country (Adarkwa and Tamakloe, 2001). Adarkwa and Tamakloe (2001) further state that, Kumasi also performs several other functions of a national, regional and local nature, all of which generate their own traffic movements.

The main traffic generators in Kumasi are the Central Business District (CBD), Suame, Ashanti New Town, Asawasi, Bantama, New Amakom and Asokwa. Most of these areas have mixed industrial, high density residential and shopping areas. Together, these areas generate about 90 percent of internal traffic in Kumasi. The choice of travel mode in the city is estimated to be 43 percent by public transport (23 percent by Taxi, 18 percent by Minibuses and 2 percent by Large Buses) which is quite significant. The proportion of trips undertaken by large buses may have increased in recent times because of the introduction of the Metro Mass Transit buses by the Government of Ghana into the city of Kumasi. However, empirical work is yet to be carried out to determine the proportion of trips undertaken by this mode.

In spite of the foregoing, it is believed that the proportion of taxis in the city has increased in recent years. Conservative estimates indicate that as of 2007, taxis constitute between 50 and 65 percent of traffic stream or queue in Kumasi.

4.2 Trip Making Characteristics of Passengers

4.2.1 Social Characteristics of Passengers

This section of the study presents social characteristics such as marital status, sex of passengers, educational level, among others. This is to provide some understanding in the category of passengers who patronize urban transport services in the study area.

4.2.1.1 Sex and Marital Status

Based on the field survey, it was revealed that 54.3 percent of passengers were males while the remaining 45.7 percent are females (refer to Table 4.1). This shows a variation from the national figure of 49 percent Male and 51 percent Female and with the Kumasi urban population structure of 46.8 percent Male and 53.2 Female (GSS, 2003). The reason for this variation is that most males migrate to Kumasi in search of job opportunities. The implication of this for trip making is that, since the male inhabitants are in the study area for work, there is the possibility that they will generate increased number of trips. This assertion may be supported by the recorded high levels of trip to work on weekdays as seen in Table 4.5.

Table 4.1: Sex Status of Passengers

Sex of Passengers	Frequency	Percentage
Male	217	54.3
Female	183	45.7
Total	**400**	**100.00**

Source: Field Survey, 2006.

Also, it was revealed as indicated in Table 4.2 that, 42.25 percent of these passengers were single with 55.2 percent, 1.8 percent and 0.8 percent being married, divorced and widowed respectively. This shows the diverse background of passengers who patronize public transport services in Kumasi Metropolis.

Table 4.2: Marital Status of Passengers

Marital Status of Passengers	Frequency	Percentage
Married	221	55.25
Single	169	42.25
Divorced	7	1.75
Widowed	3	0.75
Total	**400**	**100.00**

Source: Field Survey, 2006.

4.2.1.2 Educational Level of Passengers

The survey revealed that in terms of educational background, there are different categories of respondents with 31.25 percent of passengers having had basic education and 37.50 percent having had secondary education. This is shown in Table 4.3. The implication of this for trip making is that, people with educational levels usually are engaged in activities that may generate increased number of trips.

Table 4.3: Educational Level of Passengers

Literacy Level of Passengers	Frequency	Percentage
Basic	125	31.25
Secondary	150	37.50
Tertiary	84	21.00
Never attended school	32	8.00
Non-response	8	2.25
Total	**400**	**100.00**

Source: Field Survey, 2006.

4.2.2 Passengers' Trip Characteristics

4.2.2.1 Number of Passenger Trips

Table 4.4 shows the number of trips made by passengers in their day to day activities. From the survey, it was revealed that, about 79 percent of the passengers make one round trip a day. These trips are usually from their residence to their place of work and back to their residence after work. About 14.75 and 3.75 percent make 2 and 3 trips respectively. There was a non-response rate of 2.5 percent. This came about due to the inability of respondents to readily indicate the number of trips made.

Table 4.4: Passenger Trips per Day

Number of Passenger Trips	Frequency	Percentage
Single trip	316	79.00
Two trips	59	14.75
Three trips	15	3.75
Non-response	10	2.5
Total	**400**	**100.00**

Source: Field Survey, 2006.

4.2.2.2 Weekday Trip Purpose

These trips are generally made to work, market and social occasions. From the survey, it was realized that 67.83 percent of the trips made are to work, with about 18.59 percent going to the market during the weekdays. A detailed trip purpose on a typical weekday is shown in Table 4.5.

From the field surveys, it was further estimated that, a total of 1,451,424 vehicular trips are made in Kumasi to work places on a typical weekday, while 1,125,135 vehicular trips are made to social places in a weekday in Kumasi. In spite of the high vehicular trips recorded, non-motorised transport (specifically walking) is the most dominant mode used in travelling. An estimated number of 2,778,231 trips are made to work by walking. The implication of this for urban transportation is that, there are a considerable numbers of trips that can be carried by vehicular transport if the service provided is efficient and affordable.

Table 4.5: Weekday Trip Purpose

Trip Purpose	Frequency	Percentage
Work	270	67.50
Market	74	18.50
Social	33	8.25
Work and Market	15	3.75
Market and Social	6	1.50
Non-response	2	0.5
Total	**400**	**100.00**

Source: Field Survey, 2006.

4.2.2.3 Weekend Trip Purpose

However, on weekends, about 74.4 percent of the total trips made are to social places such as funerals, stadium to watch football matches and food selling joints to have meals respectively. Also, 20.7 percent and 4.3 percent travel to work and market respectively during weekends. This is shown in Table 4.6. From the field data, it was estimated that, there are 1,383,916 trips to social places such as the stadium in Kumasi on weekends whiles a total of 1,260,151 trips are made to work places on weekends. Non-motorised transport mode (i.e. walking) on weekends is estimated to be 1,989,745 trips. The implication of increased number of trips on weekends could serve as potential demand for the utilization of public transport modes, especially metro transit buses. This position is supported by about 14 percent of passengers using this mode for their trip purpose (refer to Table 4.8).

Table 4.6: Weekend Trip Purpose

Trip Purpose	Frequency	Percentage
Work	83	20.7
Market	17	4.3
Social	298	74.4
Market and Social	2	0.6
Total	**400**	**100.00**

Source: Field Survey, 2006.

4.2.3 Passenger Travel Time

Travel time for the various trips by passengers' ranges from 15 minutes to about 90 minutes. From the survey, it was found that an average travel time of 32.25 minutes was used in undertaking trips irrespective of the purpose. However, it was realized that, along the Lake road (refer to Map 2), about 68.08 percent of passengers travel between 30 minutes and 60 minutes over a distance of 7.2 kilometers, with about 12 percent using between 61 minutes to 90 minutes for the same distance. Along the Accra road (refer to Map 2), it was realized that, about 90.91 percent of the passengers travel an average trip distance of 14.5 kilometers within 30 minutes to about 60 minutes while about 7.27 percent do so between 61 minutes and 90 minutes. Most passengers, about 61.54 percent, along the Sunyani road (refer to Map 2) travel an average trip distance of 11.3 kilometers within 30 minutes and 60 minutes (refer to Table 4.7).

Table 4.7: Passenger Travel Time

Route name	Passenger travel time	Frequency	Percentage
Lake road (7.2 kilometers)	Less than 15 minutes	15	20.00
	30 minutes – 60 minutes	51	68.00
	61 minutes – 90 minutes	9	12.00
	Sub-Total	**75**	**100.00**
Accra road (14.5 kilometers)	Less than 15 minutes	2	1.82
	30 minutes – 60 minutes	100	90.91
	61 minutes – 90 minutes	8	7.27
	Sub-Total	**110**	**100.00**
Sunyani road (11.3 kilometers)	Less than 15 minutes	0	0.00
	30 minutes – 60 minutes	40	61.54
	61 minutes – 90 minutes	25	38.46
	Sub-Total	**65**	**100.00**
Bekwai road (11 kilometers)	Less than 15 minutes	0	0.00
	30 minutes – 60 minutes	43	63.24
	61 minutes – 90 minutes	25	36.76
	Sub-Total	**68**	**100.00**
Mampong road (8 kilometers)	Less than 15 minutes	0	0.00
	30 minutes – 60 minutes	15	18.29
	61 minutes – 90 minutes	67	81.71
	Sub-Total	**82**	**100.00**

Source: Field Survey, 2006.

Along the Bekwai road (refer to Map 2), about 63.24 percent of passengers travel within 30 minutes and 60 minutes over an average distance of 11 kilometers. From the field surveys, it was realized that, passengers along the Mampong road (refer to Map 2) take a lot of time in undertaking an average trip distance of 8 kilometers. From Table 4.7, it can be seen that, as many as 81.71 percent of passengers use within 61 minutes and 90 minutes to make the journey of 8 kilometers. The implication is that, there is a considerable level of congestion on the Mampong road corridor.

In relation to vehicle mode, it was realized that, passengers using Taxis undertake their journeys within a shorter time period than those using the other modes as can be seen in Table 4.8. From the Table, it can be seen that, passengers using Taxis along the Lake road use an average of 16.50 minutes to undertake a trip of 7.2 kilometers while those using the Metro Transit bus do so in about 30.65 minutes. Details on the other study roads have been presented in Table 4.8.

Table 4.8: Average Passenger Travel Time by Various Modes

Route name	Mode	Time (minutes)	Average Vehicular Speed (Kph)
Lake Road (7.2 kilometers)	Private	22.14	70km/hour
	Taxi	16.50	70km/hour
	Minibus	28.51	60km/hour
	Metro Transit bus	30.65	50km/hour
Accra Road (14.5 kilometers)	Private	18.45	80km/hour
	Taxi	15.21	85km/hour
	Minibus	32.25	70km/hour
	Metro Transit bus	38.57	55km/hour
Sunyani Road (11.3 kilometers)	Private	28.91	68km/hour
	Taxi	26.79	65km/hour
	Minibus	36.25	60km/hour
	Metro Transit bus	37.57	50km/hour
Bekwai Road (11 kilometers)	Private	24.21	75km/hour
	Taxi	18.10	75km/hour
	Minibus	26.78	70km/hour
	Metro Transit bus	35.67	50km/hour
Mampong Road (8 kilometers)	Private	62.46	60km/hour
	Taxi	60.25	55km/hour
	Minibus	68.98	55km/hour
	Metro Transit bus	79.84	45km/hour

Source: Field Survey, 2006.

4.2.4 Mode of Travel

The mode used in undertaking the trips in one way or the other has an influence on the travel time along all the major arterials. From the survey, it was realized that, the dominant mode for commuting is the Taxi, with about 43.90 percent of respondents using this mode. The Minibus, Metro Transit bus and Private vehicle carry 31.71 percent, 14.02 percent, and 6.71 percent of passengers sampled respectively. Details of other travel mode are presented in Table 4.9.

Table 4.9: Mode of Travel

Vehicle Mode	Frequency	Percentage
Private	27	6.71
Taxi	176	43.90
Minibus	127	31.71
Metro Transit bus	56	14.02
Taxi and Minibus	12	3.05
Private Vehicle and Minibus	2	0.61
Total	**400**	**100.00**

Source: Field Survey, 2006.

Section 4.2 presented the analysis of the various issues affecting passengers demand for urban public transport services. This section is useful because of the fact that, it gives an idea about the service level being offered to passengers who patronize urban public transport services. The next section, Section 4.3, presents the various issues in relation to drivers who operate the various modes of urban public transport services.

4.3 Driver Characteristics

4.3.1 Educational Level of Drivers

Education plays an important role in understanding the characteristics of the urban transport industry. From the survey, data in Table 4.10 revealed that, 75.33 percent of drivers have had basic education, 22.67 percent secondary education with the remaining two percent having had no formal education. The implication of this is that, there is the possibility that, drivers who are educated tend to better understand the activities they are engaged in than those who are not educated. From the data presented, it can be concluded that, the low level of educational attainment of some of the drivers account for their inability to keep proper records of their operations.

Table 4.10: Educational Level of Drivers

Level of Education	Frequency	Percentage
Basic level	133	75.00
Secondary level	34	23.53
Never	3	1.47
Total	**150**	**100.00**

Source: Field Survey, 2006.

4.3.2 Marital Status of Drivers

In relation to the marital status of drivers, it was realized that about, 76.67 percent were married with the remaining 23.33 percent being single. This is shown in Table 4.11. Within the operations of the transport service industry, there can be very hostile incidence especially between operators assistants and passengers and since it is generally believed that married people are very accommodating and in most cases patient, it can help improve the service level within the industry.

Table 4.11: Marital Status of Drivers

Marital status	**Frequency**	**Percentage**
Single	35	23.33
Married	115	76.67
Total	**150**	**100.00**

Source: Field Survey, 2006.

4.3.3 Type of Training of Drivers

Table 4.12 shows the type of training drivers providing transport services undergo. From the survey, it was realized that about 92.42 percent of the drivers learnt how to drive without going through the formal driving schools but rather through other means such as graduating from being operators' assistants or apprenticeship. Others too became drivers by trying clients' vehicles by virtue of being mechanics. Improved service level, safety level and efficiency are key elements needed within the urban transport service industry and from the data presented below there are worrying signals which need the attention of policy makers; especially if issues of safety, efficiency and effective service level are paramount to them.

Table 4.12: Type of Driver Training

Type of Training	**Frequency**	**Percentage**
Driving School	11	7.58
Apprenticeship	139	92.42
Total	**150**	**100.00**

Source: Field Survey, 2006.

4.3.4 Operators Unions

Several transport unions exist and operate in the Kumasi Metropolitan Area, providing public transport services. These unions try to seek, among other things, the interest of their members through several initiatives. From the survey, it was realized that, the dominant transport union was the Ghana Private Road Transport Union (GPRTU) to which 48.53 percent of drivers belong. This is followed by the Cooperative Transport Union (CTU) to which 27.94 percent of drivers also belong. Details are shown in Table 4.13.

Table 4.13: Drivers Membership in Transport Unions

Transport Unions	Frequency	Percentage
GPRTU	73	48.53
PROTOA	7	4.41
Cooperative Transport Union	42	27.94
Ghana National Transport Owners Association	18	11.76
Concerned Drivers Union	9	5.88
Urban Mass Transit	1	1.47
Total	**150**	**100.00**

Source: Field Survey, 2006.

Section 4.3 of the report presents the analysis of the key issues concerning drivers who provide the supply of urban public transport services. The data presented provides useful insight into the service and efficiency levels within the urban public transport service industry. As a follow up to this section, Section 4.4 provides further insight into public transport vehicle operations in Kumasi with the view to facilitate a better understanding of the supply situation of the urban transport service industry. Section 4.4 presents data on vehicle operations which also provide an overview of the supply situation within urban public transport service industry.

4.4 Vehicle Operation

4.4.1 Capacity of Vehicles

Various services are provided by different vehicle categories in the urban transport industry. From the survey, Minibuses, Taxis and Large capacity buses are used. It was further revealed that, vehicles with capacity of five are used as Taxis and they constitute about 42.86 percent. Vehicles with capacity of 15, referred to as minibuses, constitute about 22.86 percent while those with capacity of 22 (also referred to as “207) and 33 seater (usually Benz buses) form 27.14 percent and 2.86 percent respectively. Buses with capacity of over 70 people constitute another form of vehicle type used for mass transit. Details are shown in Table 4.14.

Table 4.14: Capacity of Urban Public Transport Modes

Capacity	Frequency	Percentage
5 seater	64	42.86
15 seater	34	22.86
22 seater	41	27.14
33 seater	4	2.86
Over 70 seater	7	4.29
Total	**150**	**100.00**

Source: Field Survey, 2006.

4.4.2 Number of Passengers carried

The capacity of the vehicles in a way determines the number of passengers carried per trip. From the survey, it was realized that vehicles of the Metro Mass Transit Company carry about 110 passengers per trip while the Taxis and Minibus carry 5 and 14 respectively. From Table 4.15, it can be realized that, Metro Transit buses carry between 330 passengers a day along the Mampong road to about 625 passengers along the Accra road. Details on the other roads have been presented in Table 4.15.

Table 4.15: Number of Passengers carried by Mode and Corridor per Day

Route name	Mode	Number of passengers carried
Lake road (7.2 kilometers)	Taxi	35
	Minibus	140
	Metro Transit bus	548
Accra road (14.5 kilometers)	Taxi	40
	Minibus	210
	Metro Transit bus	652
Sunyani road (11.3 kilometers)	Taxi	40
	Minibus	173
	Metro Transit bus	373
Bekwai road (11 kilometers)	Taxi	40
	Minibus	92
	Metro Transit bus	369
Mampong road (8 kilometers)	Taxi	30
	Minibus	103
	Metro Transit bus	430

Source: Field Survey, 2006.

4.4.3 Age of Vehicles

With the exception of vehicles used by the Metro Mass Transit services, almost all the vehicles used in providing public transport services are over 7 years old. Average ages of each vehicle type and the estimated number have been presented in Table 4.16. The use of over age vehicles affect the efficiency of the services provided. Again, these vehicles were used vehicles thereby compounding the problem of efficiency. The used vehicles constitute about 95.52 percent of vehicle fleet interviewed while the remaining 4.48 percent were new.

Table 4.16: Average Age and Number of Vehicles in Operation in Kumasi

Vehicle type	Average age (years)	Estimated number/Day
Taxi	10	7,867
Minibus	13	4,247
Metro Transit bus	3	124

Source: Field Survey, 2006.

4.4.4 Hours Worked per day

From the field survey, it was found that about 38.8 percent of the drivers work for about 14 hours a day. However, as shown in Table 4.17, about 82.09 percent of the drivers work between 13 to 16 hours a day. It was also realized that the least number of hours worked in a day was 9 while the longest was 18 hours. On the basis of vehicle type, it was realized that the Minibuses work for about 15 hours while the Taxis and Metro Mass transit work for 14 hours each respectively.

Table 4.17: Number of Hours Worked per Day

Hours worked	Frequency	Percentage
9 – 12	20	13.43
13 – 16	123	82.09
17 – 19	7	4.48
Total	**150**	**100.00**

Source: Field Survey, 2006.

4.4.5 Number of Trips per Day

Drivers providing urban public transport services operate an average of six round trips a day. However, as indicated in Table 4.18, about 31.34 percent of drivers make between 1 trip and 3 trips a day with about 29.85 percent making between 7 to 9 trips a day. Details of the number of trips made by the drivers are shown in Table 4.18

Table 4.18: Trips Made per Day

Number of Trips	Frequency	Percentage
1 – 3	47	31.34
4 – 6	34	22.39
7 – 9	45	29.85
10 -12	24	16.42
Total	**150**	**100.00**

Source: Field Survey, 2006.

On the basis of vehicle type, Taxis and Minibuses make an average of 7 trips each a day while the Metro transit buses make an average of 5 trips a day. In relation to the age of the vehicles used, it was realized that, Metro transit buses were on the average 3 years old and do make an average of 5 trips a day. Again, it was realized that Taxis and Minibus had the oldest vehicle fleets with an average age of 10 and 13 years respectively. The percentages of these modes were 75.48 percent for Taxis and 82.1 percent for Minibus with average daily trips of 5 and 6 trips respectively. Those that are less than the average ages (that is the remaining 24.52 percent for Taxis and 17.9 percent for Minibus) make between 7 and 9 trips for Taxis and 7 and 8 trips for Minibuses respectively. It can therefore be inferred that, older vehicles usually make lower number of trips. The variance in the number of trips made by the Metro Transit buses may be due to the large number of passengers carried per trip and their limited numbers in the industry.

4.4.6 Vehicle Travel Time

Vehicular travel times range from 15 minutes to about 80 minutes per trip for public transport services. However, an average time of 35.38 minutes was recorded for all modes. On the basis of the vehicle mode, it was realized that, Taxis, as expected, were the fastest, making a trip in 18.10 minutes for a distance of 7.2 kilometers. The minibuses came next with a travel time of 28.40 minutes while the Metro transit buses make the trip in 30.65 minutes. Details of the travel time by the various transport modes can be seen in Table 4.19.

Table 4.19: Travel Time by Vehicle Modes per Trip by Corridor

Route name	Mode	Time (minutes)	Average Vehicular Speed (Kph)
Lake Road (7.2 kilometers)	Private	22.14	70km/hour
	Taxi	18.10	70km/hour
	Minibus	28.40	60km/hour
	Metro Transit bus	30.65	50km/hour
Accra Road (14.5 kilometers)	Private	18.45	80km/hour
	Taxi	15.18	85km/hour
	Minibus	32.25	70km/hour
	Metro Transit bus	38.14	55km/hour
Sunyani Road (11.3 kilometers)	Private	28.91	68km/hour
	Taxi	26.62	65km/hour
	Minibus	36.15	60km/hour
	Metro Transit bus	37.77	50km/hour
Bekwai Road (11 kilometers)	Private	24.21	75km/hour
	Taxi	18.18	75km/hour
	Minibus	26.71	70km/hour
	Metro Transit bus	35.67	50km/hour
Mampong Road (8 kilometers)	Private	62.46	60km/hour
	Taxi	60.29	55km/hour
	Minibus	68.58	55km/hour
	Metro Transit bus	78.81	45km/hour

Source: Field Survey, 2006.

The issue of congestion is more prominent on the Mampong road than any of the study routes. This is shown by the relatively longer time used by the various modes as compared to the others. From Table 4.19, it can be seen that, Taxis along the Mampong road use 60.29 minutes to make the journey of 8 kilometers. Details on the road are presented in Table 4.19.

4.4.7 Vehicle Travel Speed

Travel speed for most transport operators within the Kumasi Metropolitan Area ranges from 50km/h to about 70km/h. From the survey it was realized that Taxis travel fastest, followed by the Minibuses and the Metro Mass Transit vehicles respectively as shown in Table 4.19.

This section (Section 4.4) of the report presents the analysis of the vehicle operations within the supply of urban public transport services. The data presented provides a very useful insight into the operations within the urban transport service industry. The following section (Section 4.5) presents data on issues influencing vehicle operating costs which also provide an input for a better understanding to the supply situation within urban public transport service industry.

4.5 Vehicle Operating Costs

4.5.1 Fuel

Fuel is one of the variables used in urban transport services in Ghana. From the survey, it was found that for a day's operations, the volume of fuel used range from 27 to 45 litres with an average of 36 litres for Taxis and 18 litres to 54 litres with an average of 40.5 litres for Minibuses. The average volume of diesel used by the Metro Transit Buses is 72 litres. Using the cost per litre (¢6,666.67 or 67GHp) at the time of the survey, it was realized that, the cost of fuel per day ranged between ¢240,000 (24GH¢) to ¢480,000 (48 GH¢) as shown in Table 4.20.

Table 4.20: Quantity and Cost of Fuel Used Daily

Vehicle Mode	Average volume of fuel used (litres)	Cost of Fuel/Day (¢)
Taxis	36	240,000
Minibuses	40.5	270,000
Metro Transit Mass	72	480,000

Source: Field Survey, 2006.

4.5.2 Insurance

Insurance is one of the cost items incurred by vehicle operators providing urban public transport services. From the survey, annual insurance cost ranged between ¢360,000 (36GH¢) to ¢700,000 (70GH¢) for Taxis and ¢540,000 (54 GH¢) to ¢2,400,000 (240 GH¢) for Minibuses. However, on the average, the cost of insurance for Taxis is ¢604,857 (65 GH¢) while that for minibus is ¢833,053 (83 GH¢) as shown in Table 4.21. This cost is incurred every year; however, payments can be graduated quarterly to help operators who are unable to pay an all- in- one installment. Generally, the cost of insurance for public transport operators, irrespective of the mode, is ¢736,242 (74 GH¢) for a year.

Table 4.21: Annual Insurance Cost per Year

Vehicle mode	Average cost per year (¢)
Taxis	604,857
Minibuses	833,053
Metro Mass Transit	1,000,000

Source: Field Survey, 2006.

4.5.3 Spare Parts

Spare parts are also one of the key elements in the operations of urban public transport services. From the survey, it was found that, spare parts were the highest cost item in the operations of transport operators; costing an average of ¢1,343,478 (134 GH¢) a year. On the basis of vehicle mode, it was realized that, the cost of spare parts for Taxis is ¢934,211 (93 GH¢) and that for Minibuses is ¢1,631,481 (163 GH¢) a year. In relation to the age of vehicles, it was realized that, some spare parts of the Metro Transit buses are changed every 4 months while that of the Taxis and Minibuses are changed between every 2 to 3 months. This also implies that, since most of the vehicles used as Taxis and Minibuses in providing urban transport services are old, there is the tendency to change spare parts more frequently than the new vehicles.

4.5.4 Lubricants

From the survey, it was realized that, most operators, constituting about 91.30 percent of respondents, change their oil twice a month. On the basis of vehicle type, it was realized that, it cost operators of Taxis ¢84,741 (8.5 GH¢) to change an oil while it cost operators of Minibuses ¢198,447 (20 GH¢). However, on the average, it cost urban transport operators ¢142,231 (14 GH¢) a month every time they change their oil. In terms of frequency of change, it was revealed that, Taxis and Minibuses change their oils twice a month whiles the Metro transit buses change their oils once a month.

4.5.5 Tyre

Tyres are one of the important elements in the operations of vehicles. In Kumasi, most operators in the urban transport industry utilize used tyres which in most cases, are worn out and burst easily. From the survey, it was realized that, most drivers change their tyres twice every year costing about ¢930,000 (93 GH¢) for Taxis and ¢1,800,000 (180 GH¢) for Minibuses. On the basis of the age of vehicles, it was realized that, vehicles of the Metro Transit Limited change tyres every 6 months while about 74.2 percent of Taxis and 84.43 percent of Minibuses change tyres every 5 months and 4 months respectively. The implication of this is that, since most of the vehicles used as Taxis and Minibuses in providing urban transport services are generally old, they tend to also use used tyres which usually burst more frequently than the new tyres.

4.5.6 Maintenance

Like any facility, vehicles also require maintenance. This ensures that, the facility is in good condition to provide efficient services. From the survey, it was realized that maintenance activities are undertaken mostly on monthly basis as can be seen in Table 4.22. It was also realized that, the cost of maintenance ranged from ¢400,000 (40 GH¢) to about ¢1,800,000 (180 GH¢) for Taxis and ¢200,000 (20 GH¢) to ¢2,000,000 (200 GH¢)

for Minibuses. However, on the average, the cost of maintenance is ¢804,444 (80.5 GH¢) for Taxis and ¢1,345,946 (135 GH¢) for Minibuses in a year.

Table 4.22: Maintenance Cost by Vehicle Mode

Vehicle mode	Cost per year (¢)
Taxis	804,444
Minibuses	1,345,946
Metro Mass Transit	1,500,000

Source: Field Survey, 2006.

4.5.7 Wages

4.5.7.1 Drivers' Salary

Drivers providing services within the urban transport industry earn an average of ¢680,000 (68 GH¢) a month. However, drivers of the Metro Mass Transit Limited earn about 840,000 (84 GH¢) a month while those driving Taxis and Minibuses earn ¢580,000 (58 GH¢) and ¢600,000 (60 GH¢) a month respectively.

4.5.7.2 Operators' Assistants' Salary

The services of conductors are used in the operations of Metro Mass Transit Company and the Minibus services. From the survey, it was realized that, Conductors working with Metro Mass Transit Company earn ¢750,000 (75 GH¢) a month while their counterparts working with the Minibus services earn ¢650,000 (65 GH¢) a month.

4.5.8 Terminal Operating Expenses

The various vehicles providing urban transport use the Kejetia bus terminal as loading points. The field survey revealed that, Taxis pay ¢2,000 (20 GHp) a day while the Minibus pay ¢2,500 (25 GHp) a day for the use of the bus terminal. It was also realized that, buses of the Metro Transit Limited do not pay for the use of the terminal in Kumasi. This may be due to the fact that, Government intends to help reduce the cost of operations so as to reduce transport fares charged by them.

4.5.9 City Plate Charges

In addition to the daily terminal charges, vehicle operators also pay an average amount of ¢320,000 (32 GH¢) a year to the city authorities for operating in the city. This is also one of the cost items incurred by transport operators in the Kumasi Metropolitan area.

4.5.10 Vehicle Income Tax

Operators of transport services pay income tax to Internal Revenue Service (IRS) for the service they provide within the country. From the survey, this cost element varied by vehicle type with Taxis paying ¢60,000 (6 GH¢) every quarter while the Minibus pay ¢117, 632 (12 GH¢) every quarter.

4.5.11 Booking Fee

Within every bus terminal, drivers pay booking fees every morning in their operations. From the survey, it was revealed that, taxi drivers pay a booking fee of ¢3,500 (35 GHp) while their counterparts driving the mini-bus pay ¢9,000 (90 GHp) a day.

Section 4.5 of the report presents the analysis of the issues influencing the cost of providing urban transport services. Section 4.6 of the report presents data on vehicle revenue operations which can provide an insight into the supply situation within urban public transport service industry.

4.6 Revenue Operations

4.6.1 Fares Charged

Transport fares charged vary by vehicle mode and distance. Fares charged by Taxis are generally higher than the other modes. From the field surveys, it was revealed that, transport fares per kilometer for Metro transit bus was ¢103.45 (1 GHp) while that for Taxis ranged from ¢324.14 (3 GHp) to ¢767.86 (8 GHp). Transport fares per kilometer for Minibus also ranged from ¢137.93 (1 GHp) to ¢734.38 (7 GHp). From the field surveys, it can be inferred that, transport fares are cheaper for passengers using metro transit modes than those using the other modes. The implication of this is that, passengers are more likely to patronize the Metro transit buses than the other public transport modes in the study area within the increasing constraints of congestion.

4.6.2 Daily Payments made to Vehicle Owners

The surveys revealed that, daily payments made to vehicle owners ranged from ¢60,000 (6 GH¢) to about ¢100,000 (10 GH¢) for Taxis, ¢110,000 (11 GH¢) to ¢600,000 (60 GH¢) for Minibus and above ¢600,000 (60 GH¢) for Metro transit buses. The variation in amounts paid is as a result of the capacity of the various modes and hence their revenue earning capacity. In addition, drivers using vehicles that are new pay more than their colleagues using old registered vehicles. The age of vehicle appears to be the criterion used to determine how much to be paid to the owners because newer vehicles are capable of doing more round trips and, therefore, earning more for its owners.

Table 4.23: Daily Payment made by Operators to Vehicle Owners by Modes

Amount	Minibus	Taxi	Metro mass
60,000 – 100,000	-	100	-
110,000 – 200,000	37.84	-	-
210,000 – 400,000	56.76	-	-
410,000 – 600,000	5.40	-	-
Above 600,000	-	-	100
Total	**100**	**100**	**100**

Source: Field Survey, 2006.

From Table 4.23, it was realised that about 56.76 percent of Minibus drivers pay between ¢210,000 (GH¢21) to ¢400,000 (GH¢40) to their owners, while about 5.4 percent pay between ¢410,000 (GH¢41) to about ¢600,000 (GH¢60) to their owners. All the Taxis operators interviewed pay between ¢60,000 (GH¢6) to ¢100,000 (GH¢10) while the drivers of the metro Transit buses pay over ¢600,000 (GH¢60) to their managements.

4.7 Profile of Mass Transit Mode in the Study Area

According to the World Bank Urban Transport Strategy Review Paper, titled Cities on the Move, Public transport serves very desperate markets. In many large cities, it serves the basic movement needs of those without private transport. In more congested cities, it may also aim to attract commuting trips of higher-income car owners or potential car owners.

The problem is that the two markets are likely to require quite different price and quality combinations. For buses this can be reconciled by the provision of higher-quality services (air conditioned, seat only, and limited stop) on the same infrastructure as that for more basic services at lower costs (World Bank, 2002).

Public Transport Services in Kumasi, as is the case for the country as a whole, are provided predominantly by the private sector, which operates a mix of buses, trotro and taxis. Quite recently the Government has imported a number of new large buses for urban transit operations. A number of them have been delivered and are operating in Kumasi under management of Metro Mass Transit. Public transport is critical to the welfare of the urban poor and a crucial element in any poverty oriented city development strategy. The Metro Mass Transit Company Limited is responsible for the provision of urban mass transit services in KMA and in Ghana in general. The services being provided are usually unscheduled and often, on demand-responsive routes, filling gaps in informal transit provision. The vehicles operated in KMA are 124; made up of Yaxin Buses, VDL Buses and DAF Buses. These buses are relatively new with an average age of 3 years. In terms of capacity, each VDL Bus has a capacity of 103 while that of the DAF Buses is 62. A Single Decker Yaxin Bus has a capacity of 103 while the Double Decker Yaxin Bus has a capacity of 120. On the average, each bus makes an average of 5 trips a day and together; carries about 37,500 people a day which represents about 14.02 percent of passengers.

Government control over the operation of public transport is virtually non-existent; however the private operations are strictly controlled by trade unions of which the most powerful is the Ghana Private Road Transport Union (GPRTU). The unions charge membership fees and drivers are obliged to register with and pay a daily fee to a local branch, which controls a terminal. The unions on behalf of the Metropolitan/District Assemblies, who own the terminals, also collect user charges. Union rules require a vehicle to be full before it can depart, a practice which is not always in the interest of passengers who often cannot board vehicles between terminals and must wait long periods until they are full.

The overall quality of public transport is poor; most vehicles are old, and maintenance standards are extremely low. High vehicle maintenance costs arising from poor road surfaces and limitations as well as the acute congestion on the urban roads imposed on earnings, the constraint of operators to invest in new vehicles. The increasing number of vehicles and their low capacities result in long queues of vehicles during the morning and evening rush hours. Poor quality of public transport characterised by inadequate vehicles, old vehicles and low maintenance standards also make urban transport services poor. According to the Department of Urban Roads (2005), the vehicles used for public transport services in Accra are characterised by 89 percent trotro with average capacity of between 12-25 passengers; 7 percent buses with capacity being more than 35 passengers and 3 percent shared taxi with a maximum of 4 passengers. In Kumasi, taxis, trotro and buses constitute 43.9 percent, 31.71 percent and 14.02 percent respectively. The average age of the vehicles within the industry is 18 years for Accra and 13 years for Kumasi.

According to the Department of Urban Roads (2005), public transport passengers at various terminals in Accra indicated that, average waiting times for taxi and trotro were very similar, ranging between 15 and 19 minutes. The average travel time was generally found to be shorter for taxis than trotros, while bus trips were in general longer than both taxi and trotro trips. Travel time and waiting time at terminals was typically 70 minutes. In Kumasi, these modes compete with others on the same road space thereby resulting in long travel time and speed levels. In relation to travel time, it was realized that, Metro Mass Transit buses on the average use 68 minutes to make an average distance of 7.5km implying a relatively longer travel time. This may be due to the low speeds recorded for the Metro Mass Transit mode which was 50km/hour. The number of routes used by Metro Mass Transit limited in the KMA is 52 along which transport fares range from ¢1,000 (10 GHp) to ¢1,500 (15GHp) per one way trip. Transport fares by Metro Mass Transit modes are the cheapest compared to the Minibuses and Taxis.

Amongst the route problems, congestion, with associated long travel time and high operating cost is the most common problem. In Accra, about 52 percent of operators report congestion as the most common problem while in Kumasi, it accounted for about 50 percent. Metro Mass Transit modes require the reallocation of existing road space, thereby substantially improving speeds, while having indeterminate impacts upon other traffic (they may reduce or increase congestion). However, the insufficient provision of lay byes and bus stops has also contributed to the problems in the industry resulting in traffic jams along the routes.

4.8 Summary

The objective of this chapter has been to analyze the relevant field data which would provide the basis for the development of the demand, cost and supply models for the urban transport industry. Key variables have been discussed with reference to the objective and research issues of the study. Some of the salient issues discussed in this chapter include the passenger characteristics, driver characteristics, vehicle operation cost, vehicle operations and the revenue operations within the urban transport service industry. The issues discussed in this chapter will be used in the next chapter where the demand, cost, supply and pricing model would be estimated and discussed.

The next chapter (Chapter Five) presents the mathematical models which are to serve as a guide in the pricing of urban transport services in Ghana. The models developed were based on the data discussed in chapter four of the report. The demand and supply models which are to help estimate the demand for public transport services and the supply of urban transport services are presented in chapter five. In addition, the cost model which is to serve as an input in the supply model is presented.

CHAPTER FIVE
DEMAND AND SUPPLY ANALYSIS OF URBAN TRANSPORT SERVICES IN THE STUDY AREA

5.0 Introduction

The previous chapter presented data obtained from field surveys which included the vehicle operating characteristics, passenger trip generation and driver characteristics. After presenting data from the field surveys, this section of the study is concerned with detailed analysis of the demand for public transport services, supply of urban transport services as well as passengers' willingness - to – pay for such services. This was done through the use of mathematical models. This is so because modelling provides a framework for knowing how a real world system will behave under some given circumstances (Okoko, 2006). It is therefore a representation of the reality which facilitates its understanding to be used as a basis for policy rationale.

The stepwise multiple regression model was used in estimating the ordinal least square (OLS) regression in stages. The method, according to Garson (2006), includes in the equation, the independent variables that best correlate with the dependent variable. In the subsequent stages in building the model, the remaining independent variable with the highest partial correlation with the dependent variable is entered, controlling the first. The process is repeated at each stage partially for previously entered independent variables until the addition of a remaining independent variable does not increase the coefficient of multiple regressions (R^2) by a significant amount.

The t-test statistics were also used to assess the significance of the individual beta coefficients; specifically in testing the null hypothesis. A common rule of thumb, according to Field (2005), is to drop from the equation all variables not significant at 0.05 levels or better. Like all significance tests, the t-test assumes randomly sampled and distributed data. For this study, the two-tailed t-test was used because, the model seeks to establish relationships without any specific direction and also aims at establishing if there is any difference or change between the variables used in estimating the models. In other words, two plausible outcomes are expected from the statistical testing.

This chapter presents an overview of the analysis of the demand for urban public transport services, cost of providing the transport services and the supply of urban transport services in the study area. Specifically, the correlation analysis between the dependent and independent variables and among the independent variables for the demand, cost and supply of urban public transport services have been presented in the chapter.

The chapter is organised under five main subsections. Section one presents the analysis of the demand for urban public transport services in the study area while section two concentrates on estimating the cost of providing urban public transport services in Kumasi. Section three presents the discussions on the supply analysis within the urban public transport industry. The analysis and results of pricing of urban public transport services are presented in section four. This section seeks to determine the model to be used in pricing urban transport services in Ghana. The final part of the chapter presents the discussions on passengers' willingness to pay for urban public transport services in Ghana taking into account the results from the pricing analysis. The outcome will be used as the basis for testing how feasible the use of the pricing model will be in addressing the pricing problem within the urban transport service industry.

5.1 Urban Public Transport Service Demand Analysis

5.1.1 Demand for Urban Public Transport Services

Demand for public transport services can be measured using three variables. These three variables, according to the TRL (2004), are:

- Annual number of passenger trips (APT);
- Annual passenger kilometres (APK); and
- Annual passenger revenue (APR).

For the purpose of this study, Annual Passenger Kilometers (APK) which is the dependent variable is used as a measure of demand. This was done on the grounds of convenience (this indicator was easy to estimate compared to the other two) and availability of data. Data on annual passenger revenue (APR) was, for instance, not readily available due to the difficulty vehicle operators have in giving accurate information. Even data from Metro Transit Limited was not forth coming hence the difficulty in estimating APR. In the case of APT, data on the average number of passenger trips was found not to be reliable due to the fact that, passengers could not easily tell the number of trips made per day, hence the decision to exclude this variable. This was to avoid the possibility of overestimating or underestimating the dependent variable.

The reason for using APK is that, it avoids the problem of double counting associated with the definition of trips. APK was derived by estimating the number of passengers in all the 34 traffic zones within the Kumasi Metropolitan Area, average passengers trip length as well as the number of days passengers make trips in a year (which is 208 days). The use of 208 days in a year in estimating APK emanates from an average of making trips on four out of the seven days in a week which was obtained from the field surveys. Thus, APK is given as follows:

$$\mathbf{APK = Number\ of\ passengers \times Average\ passenger\ trip\ length \times 208.}\ \text{............}\ \mathbf{(11).}$$

The rationale behind the demand model used in the study is generally found in economic theory where passengers choose among alternatives so as to maximize their utility; that is, to choose the package of goods and services (trips) which they consider best among all the packages available to them, bearing in mind the various constraints which might be imposed on their choice. These constraints include the limited amount of both time and money available to the passengers and constraints imposed by the travel itself in relation to the travelers' choice of how much time to spend in travel. Mathematically, it can be stated as follow:

$$\mathbf{Maximize\ Utility\ for\ Trips} \Rightarrow \mathbf{U_i = \sum_j a_j . x_{ij}}\ \text{..}\ \mathbf{(12),}$$

where

U_i = Utility of alternative i;

i = mode of transport, i.e. Taxi, Minibus, Metro Transit Bus

x_{ij} = measured attribute values, i.e. cost, time, reliability, safety, comfort, availability, etc.

a_j = unknown parameters to be evaluated

The demand function reflects the behaviour of an individual or individuals whose preference dictates the particular functional form of the relationship. Many functions used in demand analysis are based on a linear or a log-linear relationship between the dependent and independent variables (TRL Report, 2004). For this study, the relationship between the independent variables as well as between the dependent and independent variables are explained in subsequent sections to provide a basis for selecting appropriate variables for the modelling of demand.

5.1.2 Factors Affecting the Demand for Urban Public Transport Services

Just as the demand for other goods and services, the demand for public transport service is determined by several variables. Vehicle kilometers operated (which is a proxy for service level), income of passengers, trip duration, fare levels, access to transport services, total population and employment levels influence the quantity of public transport demanded. These variables are briefly discussed as follows:

i. Vehicle Kilometres Operated (Service Level)

According to TRL 2004 report (TRL 593) on *Demand for Public Transport: A Practical Guide*, a typical proxy for service level, in the sense of frequency, is vehicle-kilometers operated, although this may also change in response to network size and or period of day/week over which service is provided. The higher the vehicle kilometers operated, the greater the frequency of vehicles and the higher the demand for public transport services and vice versa. In Ghana, it is expected to increase when demand is high, especially in the areas of the city with low vehicle ownership. The reverse is the same along rural roads where passenger trips are low.

ii. Fare Levels

The use of a public transport service normally requires the payment of fares which make a contribution to the costs of provision. The fare level may be varied by time of day, day of week or even within a specific geographical zone, in order to influence patterns of demand and to maximize revenue, again with the general acceptance of travelling public. Transport services that attract higher fare levels usually record lower demand level while the reverse is true. However, in Ghana passengers tend to have little say in the determination of fare levels and as such the fares charged do not likely reflect in lower demand. This is because passengers have limited options to choose from in relation to passenger travel.

iii. Income of Passengers

The ability to pay for a journey affects the number of trips generated by a household. Households with high income can afford to satisfy more of their travel demands than low-income households. In cities where population growth or change in population is minimal, traffic growth can come about in two ways: people making additional trips and people making longer journeys. In both situations, there is clear evidence that, trip lengths are increasing with income, although the effect may not be very strong. According to TRL (2004), the elasticity is in the range of 0.09 to 0.21. It is therefore true that, increasing family income leads to greater trip production (TRL, 2004).

However, in Ghana, households with high income levels often use their private means of transport while medium to low income households are often the ones who patronize urban public mass transport services. In a similar vein, high income households often embark on more trips than their counterparts in the medium and low income categories. It was found from the field survey that, high income households made about 35 percent trips more than, those in the lower income category. In addition, about 88 percent of households using public transport services fell within the low and medium income category in Kumasi.

iv. Trip Duration

This is the time a passenger takes to undertake a journey from an origin to a destination. It involves the time the passenger spends in walking to the nearest bus or vehicle stop, waiting for a vehicle, boarding time, journey time and walking time from the bus stop to final destination or home; where applicable. The time taken to undertake a trip affects the number of trips generated by a household member. Trips that take longer times to be made are likely to be made rarely while those that can be made within a shorter period are likely to be made frequently.

v. Total Population

This refers to the total number of people that are served by public transport services within a geographical area. The larger the population in an area, the higher the potential demand for public transport services while the reverse is also true. For example, from the field studies, passengers in traffic zones 16 (Ayigya), 33 (Kentinkrono, Nsene and Oduom) and 20 (Moshie Zongo and Sepe) (refer to Appendix 2) recorded the highest number of passenger trips of 98, 102 and 107 respectively.

vi. Employment Status

Most urban trips are generally to work places and as such, communities with larger numbers of people engaged in economic activities within the settlement tend to demand higher public transport services; especially when private means of transport is limited. This is supported by the higher number of work related trips recorded during the field studies. For example, from the field surveys it was realized that, the number of work related trips constituted about 52 percent of total number of trips recorded (refer to Page 70).

5.1.3 Definition and Selection of Variables

Having identified the factors that affect the demand for urban public transport services in the above subsection, this section presents the definitions and subsequent selection of the variables that were used in the demand analysis. The reason for the selection of these variables emanates from the review of secondary literature as well as from past studies conducted. Several variables are used as independent variables in estimating the demand model including the following:

- Transport fare - Transport fare is one of the independent variables. For this study, transport fare per kilometre was used. This was to standardize transport fares between an origin and destination as well as give the expected linear relationship with the dependent variable;
- Trip duration - Trip duration is the time it takes passengers to travel from an origin to a destination, including waiting times and other components described in the foregoing. It is an independent variable which was also standardized to reflect travel time per kilometre to reflect the variations in distances and travel times;
- Population – Population refers to the number of people living in the various traffic zones. Population was used as one of the independent variables. This was based on the population likely to be served by public transport operators within traffic

zones. This is because they serve as the basis for providing urban transport services within the study area;

- Income of household – Income of household is the amount of money at the disposal of household members for spending. Income of households was also captured as an independent variable in the estimation of the demand model. This is because, as stated earlier, household income is one of the variables which influence the number of trips passengers embark on;
- Employment status – Employment status refers to the state of people living in the traffic zones in relation to the economic activities. Employment status is one of the independent variables. The reason for using this variable is as a result of the increased trips to places of work. Data on employment level was nominal and for the study, dummy variables (1 = employed; 2 = unemployed) were used in order to assign value to the responses;
- Access to transport services – Access to transport services as used in the study, is defined as the ease with which passengers are able to obtain transport services to meet their travel needs. The parameters used in measuring access to transport services were ordinal. The responses were captured and measured using an ordinal scale (1 = very good access; 2 = good access; 3 = poor access); and
- Daily vehicle kilometres operated – Daily vehicle kilometres operated is the number of kilometres vehicles providing urban transport services operate. Daily vehicle kilometres operated by the various transport modes within the traffic zones was also used as an independent variable and measured along an interval scale using field data.

Using these variables, the study sought to establish a demand model which is linear in the form:

$$\mathbf{D = a + (b_1 * TF) + (b_2 * TD) + (b_3 * P) + (b_4 * Inc) + (b_5 * EL) + (b_6 * AS) + (b_7 * VKO) + \varepsilon} \quad \text{.............} \mathbf{(12)}$$

where D = Demand;

a = Constant;

b_1-b_7 = Beta coefficients;

TF = Transport fares;

TD = Trip duration;

P = Population;

Inc = Income of households;

EL	=	Employment status;
AS	=	Access to transport services;
VKO	=	Vehicle Kilometres Operated; and
ε	=	Error term.

The error term, which is also the disturbance term used in the equation is assumed or equated to zero. The reason is because one assumption of linear regression model is that, the error term has 50 percent chance of being positive and 50 percent chance of being negative. This therefore explains the reason why the error term is predicted to be zero.

The next stage of the work was to test for the skewness of each of these independent variables. Skewness is a measure of the asymmetry of a distribution. The normal distribution is symmetric and has a skewness value of zero. A distribution with a significant positive skewness has a long right tail while a distribution with a significant negative skewness has a long left tail. As a rough guide, skewness values more than twice its standard error is taken to indicate a departure from symmetry. From the skewness test, it was realized that, the skewness values for population level, trip duration, access level, fare levels and household income were close to zero with values of 0.112, 0.531, 0.203 and 0.293 respectively, implying a relatively normal distribution. Employment status, Income level and vehicle kilometres operated however positive skewness with values 3.919, 4.908 and 2.460 respectively had implying a long right tail. Based on the results of the skewness test, there was the need to transform these variables into new forms to normalise them. Details of these transformations are discussed in section 5.1.6 of this report.

5.1.4 Test for Multicollinearity

After transforming the independent variables that appeared to have no linear relationship with the dependent variable, the next level was to redefine equation 12 and then correlate these new variables with each other. The correlation between the independent variables was to resolve the possible problem of multicollinearity. The correlation matrix presents the relationship between the independent variables used in estimating the demand for public transport services. Some of the relationships are fairly strong while others are very weak (see Appendix 2 for details).

Like many social science studies, the strength of each relationship (r) was measured based on the following parameters:

Weak relationship	$0 < r < 0.3$;
Fairly strong relationship	$0.3 < r < 0.6$; and
Strong relationship	$0.6 < r < 1.0$.

Appendix 2 presents the correlation matrix which shows the correlation between the independent variables. From Appendix 2, it can be seen that, the independent variables are not highly correlated with one another, a situation that may not give rise to the problem of multicollinearity.

5.1.4.1 Correlation with Strong and Significant Relationships

From the scale presented earlier, it was realised that, the only relationship that fell under the 'strong relationship category' was that between fares and access to transport services as indicated in Table 5.1. The relationship between these two independent variables was expected in the sense that, people with low access to urban transport services tend to pay more for the service provided by the few opportunities. This is because of the interaction between demand and supply. The relationship between access to urban transport services and fare levels is strong and has an inverse association. This position is supported by the coefficient of -0.726. The inverse association is indicated by the negative sign on the correlation coefficient. This means that, the higher the fare levels, implying longer distances, the lower the level of access. The second row of the column in question shows the significance of the relationship. From Table 5.1, it can be seen that the relationship is significant at 0.01 or 1%. The significant probability is 0.000 and as stated earlier, the correlation found cannot be explained away as occurring by chance.

Since the two independent variables were highly correlated, the study adopted fares in the final model since it gave a better coefficient of determination with the dependent variable than access to transport services.

Table 5.1: Summary of Correlation with Strong and Significant Relationship

		Fares	Access to transport
Fares	Pearson Correlation Sig. (2-tailed) N	1 400	-.726(**) .000 400
Access to transport	Pearson Correlation Sig. (2-tailed) N	-.726(**) .000 400	1 400

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed).

5.1.4.2 Correlation with Fairly Strong and Significant Relationships

Using the threshold defined in the foregoing, there are three variables with fairly strong and significant relationships; that is, $0.3 < r < 0.6$. These relationships with their significance probabilities which are less than 0.05 have been presented in Table 5.2 and discussed seriatim:

i. Fare Level and Trip Duration

The correlation between fare level and trip duration was fairly strong and significant with a correlation coefficient of 0.482 and a significance probability of 0.000. This implies that, as the duration of travel increases, transport fares also increase. This supports the well known preposition in the urban transport industry, where transport fares increases with distance up to a certain point. According to White (2002), fare elasticities are initially high for very short journeys, dropping sharply to a low, and then increasing gradually with distance, until a peak point after which they decrease to a lower level for very long distance.

ii. Fare Level and Vehicle Kilometres Operated (Service Level)

Fares are fundamental to the operations of public transport since they form a major source of income to operations. In general, if fares are increased, patronage will decrease (White, 2002). This is based on the functional relationship between fares and patronage as represented by the demand curve. The relationship between transport fares and vehicle kilometres operated was inversely fairly strong and very significant with a coefficient of -0.449, implying that, the correlation between fare levels and vehicle kilometres operated is linear. This relationship is expected since as fare levels increases, demand is likely to reduce, hence resulting in decrease in vehicle kilometres operated. The inverse relationship is as a result of the negative sign on the coefficient. The significance probability of 0.000 confirms the overall significance of the relationship.

iii. Trip Duration and Vehicle Kilometres Operated (Service Level)

The relationship between trip duration and vehicle kilometres operated was also realised to be inversely fairly strong and significant. The coefficient of correlation is -0.499 implying that, shorter vehicle kilometres travelled may be associated with long trip durations on heavily trafficked roads and is indicative of congested urban roads. For example, along the Mampong road, the Metro Mass Transit buses take about 90 minutes, travelling at an average speed of 45km/h to make a journey of 8km compared to the same mode on the Lake road (7.2kilometres) at a speed of 50km/h.

Table 5.2: Summary of Correlation with Fairly Strong and Significant Relationships

		Fares	Vehicle Kilometres Operated (Service Level)	Trip Duration
Fares	Pearson Correlation	1	-.449(**)	0.482(**)
	Sig. (2-tailed)		.000	.000
	N	400	400	400
Vehicle Kilometres Operated (Service Level)	Pearson Correlation	-.449(**)	1	-.499(**)
	Sig. (2-tailed)	.000		.000
	N	400	400	400
Trip duration	Pearson Correlation	0.482(**)	-.499(**)	1
	Sig. (2-tailed)	.000	.000	
	N	400	400	400

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed).

5.1.4.3 Correlation with Weak but Significant Relationships

Four relationships between the independent variables gave results that were significant but have weak correlation coefficients. These were correlation coefficients of less than 0.3 but have significant probability of less than 5% as can be seen in Table 5.3. The four relationships have been explained below:

i. Access Level and Trip Duration

Access to urban transport services and trip duration has a weak inverse association with a correlation coefficient of -0.288. This means that, the higher the level of access, the lower the trip duration. This relationship is expected since people with high access to urban transport services tend to take shorter periods to undertake trips, especially when walking is involved. In addition, it may be due to the possibility of lower waiting time for the service provided. This is supported by the fact that, passengers in traffic zones 7 (Bantama), 8 (Ashtown) and 12 (Anloga) (see Appendix 1) which had high access level recorded low trip duration than their counterparts in traffic zones with relatively low access level.

ii. Employment Status and Access Level

The correlation between employment status and access level was shown to be weak with a coefficient of 0.118 but which was significant with a probability of 0.019. This relationship is expected in the sense that, the level of transport access does not influence or show the employment status of passengers. However, since most of the trips made in the study area are to work, there is a significant relationship between the two independent variables even if it is weak.

iii. Employment Status and Service Level

From Table 5.3, it can be seen that, the correlation between employment status and service level was also shown to be weak with a coefficient of 0.136. The figure showing the significance probability of the relationship is 0.007 which indicate that, at the cut-off criterion of 5%, the correlation is significant and that the correlation found cannot be explained away as merely a chance happening.

iv. Access Level and Service Level

The relationship between access level and service level is weak but significant with a coefficient of 0.281(refer to Table 5.3). This implies that, as access level increases, the level of service will also increase. This relationship is expected since as the vehicle kilometres operated increase, the average waiting time for instance, will decrease thereby increasing service level. The significance probability of the relationship is 0.000 which indicates that, at the cut-off criterion of 5%, the correlation is significant.

Table 5.3: Summary of Correlation between Variables with Weak but Significant Relationships

		Access level	Trip Duration	Employment Status	Vehicle Kilometres Operated (Service Level)
Access level	Pearson Correlation Sig. (2-tailed) N	1 400	-.288(**) .000 400	.118(*) .019 400	.281(**) .000 400
Trip Duration	Pearson Correlation Sig. (2-tailed) N	-.288(**) .000 400	1 400	#	#
Employment Status	Pearson Correlation Sig. (2-tailed) N	.118(*) .019 400	#	1 400	.136(**) .007 400
Vehicle Kilometres Operated (Service Level)	Pearson Correlation Sig. (2-tailed) N	.281(**) .000 400	#	.136(**) .007 400	1 400

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
# Variable pairs with strong and fairly strong relationships

5.1.4.4 Correlation between Variables with Weak and Insignificant Relationships

From Table 5.4, it can be seen that, all the relationships that were insignificant were weak. This means the correlation coefficient of the relationships was less than 0.3 and had a significance probability of more than 0.05. Details are presented in Appendix 2. These relationships have been outlined as follows:

i. Income of Household and Vehicle Kilometres Operated (Service Level);
ii. Access Level and Population;
iii. Fare Level and Population;
iv. Fare Level and Employment Status;
v. Fare Level and Income of Household;
vi. Income and Population;
vii. Income and Trip Duration;
viii. Income of Household and Access Level;
ix. Income of Household and Employment Status;
x. Employment Status and Population;
xi. Employment Status and Trip Duration;
xii. Trip Duration and Population; and

xiii. Population and Vehicle Kilometres Operated (Service Level).

Table 5.4 presents the summary of correlation between variables with weak and insignificant relationships.

Table 5.4: Summary of Correlation with Weak and Insignificant Relationships

		Fares	Income of household	Population	Employment level	Trip duration	Access to transport	Vehicle kilometres operated
Fares	Pearson Correlation	1	.089	-.013	-.031			
	Sig. (2-tailed)		.076	.801	.533	#	#	#
	N	400	400	400	400			
Income of household	Pearson Correlation	.089	1	-.026	-.055	.095	-.087	-.033
	Sig. (2-tailed)	.076		.598	.270	.059	.083	.507
	N	400	400	400	400	400	400	400
Population	Pearson Correlation	-.013	-.026	1	.051	-.026	-.007	-.046
	Sig. (2-tailed)	.801	.598		.321	.600	.884	.354
	N	400	400	400	400	400	400	400
Employment level	Pearson Correlation	-.031	-.055	.051	1	-.013		
	Sig. (2-tailed)	.533	.270	.321		.801	#	#
	N	400	400	400	400	400		
Trip duration	Pearson Correlation		.095	-.026	-.013	1		
	Sig. (2-tailed)	#	.059	.600	.801		#	#
	N		400	400	400	400		
Access to transport	Pearson Correlation		-.087	-.007			1	
	Sig. (2-tailed)	#	.083	.884	#	#		#
	N		400	400			400	
Vehicle kilometres operated	Pearson Correlation		-.033	-.046				1
	Sig. (2-tailed)	#	.507	.354	#	#	#	
	N		400	400				400

Source: Field Survey, 2006

Variable pairs with strong and fairly strong relationships

Having established the relationship between the independent variables in sub-section 5.14, the next step was to correlate the independent variables with the dependent variable and the result is presented in the section below.

5.1.5 Correlation between Dependent and Independent Variables

After defining the independent variables and assessing the degree of correlation between the independent variables, the simple linear correlation method was used to establish the relationship between each of the independent variables and the dependent variable as well as the significance of each of the independent variables to the demand for public transport services. The reason for using this method was to eliminate variables that do not contribute significantly to the overall demand for urban public transport services in Kumasi. In addition, multicollinearity was to be assessed and removed.

The correlation matrix shown in Table 5.5 presents the relationship between the dependent variable and each of the independent variables used in estimating the demand for public transport services. The correlation between the dependent and independent variables was to determine the contribution of each of the independent variables to the demand for urban public transport services. In addition, it gives an indication of how the variations in the dependent variables are accounted for by variations in each of the independent variables. Appendix 2 presents the correlation matrix which shows the correlation between the dependent variable and each of the independent variables as well as between any pair of independent variables selected for the study.

From Table 5.5, it can be seen that the correlation between demand for public transport and transport fares was significant but an inverse one. This means that, there is a strong tendency for transport fares increases and demand to move together in a linear manner but with a negative slope. This shows the elasticity of the demand for public transport services. According to Frank and Bernanke (2003), it is the ratio of the proportional change in patronage to the proportional change in fares. It has a negative value when, as is usually the case, fares and patronage are inversely related: an increase in fares leads to a decrease in patronage and vice versa. Elasticity of demand is the percentage change in the number of trips that will occur in response to a one percent change in any one of the 'prices' of travel (if all others are kept constant).

In transport terms, elasticity is not simply the ratio by which travel frequency rate shrink in response to a one-time increase in fare or travel time, but rather, the instantaneous rate of change along the demand curve. In a similar vein, trip duration is likely to move in a linear like fashion with a negative slope. These relationships were generally expected since they portray the situation within the urban transport service industry. The relationship between demand and population is a very strong one with a correlation coefficient of 0.757. This means that, an increase in population which is a proxy of supply will have an effect on demand for urban public transport services in Kumasi.

The relationship between demand on one hand and household income, employment level and vehicle kilometres operated as individual independent variables was not linear as can be seen in Table 5.5. This means that, the relationship between demand and each of these three independent variables was not linear. These variables were therefore transformed to help determine the form of the relationship between demand and of each of the three variables. The transformation was necessary because, it made the distributions of the variables normal and this helped in accurately fitting the distribution with high R^2 with a view to understanding the exact relationship between the dependent variable and independent variables as well as to estimate various policy options.

In deciding on the functional form for the developed models, the relationship between the dependent variable and the independent variables was established. This was done by correlating the dependent variable against each of the independent variables. Correlations which provided non-linear relationships were transformed into logarithmic forms. The results of the variables which were non linear are presented in section 5.1.6.

5.1.6 Transformation of Independent Variables with Low Correlation Coefficients

After establishing that the relationship between demand as a dependent variable and income of household, employment level and vehicle kilometres operated as independent variables was not linear; the next stage was to accurately estimate the relationship between them by transforming the independent variables. After a series of transformations aimed at establishing some relationship with the dependent variable, it was realised that, the relationship between the dependent variable and the three independent variables: income of household, employment level and vehicle kilometres operated could be better estimated using the following logarithmic transformations:

a. Original income figures were transformed into $(1-\log\ \text{income})^{-1}$ .... (13);
b. 'Employment' figures were transformed to $(1+\log\ (\text{employment status}))^{-1}$ ... (14); and
c. 'Vehicle kilometres operated' were transformed into a new distribution using the relationship $(1-\log\ (\text{vehicle kilometres operated}))^{-1}$ .... (15).

The above transformations and their resulting distributions were individually used as independent variables and regressed on the dependent variables with correlation coefficient of 0.723, 0.524 and 0.621 respectively.

Table 5.5: Correlation between Dependent Variable and Independent Variables

		Annual number of passenger kilometers	Fares	Income of household	Population	Trip duration	Employment status	Vehicle kilometres operated
Annual number of passenger kilometres	Pearson Correlation	**1**	**-.186(**)**	**-.031**	**.757(**)**	**-.183(**)**	**-.020**	**.094**
	Sig. (2-tailed)		**.000**	**.532**	**.000**	**.000**	**.697**	**.060**
	N	**400**	**400**	**400**	**400**	**400**	**400**	**400**
Fares	Pearson Correlation	**-.186(**)**	1	.089	-.013	.482(**)	-.031	-.449(**)
	Sig. (2-tailed)	**.000**		.076	.801	.000	.533	.000
	N	**400**	400	400	400	400	400	400
Income of household	Pearson Correlation	**-.031**	.089	1	-.026	.095	-.055	-.033
	Sig. (2-tailed)	**.532**	.076		.598	.059	.270	.507
	N	**400**	400	400	400	400	400	400
Population	Pearson Correlation	**.757(**)**	-.013	-.026	1	-.026	.051	-.046
	Sig. (2-tailed)	**.000**	.801	.598		.600	.312	.354
	N	**400**	400	400	400	400	400	400
Trip duration	Pearson Correlation	**-.183(**)**	.482(**)	.095	-.026	1	-.013	-.499(**)
	Sig. (2-tailed)	**.000**	.000	.059	.600		.801	.000
	N	**400**	400	400	400	400	400	400
Employment status	Pearson Correlation	**-.020**	-.031	-.055	.051	-.013	1	.136(**)
	Sig. (2-tailed)	**.697**	.533	.270	.312	.801		.007
	N	**400**	400	400	400	400	400	400
Vehicle kilometres operated	Pearson Correlation	**.094**	-.449(**)	-.033	-.046	-.499(**)	.136(**)	1
	Sig. (2-tailed)	**.060**	.000	.507	.354	.000	.007	
	N	**400**	400	400	400	400	400	400

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

5.1.7 The Demand Model

After analyzing the correlation between the independent variables, the next step was to develop the demand model. The independent variables used in the estimation of the model included population, fares, trip duration, household income, employment status, service level and vehicle kilometers operated. The reason for the use of these variables stem from the fact that, based on previous studies such as the one conducted by TRL, (2004) and preliminary analysis, they are likely to affect significantly the demand for public transport services in Kumasi.

The multiple regression method was used in estimating the demand. The reason for using this method is to establish the contribution of each of the independent variables to the demand for urban transport services in the study area. The criterion for selecting or dropping an independent variable from the final model was based on their significance probability and correlation coefficients. Independent variables with significance probability of less than or equal to 0.05 were entered while those with significance probability greater than or equal to 0.10 were dropped. This is because; variables with significance probability of greater than or equal to 0.10 do not contribute significantly to the overall variability in the demand model. This was done in spite of the fact that some of them have high correlation coefficients.

Based on the criterion, it was realized that the significance probability for vehicle kilometers operated, access to transport and household income were 0.260, 0.744 and 0.839 respectively. From the figures recorded, it can be concluded that, household income, access to transport and vehicle kilometers operated were not significant in the overall model since their significance probabilities were higher than the criterion value of 0.05 needed to be included in the model; implying that, they are not robust enough to allow for their inclusion in the model. In one out of ten cases, they could result in an error.

In a similar vein, four variables were selected as being the key independent variables contributing to the demand model. These independent variables are fare levels, population level, trip duration and employment status. Based on the earlier criterion, these independent variables were selected because of their significance probability. From the regression output, it was realized that, the significance probability for population, fare level, trip duration and employment status were 0.000, 0.000, 0.004 and 0.044 respectively, which were all less than the 0.05 needed for inclusion in the final model.

From the regression output, it was realized that, population was the main independent variable contributing about 66.4% to the entire coefficient of multiple determination (R^2) of the model. This means that, 66.4% of the variations in transport demand can be explained by variations in population of the traffic zones. The next variable to be picked by the model was trip duration which contributes 10.1% of the R^2. Fare level contributes 9.4%, while employment status contributes the remaining 1% to the variability of demand.

Table 5.6 indicates the summary of the multiple stepwise regression analysis for the demand model. It can be seen from Table 5.7 that, the regression coefficient of the model is 0.932, implying a reasonably strong linear relationship between the number of passenger kilometers per annum as a dependent variable and population, fare, trip duration and employment level as an independent variable. The correlation of determination (R^2) of the model is 0.869 whiles the adjusted R^2 is 0.864. This means that about 87 percent of the variability in demand can be explained by variations in the independent variables. The F value of the model which is used to test the significance of correlation coefficient (r), correlation of determination (R^2) and the regression model as a whole is 153.29 and is significant at less than 0.001. Thus, there is a significant linear relationship overall between the dependent variable and the independent variables in the model; particularly population. As population of the traffic zones increase, this tends to impact travel needs and requirements directly.

In addition to the model fit is the Durbin-Waston test statistic which is use to test for the correlation between errors. Specifically, it tests whether adjacent residuals of the variables or error terms are correlated. From Table 5.7, Durbin-Waston was 1.865 which is close to 2, which means that the residuals are uncorrelated (Field, 2005). In simple terms, there is a rule of thumb in regression analysis, which states that, the observations should be independent of each other. This independence is tested by Durbin-Waston which must fall between 1.5 and 2.5.

Table 5.6: Summary of Multiple Stepwise Regression Analysis of Demand for Urban Transport Services

Independent variables	Unstandardized Coefficients	Standardized Coefficients	t values
Constant	163093244.02		3.528**
Population	4302755.55	.756	24.191**
Fares per Kilometers	-72226.23	-.130	-3.646**
Trip Duration per Kilometers	-5850058.76	-.102	-2.858**
Employment Levels	-77682443.96	-.063	-2.022**
Observations	400		
R	0.932		
R^2	0.869		
Adjusted R^2	0.864		
F	153.29		
Durbin-Watson Statistic	1.865		

Note: .01< p <.05**p <.01; **: very significant; R^2: Coefficient of determination; R: regression coefficient (estimate of the change in the dependent variable that can be attributed to a change of one unit in the independent variable)

From the foregoing discussions, the final output for the demand model obtained from the multiple stepwise regression analysis is given as:

$$\mathbf{D = 163093244.02 + 4302756 \times Pop - 72226.23 \times Fl - 5850058.76 \times TD - 77682443.96 \times (1 + \log(empst))^{-1}} \quad \textbf{(16)}$$

Where D = Demand;

Pop = Population;

Fl = Fare Level;

TD = Trip Duration; and

empst = Employment Status

The model derived from the regression analysis is aimed at estimating demand for urban public transport services in Kumasi. From the equation, it can be seen that, population, fare levels, trip duration and level of employment influence the demand for urban public transport services. This means that, any attempt to model the demand for urban transport services in Kumasi in future, should take into consideration these variables, since they together contribute substantially to the overall demand for urban public transport services.

The demand model will be used to estimate the demand for urban public transport services in Kumasi at any given time as well as predict the future demand given certain conditions. It is expected that, the results from the model will serve as useful information in the planning and management of urban transport services in the study area.

This section of the study was to estimate the demand for public transport services in the study area and having derived the demand model for public transport services in Kumasi, the study subsequently sought to estimate the cost of providing urban public transport services in the study area. This aspect of the study is crucial because it forms an important input to the estimation of the overall supply situation in Kumasi.

5.2 Estimating the Cost of Providing Urban Public Transport Services

5.2.1 Cost of Providing Urban Public Transport Services

The dependent variable or criterion variable for estimating the cost of operating urban transport service is the vehicle operating cost (VOC). According to Booz-Allen and Hamilton Inc. (1999), vehicle operating costs refer to costs that vary with usage and are measured per vehicle-mile and may refer to costs borne by individual transportation users. Operating costs may include: fuel, tyres, maintenance and repair, and mileage-dependent vehicle depreciation. Vehicle operating costs are affected not only by the cost of expendable items, such as fuel, but also by how quickly they are used. In estimating the cost of providing urban transport services, the Highway Development and Management IV (HDM IV) Software was used.

The reason for using the HDM IV software is due to the fact that, the model is reliable and the most comprehensive way of determining VOCs of different vehicles. This is because it takes into consideration parameters such as the road condition and age of vehicle, among others, which are usually, left out when calibrating VOCs manually. In addition, operators tend to underestimate the key variables that influence the cost of their operations. This may be due to the fact that, they have very little knowledge of it and this tends to affect pricing. Again, the use of the HDM IV is due to the fact that, it makes a lot of sense since so far, it is the officially accepted source for calibrating VOCs for different vehicles and road surface types. In Ghana, this model is what is used in determining different VOCs for different vehicles and different road types and terrains. Currently, default values for specific road types and vehicle types have been calibrated for Ghana with assistance from University of Birmingham, United Kingdom.

The HDM IV model used several data in computing the VOCs. They include route length, width of carriageway, width of road shoulder, direction of traffic flow, vertical and horizontal alignments of route, riding quality, surface condition, vehicle class and vehicle type, number of wheels and axles, passenger car equivalent units, annual ADT volume on study road, traffic condition on study road, number of traffic lanes on the carriageway, annual distance travelled, annual labour hours, crew hours and non-working hours, fuel, maintenance, spare parts, lubricant, tyre, insurance, overhead and cost of vehicle. The use of the above components is predicted in resource terms. Separate sets of equations are used for the different vehicle classes providing urban public transport services. Road user costs are calculated by predicting the physical quantities of the resources consumed and then multiplying them by corresponding user specified unit costs. In using the HDM IV model, the default values for vehicular speed, average daily traffic volume was replaced with empirical data recorded during the field surveys. The reason is that, the default values could lead to either an overestimation or underestimation of VOCs.

5.2.2 Comparing VOCs from HDM IV and Field Data

Table 5.7 and Figure 11 present the VOC results calculated using both the manual method and the HDM IV. From the Table, it can be seen that, the variance from the two methods was quite significant, resulting in the selection of one of the two methods. In deciding on the appropriateness of the method used in estimating the VOC, a statistical test of the means derived from the two methods was undertaken. This was to determine if there is any statistical significance from the results of the two methods. The paired sample statistics method was used in testing the significance between the results of the two methods.

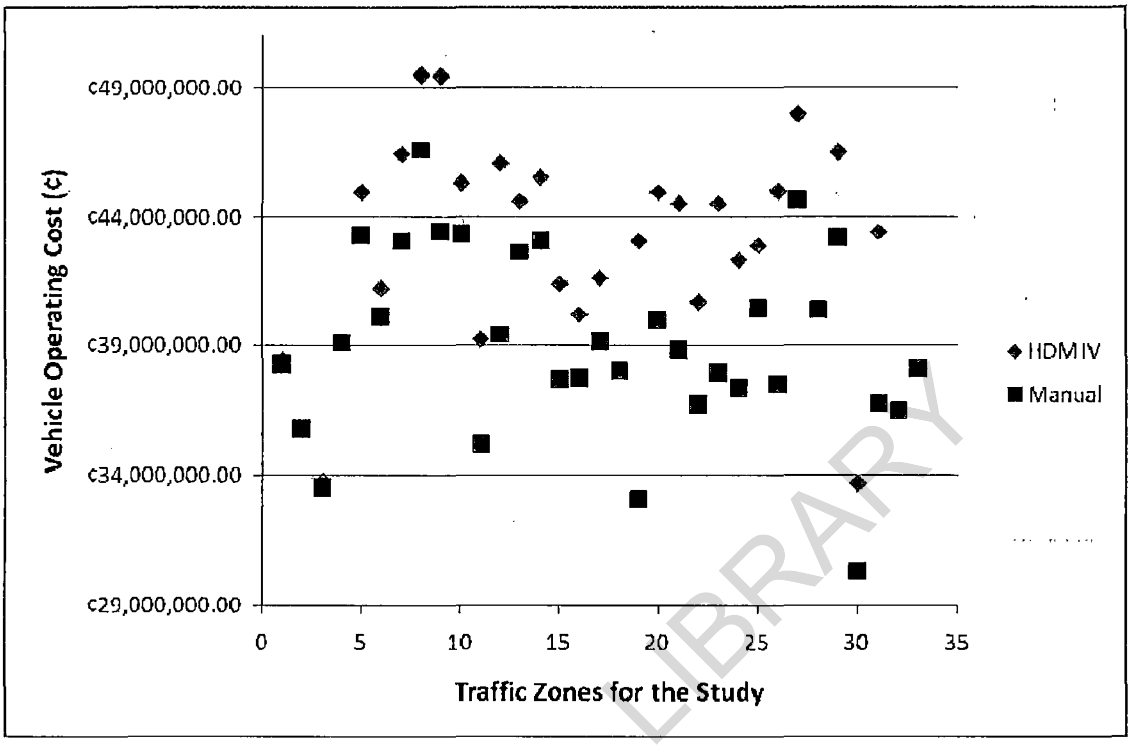
The results of the paired sample statistics indicate that, there is some significance between the mean VOC from the field data and that derived using HDM IV. Table 5.8 shows the summary aggregate results from the two methods. From the results of the means and the standard deviations from the two methods, it can be seen that, there is wide variation of the results. This is supported by a t value of -6.495 and a significant probability of 0.000.

Table 5.7: Summary of VOCs from HDM IV and Manual for Traffic Zones

Traffic Zones	HDM IV	Manual	Variance (HDM IV - Manual)
1	38,435,200.00	38,255,200.00	180,000.00
2	35,775,571.43	35,775,571.43	0
3	33,769,650.00	33,519,650.00	250,000.00
4	39,103,285.71	39,103,285.71	0
5	44,953,833.33	43,287,166.67	1,666,666.67
6	41,200,111.11	40,089,000.00	1,111,111.11
7	46,413,916.67	43,080,583.33	3,333,333.33
8	49,468,142.86	46,611,000.00	2,857,142.86
9	49,415,400.00	43,415,400.00	6,000,000.00
10	45,327,600.00	43,327,600.00	2,000,000.00
11	39,204,000.00	35,204,000.00	4,000,000.00
12	46,086,500.00	39,419,833.33	6,666,666.67
13	44,638,600.00	42,638,600.00	2,000,000.00
14	45,548,500.00	43,048,500.00	2,500,000.00
15	41,405,750.00	37,655,750.00	3,750,000.00
16	40,210,500.00	37,710,500.00	2,500,000.00
17	41,633,250.00	39,123,250.00	2,510,000.00
18	37,983,100.00	37,983,100.00	0
19	43,090,000.00	33,090,000.00	10,000,000.00
20	44,975,000.00	39,975,000.00	5,000,000.00
21	44,522,750.00	38,772,750.00	5,750,000.00
22	40,683,200.00	36,683,200.00	4,000,000.00
23	44,546,666.67	37,880,000.00	6,666,666.67
24	42,321,500.00	37,321,500.00	5,000,000.00
25	42,902,750.00	40,402,750.00	2,500,000.00
26	45,003,750.00	37,503,750.00	7,500,000.00
27	47,981,333.33	44,648,000.00	3,333,333.33
28	40,382,500.00	40,382,500.00	0
29	46,519,666.67	43,186,333.33	3,333,333.33
30	33,687,000.00	30,353,666.67	3,333,333.33
31	43,433,333.33	36,766,666.67	6,666,666.67
32	36,501,333.33	36,501,333.33	0
33	38,062,500.00	38,062,500.00	0
34	38,993,833.33	35,660,500.00	3,333,333.33
Total	42,277,035.57	39,324,418.12	2,952,617.45

Source: Field Survey, 2006

Figure 11: Scatter Diagram showing the results of the HDM IV Model and Manual Calibration



Source: Field Survey, 2006

The implication of this is that, the mean from the use of the HDM IV model is statistically and significantly different from the mean of the use of field data. Details from the paired sample statistics is presented in Appendix 14.

Table 5.8: Summary of VOCs from the HDM IV and Field Data

Parameters	HDM IV	Manual Calibration
Mean	39324418.12	42277035.57
Standard deviation	7535724.306	9865218.489

Source: Field Survey, 2006

Since the difference between the two methods was statistically significant, there was the need to select one for the study. The result from the HDM IV software was used for the study because, the results are more reliable since vehicle operators do not keep proper records of their operations hence the manual calibration may be inaccurate. In addition, the HDM IV considers the surface conditions on which the vehicles operate as well as several other factors.

5.2.3 Defining the Dependent Variable

For this study, the dependent variable is the operating cost of vehicles providing urban public transport services. As stated earlier, vehicle operating cost (VOC) refers to costs that come about as a result of the usage of the vehicles and are measured per vehicle-kilometres. VOC may also refer to costs borne by individual transportation users.

5.2.4 Factors Affecting the Cost of Providing Urban Public Transport Services

The cost of providing urban transport service which is a key determinant of the supply levels of transport service is a function influenced by several variables. These variables include cost of fuel, spare parts and maintenance cost, tyre cost, lubricant cost, cost of overheads, trip length and hours worked. The dependent and independent variables used in the regression analysis are defined in the next two sections.

5.2.5 Definition of Independent Variables

After identifying the factors that affect the cost of providing urban public transport services in Kumasi, this section presents the definitions and subsequent selection of the variables that were used as independent variables in the cost estimation. The variables used as independent variables in estimating the cost model include the following:

- Fuel – Fuel is one of the independent variables to be used in the estimation of the cost model. For this study, the amount spent on fuel a year was used. This was derived by multiplying the number of litres used per year by the cost per litre;
- Spare parts / maintenance - The cost of spare parts and maintenance is another independent variable used in estimating the cost of urban transport service. For this study, the annual cost incurred during maintenance activities as well as the cost of the parts used in replacing worn out ones were summed up. Spare parts/maintenance cost was standardised to reflect per kilometre cost per year;
- Tyre cost – Tyre cost is one of the independent variables used in estimating cost of providing urban transport services in Kumasi. In using this variable, it was standardized to reflect kilometre cost per year;

- Lubricant cost – Another independent variable is the cost of lubricant. Just like fuel, it was derived by establishing the frequency of changing lubricants, the cost per litre of the lubricant and the total litres used per year;
- Overhead cost – Overheads constitute cost items other than fuel, spare parts, tyre or lubricants per year. It includes cost items such as tolls, wages of drivers and their assistants, terminal fees, and vehicle embossment fees. Together, they constitute a substantial amount to the total cost of providing the service;
- Trip length – The length of trips is one of the key independent variables used in estimating the cost model. For this study, trip length is the number of kilometres vehicles travel within a year; and
- Hours worked – Another independent variable used in estimating the cost of providing urban public transport services is hours worked. For this study, hours worked is the actual number of hours the vehicles are operated and it includes time spent loading, unloading and refueling. It does not include vehicle idle time while waiting at the terminal for passengers.

Having defined the dependent variable and independent variables used in estimating the cost model, the next step was to correlate the independent variables among themselves to test for multicollinearity. This was followed by the correlation of the independent variables with the dependent variable.

5.2.6 Test for Multicollinearity

The correlation matrix presents the relationship between the dependent and independent variables as well as among the independent variables used in estimating the cost of providing public transport services. The correlation between the independent variables was aimed at testing and resolving the possible problem of multicollinearity. Appendix 3 presents the results of the correlation matrix which is the correlation between the independent variables. From Appendix 3, it can be seen that, the independent variables are not highly correlated with one another because the correlation coefficient recorded were not high, a situation that will result in the problem of multicollinearity. This supports the assumption of linearity of relationships which is needed for the multiple stepwise regression analysis.

5.2.6.1 Correlation with Strong and Significant Relationships

Correlation relationships between the independent variables that were strong and significant were also discussed. From the criterion of having correlation coefficient of greater than 0.6 but less than 1, it was realized that, two relationships are strong and significant. These relationships are presented as follows:

i. *Fuel Cost and Trip Length*

Fuel cost and trip length has a very strong association with a correlation coefficient of 0.600. This relationship is expected since as trip length increases, fuel cost also increases; all other things being equal. The second row of the column in question shows the significance of the relationship. From Table 5.9, it can be seen that, the relationship is significant at 5%, with the significance probability of 0.000.

ii. *Overhead Cost and Lubricant Cost*

Table 5.9 shows the correlation between overhead cost and lubricant cost to be strong with a coefficient of 0.649. This suggests a very strong association between overhead cost and lubricant cost. The reason for this assertion is from the magnitude of the coefficient which is 0.649. This is because most of the vehicles used in providing urban transport are very old with older engines hence the increase in the consumption levels of lubricants. The figure showing the significance probability of the relationship is 0.000 which indicate that, at the cut-off criterion of 5%, the correlation is significant.

Table 5.9: Summary of Correlation with Strong and Significant Relationships

		Overhead cost	Lubricant cost	Fuel cost	Trip length
Overhead cost	Pearson Correlation	1	.649(**)		
	Sig. (2-tailed)		.000	#	#
	N	150	150		
Lubricant cost	Pearson Correlation	.649(**)	1		
	Sig. (2-tailed)	.000		#	#
	N	150	150		
Fuel cost	Pearson Correlation			1	.600(**)
	Sig. (2-tailed)	#	#		.000
	N			150	150
Trip length	Pearson Correlation			.600(**)	1
	Sig. (2-tailed)	#	#	.000	

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed), # Variable pairs with fairly strong and weak relationships

5.2.6.2 Correlation with Fairly Strong and Significant Relationships

Table 5.10 shows the correlation with fairly strong and significant relationships. Relationships with coefficients of $0.3 < r < 0.6$ and significant probability of less than 0.05 were classified under this subsection and are briefly explained below:

i. *Spare parts/Maintenance Cost and Tyre Cost*

The correlation between spare parts/maintenance cost and tyre cost was shown by a coefficient of 0.422, implying a fairly strong association between them. This may be due to the fact that, there is a possible overlap in the classification of maintenance/spare parts and tyre cost by vehicle operators. More specifically, some operators do classify tyre changes as maintenance activity. In addition, because most vehicles within the industry are old, averaged about 13 years, there seem to be a greater pressure on tyres used for urban transport services. This is also compounded by the use of second hand tyres which easily get burst under pressure. This ultimately leads to higher cost of replacement.

ii. *Spare parts/Maintenance Cost and Insurance Cost*

From Table 5.10, it can be seen that the correlation between spare parts/maintenance cost and insurance cost was also shown to be fairly strong with a coefficient of 0.482. The significance probability of the relationship is 0.000, implying that, at the cut-off criterion of 5%, the correlation is significant and as such the use of both variables in the cost model does not pose any problem.

iii. *Spare parts/Maintenance Cost and Overhead Cost*

The relationship between spare parts/maintenance cost and overhead cost was expected to be significant and strong. From the correlation analysis, it was realised that, the correlation between spare parts/maintenance and overhead cost was indeed fairly strong with a coefficient of 0.408. This implies that, as the cost of maintenance/spare parts increases, the cost of overhead also increases. This may be due to the over aged nature of the vehicles (average age recorded is 13 years) used in the operations of urban public mass transport services in the study area.

Table 5.10: Summary of Correlation between Variables with Fairly Strong and Significant Relationships

		Spare parts/ maintenance	Tyre	Insurance	Overheads	Lubricant	Fuel	Hours worked	Trip length
Spare parts/ maintenance	Pearson Correlation	1	.422(**)	.358(**)	.408(**)	.498(**)			
	Sig. (2-tailed)		.000	.000	.000	.000	#	#	#
	N	150	150	150	150	150			
Tyre	Pearson Correlation	.422(**)	1		.326(**)	.536(**)			
	Sig. (2-tailed)	.000		#	.000	.000	#	#	#
	N	150	150		150	150			
Insurance	Pearson Correlation	.358(**)		1	.304(**)	.383(**)			
	Sig. (2-tailed)	.000	#		.000	.000	#	#	#
	N	150		150	150	150			
Overheads	Pearson Correlation	.408(**)	.326(**)	.304(**)	1		-.387(**)	.349(**)	.335(**)
	Sig. (2-tailed)	.000	.000	.000		#	.000	.000	.000
	N	150	150	150	150		150	150	150
Lubricant	Pearson Correlation	.498(**)	.536(**)	.383(**)		1	.378(**)		-.391(**)
	Sig. (2-tailed)	.000	.000	.000	#		.000	#	.000
	N	150	150	150		150	150		150
Fuel	Pearson Correlation				-.387(**)	.378(**)	1		
	Sig. (2-tailed)	#	#	#	.000	.000		#	#
	N				150	150	150		
Hours worked	Pearson Correlation				.349(**)			1	
	Sig. (2-tailed)	#	#	#	.000	#	#		#
	N				150			150	
Trip length	Pearson Correlation				.335(**)	-.391(**)			1
	Sig. (2-tailed)	#	#	#	.000	.000	#	#	
	N				150	150			150

Source: Field Survey, 2006. ** Correlation is significant at the 0.01 level (2-tailed), # Variable pairs with either strong or weak relationships *iv. Spare parts/Maintenance Cost and Lubricant Cost*

The correlation between spare parts/maintenance cost and lubricant cost was shown to be fairly strong with a coefficient of 0.498. This relationship was also expected due to the fact that; the level of lubricant consumption depends on the condition of the vehicle, and hence, if the parts of the vehicle are not in good condition and maintenance activities are not undertaken as expected, the cost incurred on lubricants is likely to go up.

v. Tyre Cost and Overhead Cost

The correlation between tyre cost and overhead cost was shown to be fairly strong with a coefficient of 0.326 as can be seen from Table 5.10. This implies that, an increase in tyre cost may lead to an increase in overhead cost. This is because, increase in overhead activities lead to increase in vehicle utilization which has an ultimate effect on the use of tyres.

vi. Tyre Cost and Lubricant Cost

The relationship between tyre cost and lubricant cost was expected to be non-linear due to the fact that, the two cost items do not have any bearing on each other. However, from the field analysis, it was realized that, the correlation between tyre cost and lubricant cost was shown to be fairly strong and significant with a coefficient of 0.536; implying that, the relationship between the two variables is linear. The variation may be due to the fact that, vehicles with poor tyre often lead to increase in pressure in the movement of the vehicle which eventually result in increase in fuel and lubricant consumption.

vii. Insurance Cost and Overhead Cost

The correlation between insurance cost and overhead cost was shown to be significant and also fairly strong with a coefficient of 0.515, implying that, the relationship between insurance cost and overhead cost is linear. This linear relationship may be due to the fact that, increase in overhead activities is likely to result in an increase vehicle operations which require increase insurance cost. Even though all the public mass transport vehicles use third party insurance, large capacity vehicles pay higher insurance than the smaller ones, which incur lower overhead cost.

viii. Insurance Cost and Trip Length

Insurance cost and trip length has an inversely fairly strong linear association and is shown by the correlation coefficient of -0.559. The inverse association is indicated by the negative sign on the correlation coefficient. This means that there is a strong linear relationship between insurance cost and trip length with negative slope. In everyday terms, it means that insurance and trip length affect one another. The significance probability of the relationship is 0.000 which implies that, the relationship is significant at 5%.

ix. Overhead Cost and Trip Length

The expected relationship between overhead cost and trip length is strong. This is because there is a strong relationship between trip length and overhead cost. This was confirmed from the field analysis. From Table 5.10, it can be seen that, the correlation between overhead cost and trip length was shown to be fairly strong with a coefficient of 0.335; implying that, there is a linear relationship between overhead cost and trip length. The figure showing the significance probability of the relationship is 0.000 which indicates that, at the cut-off criterion of 5%, the correlation is significant and cannot be explained away as merely a chance happening.

x. Overhead Cost and Fuel Cost

The correlation between overhead cost and fuel cost can be said to be fairly strong and inverse. From Table 5.10, it can be seen that, the correlation coefficient is -0.387 which is fairly strong. This implies that, an increase overhead operation is likely to result in vehicle utilization which also leads to increased fuel consumption. The level of significance shown by the significance probability is 0.000, implying that; there is a 0.00% chance of the strong coefficient not occurring by chance at the recommended threshold of 5%.

xi. Fuel Cost and Lubricant Cost

The correlation between fuel cost and lubricant cost can be said to be fairly strong, implying a linear relationship between the two variables. From Table 5.10, it can be seen that, the correlation coefficient is -0.378 which is fairly high. Again, the level of significance shown by the significance probability is 0.000 which is lower than the 0.05 cut off criterion. The fairly strong relationship between the two variables may be due to the presence of intervening variables, in the form of the age and condition of the vehicles used. From the field studies, it was found that most urban transport vehicles recorded were about 13 years, which has resulted in increased fuel consumption.

xii. Trip Length and Lubricant Cost

Trip length and lubricant cost has a fairly strong inverse association. This position is supported by the coefficient of -0.391. This means that, the relationship between trip length and lubricant cost is strong and linear. This relationship may be due to the use of over aged vehicles providing urban transport services within the study area. From the field surveys, the average age of vehicles used in urban transport services is 13 years. From Table 5.10, it can be seen that, the relationship is significant at 5% with a significant probability of 0.000.

xiii. Overhead Cost and Hours Worked

The correlation between overhead cost and hours worked was shown to be fairly strong with a coefficient of 0.349. The result is expected since as the number of working hours for vehicles increase, the overhead cost of those vehicles also increases. The figure showing the significance probability of the relationship is 0.000 which indicate that, at the cut-off criterion of 5%, the correlation is significant.

5.2.6.3 Correlation with Weak and Significant Relationships

Relationships that are weak and significant are relationships with correlation coefficient of less than 0.3 and significant probability of less than 0.05. From the above criteria, it was realized that, the following correlations were weak but significant:

i. Spare Parts/Maintenance Cost and Trip Length

Spare parts/maintenance cost and trip length has a weak and inverse association with a correlation coefficient of -0.220 as can be seen in Table 5.11. The inverse association is indicated by the negative sign on the correlation coefficient implying that trip length and the cost of spare parts/maintenance activities have a linear relationship with a negative slope. This inverse relationship was not expected since as vehicles embark on trips, the cost of changing spare parts and undertaking maintenance activities increases. The unexpected results may be due to the possibility of vehicle operators not undertaking maintenance activities or changing their spare parts as expected.

ii. Tyre Cost and Insurance Cost

From literature, the relationship between tyre cost and insurance cost is expected to be weak. From the analysis of field data, this known fact was realised as the relationship found between the two variables was weak. This position is as a result of the correlation coefficient of 0.195 shown by the correlation matrix in Table 5.11. In spite of the weak correlation coefficient, the relationship was found to be significant. The significance probability of the correlation is shown as 0.017. This makes the relationship significant at 5%. This therefore shows that, the sample and the response from the field studies was good and reliable.

iii. Spare Parts /Maintenance Cost and Fuel Cost

The relationship between spare parts/maintenance cost and fuel cost is expected to be weak because the two variables are only weakly related in the operations of urban public transport services. This position is supported by the correlation analysis. From the analysis, it was realised that, the correlation between spare parts/maintenance cost and fuel cost was weak with a coefficient of -0.222 with significance probability of 0.006 which indicate that, at the cut-off criterion of 5%, the correlation is significant.

iv. Fuel Cost and Hours Worked

Based on the criteria for determining the significance and strength of the relationship, it was realized that, the correlation between fuel cost and hours worked was inversely weak. This is explained by a coefficient of -0.225, implying that, there is a possibility that hours worked and fuel cost had a linear relationship with a negative slope. The level of significance supports this assertion and from Table 5.11, it can be seen that, the significance probability is 0.006. This relationship was not expected since as working hours increase, the level of fuel consumed was supposed to also increase. However, the distortion may be due to the fact that the long hours of work did not translate into the longer trip lengths made by vehicle operators due to longer waiting times at the bus terminal.

v. Hours Worked and Lubricant Cost

The relationship between hours worked and lubricant cost is linear and weak but significant. This position is as a result of the correlation coefficient of 0.197 shown in the correlation matrix in Table 5.11. The significance probability of the correlation is 0.016 which is lower than the cut off criterion of significance probability of 5%. This may be due to the fact that, long hours worked does not necessarily translate into long trip length which requires substantial amount of lubricant.

Table 5.11: Summary of Correlation with Weak and Significant Relationships

		Insurance cost	Fuel cost	Hours worked	Trip length	Spare parts / maintenance cost	Lubricant cost	Tyre cost
Insurance cost	Pearson Correlation Sig. (2-tailed) N	1 150	#	#	#	#	#	.195(*) .017 150
Fuel cost	Pearson Correlation Sig. (2-tailed) N	#	1 150	.225(**) .006 150	#	-.222(**) .006 150	#	#
Hours worked	Pearson Correlation Sig. (2-tailed) N	#	.225(**) .006 150	1 150	#	#	.197(*) .017 150	#
Trip length	Pearson Correlation Sig. (2-tailed) N	#	#	#	1 150	-.220(**) .007 150	#	#
Spare parts / maintenance cost	Pearson Correlation Sig. (2-tailed) N	#	-.222(**) .006 150	#	-.220(**) .007 150	1 150	#	#
Lubricant cost	Pearson Correlation Sig. (2-tailed) N	#	#	.197(*) .017 150	#	#	1 150	#
Tyre cost	Pearson Correlation Sig. (2-tailed) N	.195(*) .017 150	#	#	#	#	#	1 150

Source: Field Survey, 2006

** Correlation is significant at the 0.01 level (2-tailed); * Correlation is significant at the 0.05 level (2-tailed); # Variable pairs with either strong or fairly strong relationships.

5.2.6.4 Correlation with Weak and Insignificant Relationships

The relationships with correlation coefficients of less than 0.3 and significant probability of more than 0.05 were classified as weak and insignificant (refer to Table 5.12). From Appendix 3, the following relationships fell under this category:

i. Spare Parts / Maintenance Cost and Hours Worked;
ii. Tyre Cost and Fuel Cost;
iii. Tyre Cost and Hours Worked;
iv. Tyre Cost and Trip Length;
v. Insurance Cost and Fuel Cost;
vi. Insurance Cost and Hours Worked; and
vii. Insurance Cost and Trip Length.

From the outlined relationships, it was realised that, they all meet expectations except for tyre cost and trip length as well as tyre cost and fuel cost. The relationship between tyre cost and trip length was expected to be strong and significant. In a similar vein, the relationship between tyre cost and fuel cost was also expected to be fairly strong. However, the results showed a weak relationship. The unexpected result may be due to the fact that, most operators use worn out tyres which easily get burst during operations. It could also be that, the sample was not significant or questions were not answered properly in the survey.

Table 5.12: Summary of Correlation with Weak and Insignificant Relationships

		Fuel cost	Hours worked	Tyre cost	Insurance cost	Trip length	Spare parts/ maintenance cost
Fuel cost	Pearson Correlation	1		-.048	-.008		
	Sig. (2-tailed)		#	.563	.923	#	#
	N	150		150	150		
Hours worked	Pearson Correlation		1	-.071	.134		.066
	Sig. (2-tailed)	#		.387	.102	#	.423
	N		150	150	150		150
Tyre cost	Pearson Correlation	-.048	-.071			-.088	
	Sig. (2-tailed)	.563	.387	#	#	.286	#
	N	150	150			150	
Insurance cost	Pearson Correlation	-.008	.134			.042	
	Sig. (2-tailed)	.923	.102	#	#	.606	#
	N	150	150			150	
Trip length	Pearson Correlation			-.088	-.042		
	Sig. (2-tailed)	#	#	.286	.606	#	#
	N			150	150		
Spare parts / maintenance cost	Pearson Correlation		.066				
	Sig. (2-tailed)	#	.423	#	#	#	#
	N		150				

Source: Field Survey, 2006

Variable pairs with either strong or fairly strong relationships

5.2.7 Correlation among Dependent Variable and between Independent Variables

Appendix 3 also presents the correlation between the dependent variable and the independent variables. From this table, it can be seen that, there is a strong linear relationship between the dependent variable and five independent variables. These variables are spare parts/maintenance cost, tyre cost, overhead cost, trip length and lubricant cost. The relationship between the dependent variable and spare parts/maintenance cost, tyre cost, overhead cost, trip length, insurance cost, fuel cost and lubricant cost is shown by a coefficient of correlation of 0.426, 0.635, 0.568, 0.273, 0.395, 0.332 and 0.482 respectively. It can further be seen from Appendix 4 that, the relationship between the dependent variable and hours worked as an independent variable was not significant. This assertion is shown by the correlation coefficients obtained from the correlation analysis (see Appendix 3). This therefore led to its transformation in order to improve the significance of the relationship between hours worked and the dependent variable. This variable was therefore transformed to help determine the form of the relationship between cost and of hours worked. The transformation was necessary because, it made the distributions of the variable normal and this helped in accurately fitting the distribution with high R^2 with a view to understanding the exact relationship between the dependent variable and the independent variables as well as to estimate various policy options.

5.2.8 Transformation of Independent Variables with Low Coefficient of Determination (R^2)

The transformation of hours worked as independent variable revealed that, the relationship between the independent variable and dependent variables can be approximated using a log function with a correlation coefficient of 0.326 which is fairly strong according to the threshold of greater than 0.3 but less than 0.6. The significance probability of the relationship is 0.007 which is significant at the 5%.

5.2.9 The Cost Model

After the correlation analysis between the independent variables, the next step was to develop the cost model to be used in estimating the cost of providing urban transport services. This sought to determine the key variables contributing to the cost of providing urban transport services as well as their level of contribution. The outcome was to help in adjusting transport fares accordingly in case of a change in one of the independent variables. The independent variables used in the estimation of the cost model are spare parts/maintenance cost, tyre cost, insurance cost, overhead cost, fuel cost, hours worked, trip length and lubricant cost. This is because they are very significant statistically and contribute to the cost of providing urban transport services. The dependent variable is vehicle operating cost.

The multiple regression method was again used in estimating the cost model. The criterion for selecting or dropping an independent variable from the final model was based on its significance probability. Independent variables with significance probability of less than or equal to 0.05 were entered while those with significance probability greater than 0.05 were dropped. Based on this criterion, it was realized that the significance probability for insurance cost was 0.196, implying that insurance cost was not significant to the overall model since it was higher than the criterion value of 0.05 needed to be included in the model.

Seven variables were selected as being the key independent variables contributing to the cost model. These independent variables are tyre cost, overhead cost, trip length, fuel cost, spare parts/maintenance cost, hours worked and lubricant cost. Based on the earlier criterion, it was realized that, these independent variables were selected because of their significance probability. From the regression output, it was realized that, the significance probability for tyre cost, overhead cost, trip length, fuel cost and lubricant cost were 0.000 while that for spare parts/maintenance cost was 0.004. These significance probabilities were all less than the 0.05 needed to be included in the final model.

From the model results, it was realized that, tyre cost is the main independent variable contributing about 40.4% to the entire coefficient of determination (R^2) of the model. The next variable to be picked by the model is fuel cost which contributes 31.9% of the model. Trip length, overhead cost, spare parts/maintenance, hours worked and lubricant cost contribute 5.1%, 14.9%, 2%, 0.3% and 0.6% respectively to the variability in the cost of providing urban transport services.

Table 5.13 indicates the summary of the multiple stepwise regression analysis for the cost model. From the table, it can be seen that the regression coefficient was 0.975. This indicates a reasonably strong relationship between vehicle operating cost as a dependent variable and tyre cost, overhead cost, trip length, fuel cost, spare parts/maintenance cost, hours worked and lubricant cost as independent variables together. The correlation of determination (R^2) of the model is 0.952 whiles the adjusted R^2 is 0.949. This means that about 95 percent of the variability in cost can be explained by the regression on the independent variables. The F value of the model is 395.61 and this is significant at less than 5%. Thus, there is a significant relationship overall between the vehicle operating cost and the independent variables in the model.

In addition to the model fit is the Durbin-Waston test statistic which is a test for the correlation between errors. Specifically, it tests whether adjacent residuals are correlated. From Table 5.13, it can be realized that, Durbin-Waston was 1.56 which indicates that, the residuals of the model were uncorrelated.

Table 5.13: Summary of Multiple Stepwise Regression Analysis for Cost of Urban Transport Services

Independent variables	Unstandardized Coefficients	Standardized Coefficients	t values
Constant	2224173.77		-12.43**
Overhead cost	20161.83	0.587	22.42**
Trip length	561.84	0.304	12.61**
Tyre cost	24624.89	0.384	16.45**
Fuel cost	1347.56	0.491	20.07**
Spare parts / maintenance cost	26838.34	0.149	6.67**
Lubricant cost	13304.03	0.116	3.97**
Hours worked	714.79	0.057	2.76**
Observations	150		
R	0.975		
R^2	0.952		
Adjusted R^2	0.949		
F	395.806		
Durbin-Watson Statistic	1.56		

Note: .01< p <.05** p <.01; **: very significant; R^2: Coefficient of determination; R: regression coefficient (estimate of the change in the dependent variable that can be attributed to a change of one unit in the independent variable).

From Table 5.13, the final output for the cost model obtained from the multiple stepwise regression analysis is given as:

$$\mathbf{Cost = 20161.83 \times Oc + 561.84 \times Tl + 24624.89 \times Tc + 1347.56 \times Fc + 26838.34 \times S/Mcost + 13304.03 \times Lc + 714.79 \times Hw + 2224173.77} \qquad \mathbf{(17)}$$

Where Oc	=	Overhead cost;
Tl	=	Trip length;
Tc	=	Tyre cost;
Fc	=	Fuel cost;
S/Mcost	=	Spare parts/Maintenance cost;
Lc	=	Lubricant cost; and
Hw	=	Hours worked

From the analysis of the cost model, it can be concluded that, overhead cost, trip length, tyre cost, fuel cost, lubricant cost, hours worked, spare parts and maintenance cost determine the cost of operating urban public transport services in the study area.

Section 5.2 of the study sought to develop the model that will help in the estimation of cost of providing urban transport service in the study area. The result, which is the cost model, is one of the independent variables affecting the supply of urban transport services. Section 5.3 of the report, therefore, presents the results of the supply model which is very crucial in the pricing of urban public transport services. This model together with the demand model will help in determining the pricing model.

5.3 Urban Public Transport Service Supply Analysis

5.3.1 Supply of Urban Public Transport Services

The rationale behind the supply model used in the study is also generally found in economic theory in which vehicle operators and owners choose among alternative opportunities, in order to invest in the urban transport service industry. In so doing, service providers aim at maximizing their utility; that is, to provide a service that will offer them with the best return on their investment.

The supply function reflects the behaviour of service providers or vehicle owners whose interest and preference dictate the functional form of the relationship. For this study, supply was equated to the number of vehicular trips per year. The reason for using this is because, the actual vehicles operating within the study area is what is available for passengers to use when making trips. Vehicles that were not on the road or available for use were therefore left out. The relationship between the dependent variable (number of vehicular trips per year) as well as between the independent variables is explained in the subsequent subsections.

5.3.2 Factors Affecting the Supply of Urban Public Transport Services

Several factors affect the supply of urban public transport services. These factors include the cost of providing the service, profit levels, price of the vehicle used and the number of passengers to be served by public transport service. Before estimating the supply model, the cost of providing the service which is a very critical component was estimated. This provided the basis for the subsequent modelling of the supply function. The reason for estimating the cost model was that, unlike other independent variables, cost of providing the services was determined by several variables. These variables, in most cases, were individually used as a basis in determining transport fares. For example in Ghana, fuel prices have been used, and continue to be used, as the basis for the determination of transport fares under the assumption that, it increases the vehicle operating cost by the same margin of fuel price increases. The subsequent section therefore estimates the supply function of urban public transport services.

5.3.3 Definition of Dependent Variable

The number of vehicles available as used in this study refers to the total number of vehicles providing urban public transport services within the study area. The number of vehicles available to provide urban transport service affects the supply of urban public transport services. Where the total number of vehicles increase, the supply of transport services also increases and vice versa. For this study, supply is used as a proxy of the number of public transport vehicles available within all the 34 traffic zones of the study area.

5.3.4 Defining the Independent Variables

Profit is one of the independent variables that influence the supply of transport services and is the returns transport owners or operators make after deducting their cost from the revenue. The level of profit operators make is one important decision criterion considered investing in the urban transport industry. It is anticipated that, higher profit margins may manifest in increased investment levels resulting in an increase in number of vehicles and vice versa.

The price of the vehicle is another independent variable and is the market price at which vehicle owners purchased their vehicles for their operations. Generally, higher vehicle prices discourage the number of potential investors who may be willing or have the resources, to invest in the industry by purchasing vehicles.

The next predictor variable is the demand for the service. The level of demand for public transport services as used in the study refers to the number of passengers that use urban public transport services within a particular traffic zone. It is generally expected that, the higher the demand for public transport services, the more likely an increase in the supply of transport services.

5.3.5 Test for Multicollinearity

The correlation between the independent variables, as presented in Table 5.14, was to test and resolve any possible problem of multicollinearity. Table 5.14 presents the correlation matrix which is the correlation between the dependent variable and independent variables. From Table 5.14, it can be seen that, the independent variables are not highly correlated with one another, except between demand and number of vehicles available, a situation that may give rise to the problem of multicollinearity. In spite of the linear relationship, the problem of multicollinearity does not occur. This is because most of the correlation coefficients are not greater than 0.90 and in addition, several independent variables in the matrix do not have correlation coefficients greater than 0.7 (refer to Table 5.14). This supports the assumption of linearity of relationships which is needed for the multiple stepwise regression analysis. In addressing the problem, the number of vehicles available was dropped and demand used since demand gave a better correlation coefficient of determination.

5.3.6 Correlation between Dependent Variable and Independent Variables

Having defined the independent variables and dependent variable, the next step was to correlate the dependent variable with each of the independent variables. The correlation matrix in Table 5.14 presents the relationship between the dependent variable and independent variables used in estimating the supply of public transport services.

From Table 5.14, it can be seen that, all the independent variables contribute significantly to the overall supply situation in the study area. Specifically, it can be seen that, as supply increases, profit levels decreases. This is shown by the inverse correlation coefficient of -0.283. This result depicts the reality within any economic industry, where increased profit levels tend to attract other competitors within the industry, thereby leading to an increased supply.

Table 5.14: Summary of Multiple Stepwise Regression Analysis of Supply of Urban Transport Services

		Annual Number of vehicular trips	Profit level	Demand	Number of vehicles available	Cost of vehicle
Annual Number of vehicular trips	Pearson Correlation	1	-.283(**)	-.410(**)	-.258(**)	-.477(**)
	Sig. (2-tailed)		.000	.000	.001	.000
	N	150	150	150	150	150
Profit level	Pearson Correlation	-.283(**)	1	.047	-.040	.489(**)
	Sig. (2-tailed)	.000		.565	.626	.000
	N	150	150	150	150	150
Demand	Pearson Correlation	-.410(**)	.047	1	.972(**)	-.006
	Sig. (2-tailed)	.000	.565		.000	.939
	N	150	150	150	150	150
Number of vehicles available	Pearson Correlation	-.258(**)	-.040	.972(**)	1	-.130
	Sig. (2-tailed)	.001	.626	.000		.113
	N	150	150	150	150	150
Cost of vehicle	Pearson Correlation	-.477(**)	.489(**)	-.006	-.130	1
	Sig. (2-tailed)	.000	.000	.939	.113	
	N	150	150	150	150	150

Source: Field Survey, 2006

** Correlation is significant at the 0.05 level (2-tailed).

5.3.6.1 Correlation with Strong and Significant Relationship

i. *Demand Level and Vehicle Availability*

Demand level and number of vehicles available have a very strong association. This position is supported by the coefficient of 0.972. This relationship is expected since as number of vehicles available increases, demand level also increases. From Table 5.14, it can be seen that the relationship is significant at 5%. The significance probability showing is 0.000 and as stated earlier, the correlation between demand level and number of vehicles available cannot be explained away as occurring by chance.

Based on the correlation coefficient, it was realized that there was a problem of multicollinearity since the figure recorded goes against the rule of thumb; that is, multicollinearity may be a problem if a correlation is greater than 0.90 or several are greater than 0.7 in the correlation matrix formed by all the independent variables.

From the results of the correlation analysis, there was a problem of multicollinearity, hence, the final model was developed using demand level instead of the number of vehicles available. The reason is that, the inclusion of demand level provides an improved correlation coefficient and coefficient of determination than the number of vehicles available in the final model.

5.3.6.2 Correlation with Fairly Strong and Significant Relationship

i. *Profit Level and Cost of Vehicle*

The correlation between profit level and cost of vehicle was shown to be fairly strong with a coefficient of 0.489 implying that, there is a linear relationship between profit level and the cost of vehicle with a positive slope. In addition, it may mean that, most prospective vehicle owners do not invest in the industry when profit levels are low. The significance probability of the relationship is 0.000 and at a cut-off criterion of 5%, the correlation is significant.

5.3.6.3 Correlation with Weak and Significant Relationship

i. Profit Level and Demand

Profit level and demand level have a weak inverse association which is supported by the coefficient of -0.283. The second row of the column in question shows the significance of the relationship. From Table 5.14, it can be seen that, the relationship is significant at 5%. The significant probability is 0.000 and as stated earlier, the correlation between profit level and demand level cannot be explained away as occurring by chance.

5.3.6.4 Correlations with Weak and Insignificant Relationships

i. Demand Level and Cost of Vehicle

The relationship between demand level and cost of vehicle was expected to be very weak because of the non-linear relationship between the two variables. From the analysis, it was realised that, the correlation between demand level and cost of vehicle can be said to be inversely weak and insignificant, implying that the relationship may not be linear. This was not a cause for concern since there was no problem of multicollinearity. From Table 5.14, the correlation coefficient is -0.06 which is very low. Again, the level of significance shown by the significance probability is 0.939 which is higher than the 0.05 cut off criterion.

ii. Vehicle Availability and Cost of Vehicle

The relationship between cost of vehicle and the vehicles available was expected to be strong, implying a linear and significant relationship. However, from the analysis, it was realised that, the relationship between number of vehicles available and cost of vehicle can also be said to be inversely weak and non-linear. From Table 5.14, the correlation coefficient is -0.130 which is very low. The level of significance shown by the significance probability is 0.113 which is higher than the 0.05 cut off criterion. This means that, the correlation can be explained as occurring by chance. The difference in the results may be due to the fact that, the sample is not good enough or the responses obtained from the field surveys was not reliable.

iii. Profit Level and Vehicle Availability

The relationship between profit level and vehicle availability was shown to be weak and insignificant with a correlation coefficient of 0.047. This result conforms with the result between profit level and the cost of vehicle leading to low investment in the industry. The significance probability of the relationship is 0.626 which indicate that, at the cut-off criterion of 5%, the correlation is not significant. This means that, the correlation found can be explained away as merely a chance happening.

5.3.7 The Supply Model

After the correlation analysis, the supply model was developed. This model is to be used in estimating the supply of urban transport services in the study area and also to help determine the key variables contributing to the supply of urban transport services as well as their levels of contribution. The independent variables used in the estimation of the supply model are cost of providing urban transport service, profit level, demand for the services and cost of vehicle. The dependent variable is annual number of vehicular trips.

The multiple stepwise regression method was used in estimating the supply model. The criterion for selecting or dropping an independent variable from the final model was based on significance probability. Independent variables with significance probability of less than or equal to 0.05 were entered while those with significance probability greater than or equal to 0.10 were dropped.

On the basis of the criterion, all the four variables were selected as being the key independent variables contributing to the supply model. These independent variables are cost of providing urban transport service, profit level, demand level and cost of vehicles. Based on the earlier criterion, it was realized that, these independent variables were selected because of their significance probability. From the regression output, it was realized that, the significance probability for demand level, cost of providing urban transport service, cost of vehicle and profit level were 0.000, 0.000, 0.000 and 0.006 respectively which were less than the 0.05 needed to be included in the final model.

From the model results, it was realized that, cost of vehicle is the main independent variable contributing almost about 43.2% to the entire coefficient of determination (R^2) of the model (annual number of vehicular trips). The next variable to be picked by the model is demand for the service which contributes 17.1% of the model. Cost of providing urban transport service contributes 16.5% while Profit level contributes 2.2% to the final model. Table 5.15 is the summary of the multiple stepwise regression analysis for the cost supply. From the table, it can be seen that the regression coefficient is 0.893. This indicates a reasonably strong relationship between annual number of vehicular trips as a dependent variable and the following independent variables: cost of vehicle, demand for transport services and profit level.

The coefficient of multiple determination (R^2) of the model is 0.797 while the adjusted R^2 is 0.793. This means that about 80 percent of the variability in the supply of urban transport services can be explained by the independent variables. The F value of the model of 51.161 is significant at less than 5%. Thus, there is a significant relationship overall between the annual number of vehicular trips and the independent variables in the model. In addition to the model fit, the Durbin-Waston test statistic which test the independence of the observations used in the model is 1.225.

Table 5.15: Results of Multiple Stepwise Regression Analysis for Supply of Urban Transport Services

Independent variables	Unstandardized Coefficients	Standardized Coefficients	t values
Constant	59.503		0.061
Demand for Service	-8.470	-2.329	-8.749**
Log Profit levels	507.508	0.246	2.805**
Cost of Vehicles Cost of providing urban transport service	-5.6753 123.76	-0.431 0.197	-4.489** 2.142**
Observations	150		
R	0.893		
R^2	0.797		
Adjusted R^2	0.793		
F	51.161		
Durbin-Watson Statistic	1.225		

Note: .01< p <.05**p <.01; **: very significant; R^2: Coefficient of determination; R: regression coefficient (estimate of the change in the dependent variable that can be attributed to a change of one unit in the independent variable)

From the table above, the final output for the supply model obtained from the multiple stepwise regression analysis is given as:

$$\textbf{Supply} = \mathbf{59.503 - 8.470 \times D + 507.508 \times Log\_p - 5.6753 \times Cv + 123.76 \times Cs} \text{.............} \textbf{(18)}$$

where	D	=	Demand for the services;
	Log_p	=	Profit level;
	Cv	=	Cost of vehicle; and
	Cs	=	Cost of providing service

The model derived from the regression analysis is to help estimate the supply of urban public transport services in Kumasi. From the equation, it can be seen that, demand for urban transport service, profit level, cost of vehicle and cost of providing urban transport services determine the level of supply of urban public transport services. This means that, in modelling the supply of urban transport services in Kumasi, variables such as demand level, profit level, cost of providing urban transport service and cost of vehicle should be considered since they contribute substantially to the overall supply of urban public transport services.

5.4 Pricing of Urban Transport Services

Having estimated the demand and supply models, the next stage was to develop a model for pricing, taking into consideration the demand and supply of the service. From literature, it has been established that, the price of every good is determined by the demand for the product or service and its supply level. Prices are set at the point where demand and supply intersect.

After estimating and analyzing the demand and supply models, they were used to estimate the demand for and supply of urban public transport services. The results were further used in determining how they influence the pricing of urban public transport services in the study area. The regression method was once again used to establish how demand and supply influence the decision of setting transport prices. The reason for using this method is to establish if the independent variables contribute significantly to the overall pricing of urban public transport services in Kumasi. In other words, it is to help eliminate the variables that do not contribute significantly to the supply and demand models.

5.4.1 Factors Affecting Pricing of Urban Transport Services

The two main factors influencing the price of urban transport services in Kumasi are the demand for the service and the supply level being provided by transport owners. These variables individually contribute to the determination of prices of urban transport services in Kumasi. The subsequent section therefore presents a brief definition of the independent variables that influence the pricing of urban public transport services in the study area.

5.4.2 Definition of Dependent Variable

For this study, transport tariffs or fares are used as the dependent variable. The reason for using this is that, it represents what passengers pay for the benefit of transport services as well as what operators earn on their investment by providing urban transport services. The fares were standardized to represent transport cost per kilometre. The reason for standardizing the dependent variable is as a result of the differences in distance between origins and destinations along the study routes.

5.4.3 Definition of Independent Variables

The independent variables used in estimating the pricing model were demand for urban transport services and supply of urban public transport services. For this study, these variables have been defined as follows:

- Annual passenger kilometres – this is the total passenger kilometres travelled within the year and represents the demand for urban transport services. It was derived by estimating the total length of trips made by passengers. This is measured in kilometres and it gives a proxy to the actual distance which passengers will be willing to make in a year; and
- Annual number of vehicular trips – this represents the supply of urban transport services. Annual number of vehicular trips gives an idea of the number of trips vehicles make available to passengers who will be patronising the service being provided. It was estimated from the total number of trips, vehicle operators make in a year based on demand levels.

5.4.4 Correlation between Independent Variables

The correlation between demand for urban public transport services and supply of urban public transport services was seen to be fairly strong with a correlation coefficient of 0.518. In addition, the relationship was very significant with a significance probability of 0.000. This means that, there is a strong possibility for demand of urban public transport services and supply of urban transport services to operate in a linear manner. This relationship may be explained by the fact that, users of urban public transport services in most cases do not have alternative means of travelling and as a result tend to pay anything that is charged for the service. In addition, it can be argued that, supply is there to satisfy demand and never there on its own.

5.4.5 The Pricing Model

Table 5.16 indicates the summary of the regression analysis for the pricing model. From the table, it can be seen that the regression coefficient is 0.940. This indicates a reasonably strong relationship between transport prices as a dependent variable and demand for urban public transport services and supply of urban transport services as independent variables. The correlation of determination (R^2) of the model is 0.884 whiles the adjusted R^2 is 0.882.

Table 5.16: Summary of Multiple Stepwise Regression Analysis for Price of Urban Transport Services

Independent variables	**Unstandardized Coefficients**	**Standardized Coefficients**	**t values**
Constant	570.34		14.724**
Demand for urban transport service	- 0.118	0.597	19.284**
Supply of urban transport services	0.101	0.518	16.746**
Observations	150		
R	0.940		
R^2	0.884		
Adjusted R^2	0.882		
F	558.848		
Durbin-Watson Statistic	0.965		

Note: .01< p <.05** p <.01; **: very significant; R^2: Coefficient of determination; R: regression coefficient (estimate of the change in the dependent variable that can be attributed to a change of one unit in the independent variable)

This means that about 88 percent of the variability in pricing of urban transport services can be explained by variations in the independent variables. The F value of the model which is 558.848 is significant at less than 5%. Thus, there is an overall significant relationship between the prices of urban public transport services and the independent variables in the model.

Demand and Supply in the final pricing model are to be determined exogenously using the linear regression model. The linear model is appropriate due to the fact that, the phenomenon being studied is dynamic and ongoing and as such, can give a result which is equally appropriate like the exponential and geometric models.

From the equation, it can be seen that, transport prices are influenced by the demand for service and the level of supply of urban public transport services. This model which was derived from the analysis of the demand and supply situation on the market is to help estimate the price which is needed to reflect a perfect market situation within the urban public transport service industry in Kumasi. This implies that, in modelling the price of urban transport services in Kumasi, the demand level and supply level should be considered since they together contribute to the overall pricing of urban public transport services.

From the table above, the final output for the pricing model obtained from the regression analysis is given as: $\textbf{Price} = \textbf{570.34} + \textbf{0.101} \times \textbf{Supply} - \textbf{0.118} \times \textbf{Demand}$ **....... (19)**

5.5 Testing the Predictive Power of the Estimated Models

After the development of the various models, the next stage was to test their predictive power. This was to determine whether the models developed predict the reality and the vertical distances between the observed values and the predictions obtained, using the fitted line. In doing this, the model was used to predict the various dependent variables. Due to the fact that the study was carried out at 95% confidence interval, the predictive power of the models should indicate a percentage variation between the observed and the predictive values being less than or equal to 0.05. Therefore, if the visually determined line obtained from the model fits the data well, the deviations (errors) will be small. To obtain an overall measure of the quality of fit, the sum of squared deviations or sum of squared errors were used with various results presented as follows.

5.5.1 The Demand Model

The demand model is expected to predict the demand for public transport services in Kumasi. As stated above, a good predictive power of the model is given when the sum of squared deviations is small. Table 5.17 presents the results for the various traffic zones within the study area.

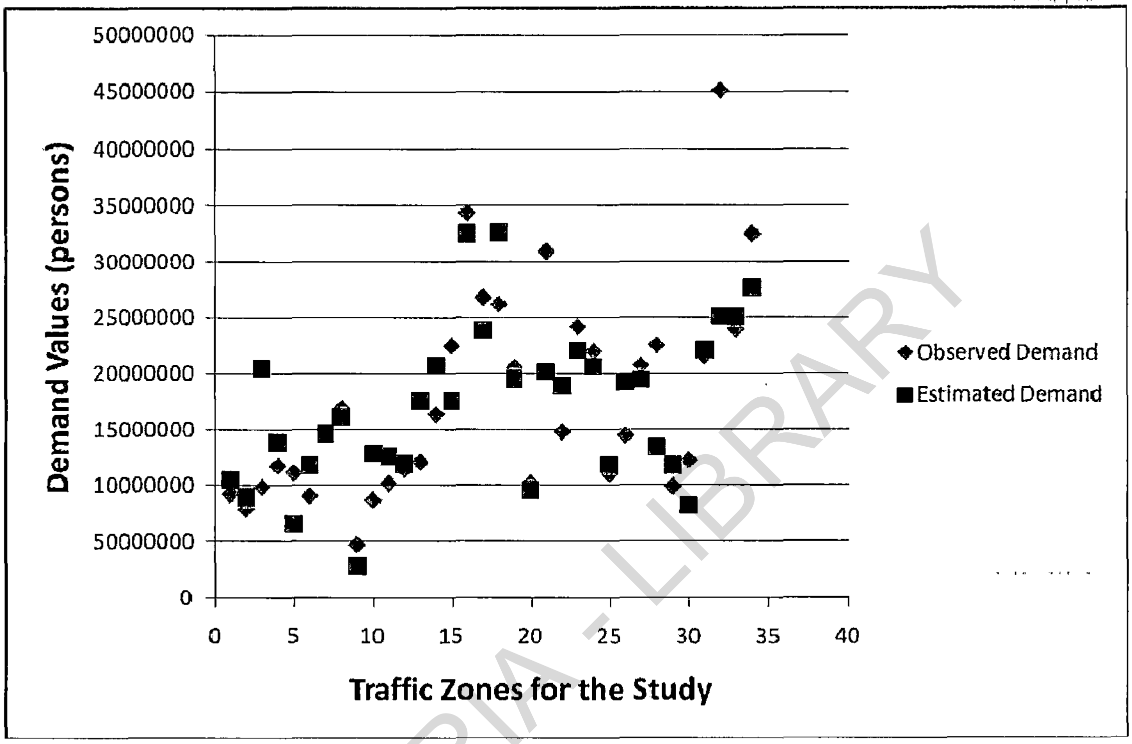
Table 5.17: Summary of Results of the Demand Model for Traffic Zones

Traffic zones	Observed Demand	Estimated Demand	Variance (Estimated - Observed)
1	92353835.64	104556574.7	12202739.09
2	78882409.41	89479900.14	10597490.74
3	98032757.94	205566072.4	107533314.4
4	117176660	138572167.7	21395507.65
5	110927708.9	65682774.4	-45244934.52
6	90406908.94	118067703.1	27660794.15
7	146871165.2	146632598.6	-238566.586
8	169013157.2	161003872	-8009285.186
9	47435304.68	28503403.34	-18931901.34
10	86801493.43	128527849.9	41726356.44
11	101644391.9	126234913.6	24590521.69
12	114007113.6	119064477.4	5057363.732
13	120780567.5	176181352.4	55400784.93
14	163565317.2	207256010.8	43690693.61
15	225149091	176190978.4	-48958112.62
16	343368425.1	325283154.1	-18085271.03
17	268008234.9	239444368.8	-28563866.03
18	262193840.3	326386819	64192978.73
19	205806275.6	195379458.3	-10426817.32
20	102032154.2	95908963.42	-6123190.765
21	309436019.9	201834553.7	-107601466.2
22	147795172.4	189240563.7	41445391.29
23	242051436.9	221012695.6	-21038741.32
24	220096215.1	206155474.6	-13940740.51
25	109946420.6	118386438.9	8440018.316
26	144526013.4	192820080.8	48294067.38
27	207697120.6	194679900.8	-13017219.81
28	225880651.3	134112458.1	-91768193.18
29	98813209.74	117992486.6	19179276.9
30	122272714.7	82047023.3	-40225691.45
31	215843627.3	221487283.7	5643656.386
32	451116489.2	251363510.5	-199752978.7
33	239883787.9	251239657.4	11355869.44
34	324981638.8	277448570.4	-47533068.43
Total	161695422.8	161695442.7	19.86212274

Source: Field Survey, 2006

Figure 12 also presents the scatter diagram for the correlation between observed and estimated demand.

Figure 12: Scatter Diagram between Estimated and Observed Demand for Urban Transport Services



Source: Field Survey, 2006

From the computations, it was realized that the sum of the squared deviations for the demand model was 19.86 (see Table 5.18), implying that, the variation between the observed dependent variable and the predicted dependent variable was small and the line obtained fits well. This is because the percentage variance between observed and estimated values was 0.000012% which is less than the 5% error margin.

Table 5.18: Summary of Testing the Demand Model

Observed Average Demand	Estimated Average Demand	Variance (Standard Error of Estimate)
161, 695,422.83	161,695,442.69	19.86

Source: Field Survey, 2006

5.5.2 The Cost Model

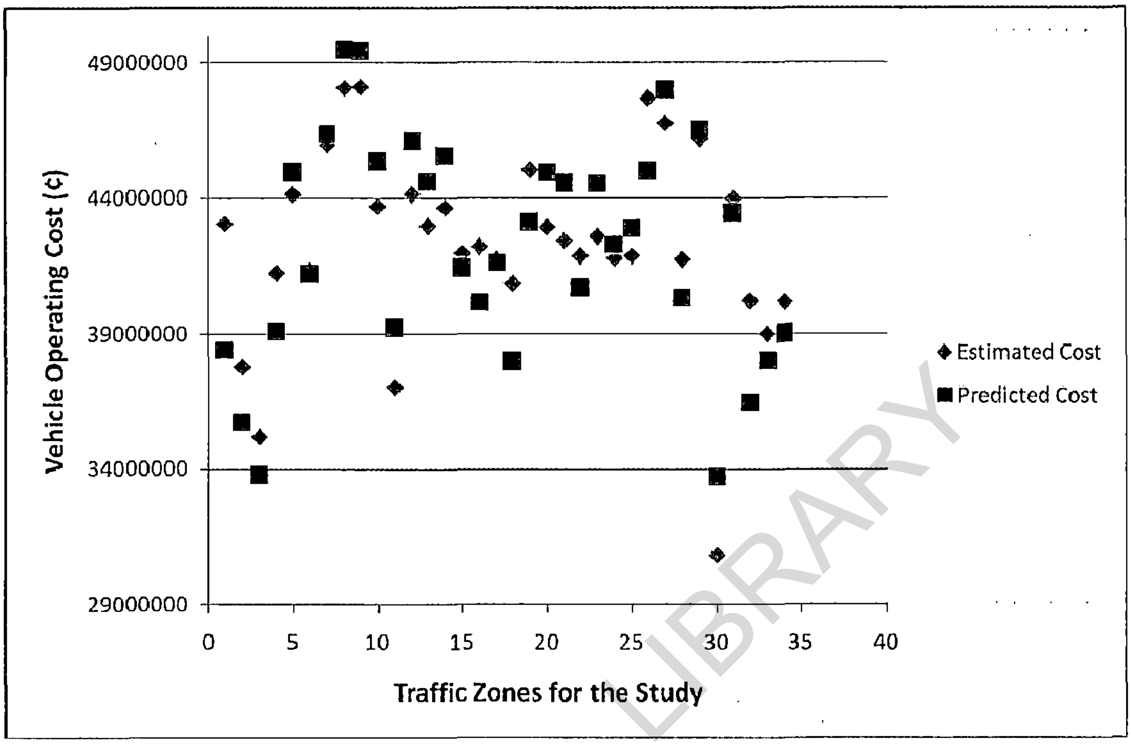
Table 5.19 and Figure 13 present the results of the cost model as against the observed values for the various traffic zones. The cost model derived is to be used to predict the cost of operating urban public transport services in Kumasi.

Table 5.19: Summary of Results of the Cost Model for Traffic Zones

Traffic zones	Estimated Cost	Predicted Cost	Variance (Estimated - Observed)
1	43076745.59	38435200.00	4641545.59
2	37805709.66	35775571.43	2030138.23
3	35199521.21	33769650.00	1429871.21
4	41245029.80	39103285.71	2141744.09
5	44159260.40	44953833.33	-794572.93
6	41317870.20	41200111.11	117759.09
7	45985879.73	46413916.67	-428036.93
8	48091361.05	49468142.86	-1376781.81
9	48141903.23	49415400.00	-1273496.77
10	43715835.81	45327600.00	-1611764.19
11	37048789.84	39204000.00	-2155210.16
12	44164169.13	46086500.00	-1922330.87
13	42967401.90	44638600.00	-1671198.10
14	43672025.57	45548500.00	-1876474.43
15	41986202.25	41405750.00	580452.25
16	42218578.85	40210500.00	2008078.85
17	41766572.60	41633250.00	133322.60
18	40863762.39	37983100.00	2880662.39
19	45036319.74	43090000.00	1946319.74
20	42951997.69	44975000.00	-2023002.31
21	42416943.50	44522750.00	-2105806.50
22	41868147.60	40683200.00	1184947.60
23	42586933.44	44546666.67	-1959733.22
24	41779503.87	42321500.00	-541996.13
25	41899754.46	42902750.00	-1002995.54
26	47688599.20	45003750.00	2684849.20
27	46785772.00	47981333.33	-1195561.33
28	41737068.38	40382500.00	1354568.38
29	46177617.85	46519666.67	-342048.82
30	30836304.54	33687000.00	-2850695.46
31	43995978.43	43433333.33	562645.09
32	40232999.24	36501333.33	3731665.91
33	39001280.46	38062500.00	938780.46
34	40209919.77	38993833.33	1216086.43
Total	**42407734.19**	**42277035.57**	**130698.62**

Source: Field Survey, 2006

Figure 13: Scatter Diagram between Estimated and Observed Cost of Urban Transport Services



Source: Field Survey, 2006

From computations, it was realized that the sum of squared deviations for the cost model was 130,698.62 (see Table 5.20), which is about 0.31% more than the observed average cost value. This implies that, the variation between the observed dependent variable and the predicted dependent variable is small and that, the line obtained fits well. The reason is that, the percentage variance is less than the 5% error margin.

Table 5.20: Summary of Testing the Cost Model

Observed Average Cost	Estimated Average Cost	Variance (Standard Error of Estimate)
42,277,035.57	42,407,734.19	130,698.62

Source: Field Survey, 2006

5.5.3 The Supply Model

The supply model is expected to be used in predicting the supply of public transport services in Kumasi. As stated above, a good predictive power of the model is given when the sum of squared deviations is small. Details of the results for the various traffic zones have been presented in Table 5.21 and Figure 14.

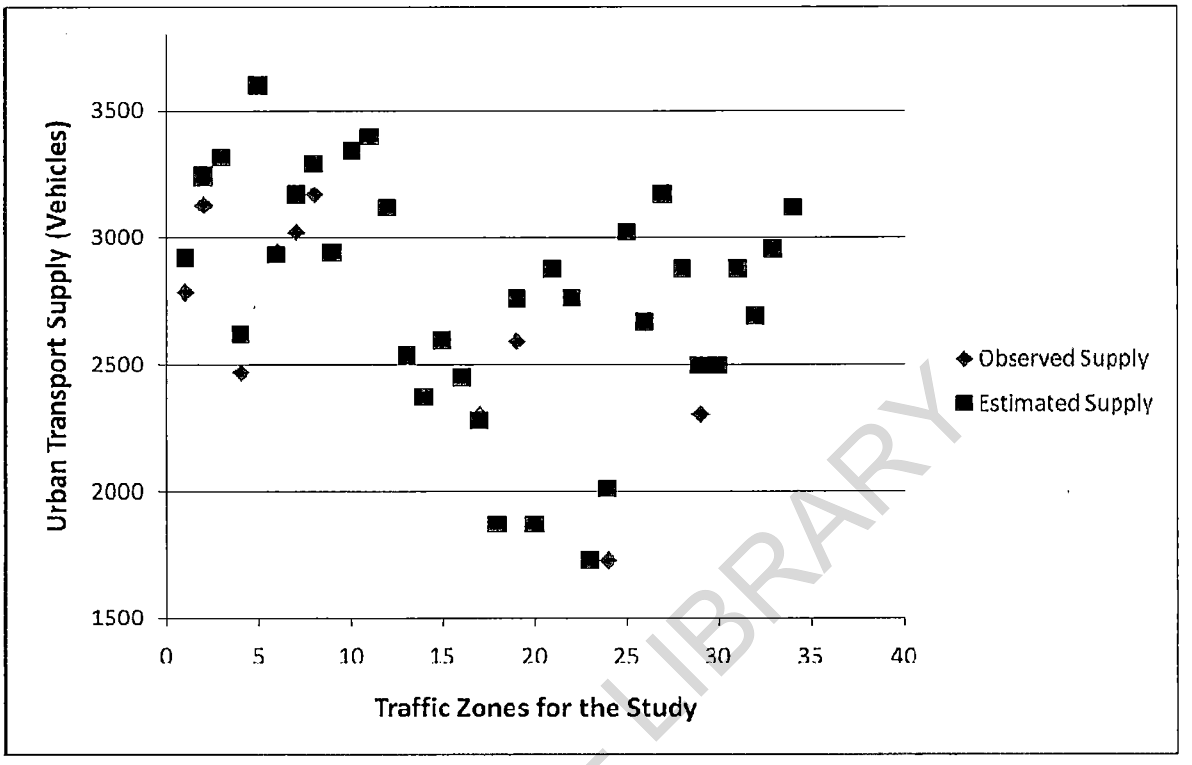
Table 5.21: Summary of Results of the Supply Model for Traffic Zones

Traffic zones	Observed Supply	Estimated Supply	Variance (Estimated - Observed)
1	2784.00	2919.67	135.67
2	3126.86	3239.43	112.57
3	3312.00	3313.75	1.75
4	2468.57	2621.71	153.14
5	3600.00	3600.33	0.33
6	2944.00	2935.11	-8.89
7	3024.00	3168.00	144.00
8	3168.00	3291.43	123.43
9	2937.60	2937.60	0.00
10	3340.80	3340.80	0.00
11	3398.40	3398.40	0.00
12	3120.00	3120.00	0.00
13	2534.40	2535.40	1.00
14	2376.00	2375.50	-0.50
15	2592.00	2592.00	0.00
16	2448.00	2448.00	0.00
17	2304.00	2284.00	-20.00
18	1872.00	1872.00	0.00
19	2592.00	2757.33	165.33
20	1872.00	1872.00	0.00
21	2880.00	2880.00	0.00
22	2764.80	2764.80	0.00
23	1728.00	1728.00	0.00
24	1728.00	2016.00	288.00
25	3024.00	3024.00	0.00
26	2664.00	2664.00	0.00
27	3168.00	3168.00	0.00
28	2880.00	2880.00	0.00
29	2304.00	2496.00	192.00
30	2496.00	2496.00	0.00
31	2880.00	2880.00	0.00
32	2688.00	2688.00	0.00
33	2952.00	2952.00	0.00
34	3120.00	3120.00	0.00
Total*	**2833.92**	**2867.54**	**33.62**

Source: Field Survey, 2006

*Average

Figure 14: Scatter Diagram between Estimated and Observed Supply of Urban Transport Services



Source: Field Survey, 2006

From the computations, it was realized that the sum of squared deviations for the demand model was 33.62 (see Table 5.22), implying that, the variation between the observed dependent variable and the predicted dependent variable was small. The percentage change of the variation between the estimated supply and the observed supply is 1.2%.

Table 5.22: Summary of Testing the Supply Model

Observed Average Supply	Estimated Average Supply	Variance (Standard Error of Estimate)
2833.92	2867.54	33.62

Source: Field Survey, 2006

5.5.4 The Pricing Model

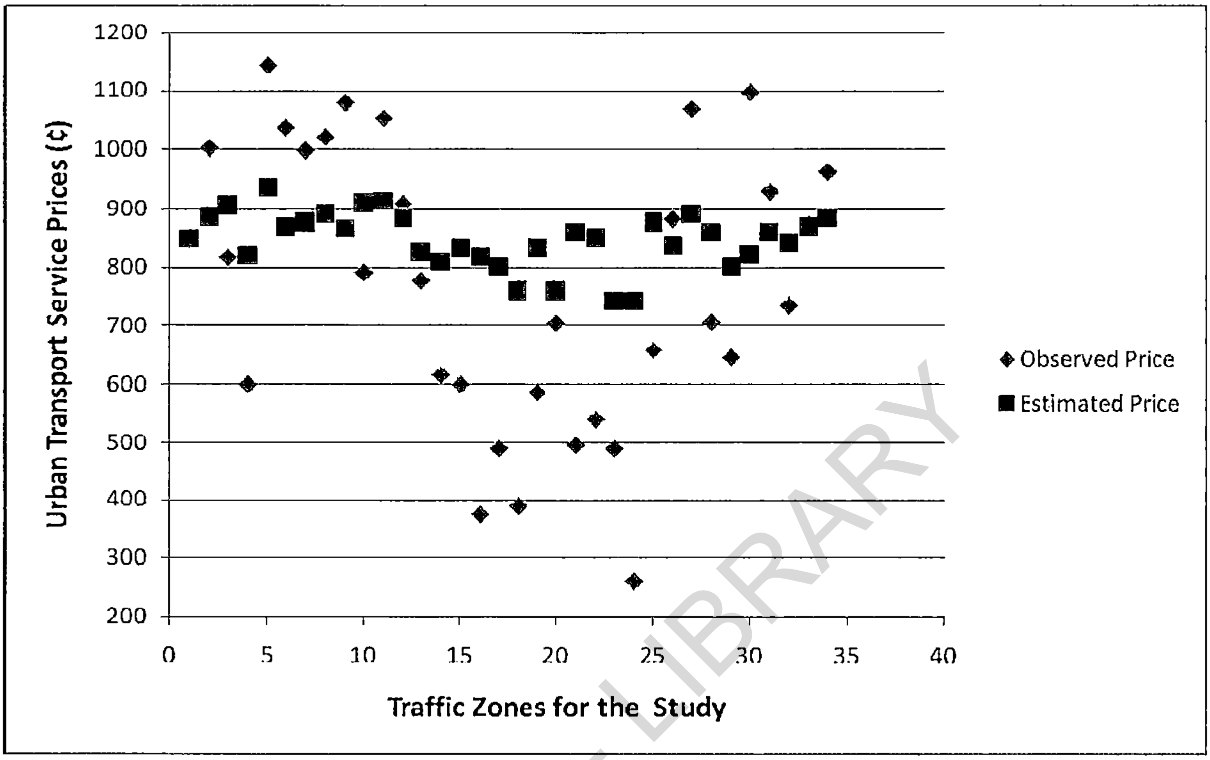
Table 5.23 and Figure 15 present the results of the observed and estimated prices for urban transport services in the study area. The Pricing model developed is to be used in predicting future transport prices for public transport services in Kumasi, especially as parameters within the industry changes. From the Table, it can be seen that, the variance between the predicted and observed prices was not very large which indicates the reliability of the model in predicting the reality.

Table 5.23: Summary of Results of the Pricing Model for Traffic Zones

Traffic zones	Observed Price	Estimated Price	Variance (Estimated - Observed)
1	848.13	850.60	2.47
2	1001.80	885.27	-116.53
3	817.61	903.94	86.33
4	599.93	818.74	218.81
5	1142.44	933.02	-209.42
6	1037.11	866.77	-170.34
7	998.08	874.86	-123.23
8	1019.43	889.37	-130.06
9	1078.08	866.14	-211.94
10	790.40	906.88	116.48
11	1052.27	912.67	-139.60
12	906.97	884.55	-22.42
13	777.09	825.40	48.31
14	617.13	809.34	192.22
15	600.37	831.16	230.79
16	375.80	816.57	440.78
17	489.24	802.07	312.83
18	389.13	758.40	369.27
19	586.97	831.14	244.17
20	704.21	758.44	54.23
21	495.56	860.27	364.71
22	539.74	848.62	308.88
23	490.03	743.87	253.85
24	261.08	743.87	482.79
25	659.41	874.84	215.43
26	882.15	838.46	-43.70
27	1069.33	889.40	-179.93
28	706.63	860.27	153.64
29	647.15	802.10	154.95
30	1096.91	821.53	-275.38
31	928.02	860.29	-67.73
32	734.58	840.83	106.25
33	871.81	867.54	-4.27
34	962.00	884.53	-77.48
Total	**814.98**	**855.63**	**40.65**

Source: Field Survey, 2006

Figure 15: Scatter Diagram between Estimated and Observed Prices of Urban Transport Services



Source: Field Survey, 2006

From the computations, it was realized that the sum of squared deviations for the pricing model was 40.65 (see Table 5.24), implying that, the variation which is about 4.99% between the observed dependent variable and the predicted dependent variable was small and that the line obtained fits well.

Table 5.24: Summary of Testing the Pricing Model

Observed Average Price	Estimated Average Price	Variance (Standard Error of Estimate)
814.98	855.63	40.65

Source: Field Survey, 2006

Sections 5.2 to 5.5 have outlined the analysis of the cost, demand, supply and pricing models for the urban transport service industry in the study area. All these models are to help estimate the cost, demand, supply and prices of urban transport services in the study area. In doing this, there was the need to look at the passengers who will be expected to use the service and in return pay for it. In view of this, passengers' willingness to pay for the urban transport services has been analysed. Section 5.6 of the study presents detailed analysis of passengers' willingness to pay for urban transport services in Kumasi.

5.6 Estimating the Passengers Willingness to Pay for Urban Public Transport Services

According to Okoko (2003), the concept of willingness to pay is predicated on the ideals of economic welfare where an individual or household maximizes its welfare subject to stated constraints. Willingness to pay technique is also founded in the Contingency Valuation Method (Binam et al, 2006). They argue that, the fundamental principle of this method is that, the preferences of individuals must serve as a base of evaluation for gains and losses of non-market goods and services, such as, urban transport services.

Willingness to pay is the amount that an individual or household is prepared to pay for the benefit of services being offered or about to be offered. For this study, the service being provided is urban public transport services and the objective function is to maximize an economic basket of urban public transport services. Owing to the fact that the study deals with nominal variables for the dependent and some independent variables, it adopted the logistic regression method. This method is a form of regression which is used when the dependent variable is a dichotomy and the independent variables are of any type. This means that, the independent variables can be nominal, ordinal or scaled. As mentioned previously, the independent or predictor variables in logistic regression can take any form. That is, logistic regression makes no assumption about the distribution of the independent variables. They do not have to be normally distributed, linearly related or of equal variance within each group. The relationship between the predictor and response variables is not a linear function in logistic regression; instead, the logistic regression function is used.

Logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independent variables and to determine the percent of variance in the dependent variable explained by the independent variables; to rank the relative importance of independent variables; to assess interaction effects; and to understand the impact of covariate control variables. Its assumptions are consistent with having a categorical dependent variable assumed to be a proxy for a true underlying continuous normal distribution.

5.6.1 Factors Affecting Passengers' Willingness to Pay for Public Transport Services

Several authors, as cited by Binam et al (2006), Whittigton et al., (1990), Flores and Richard (1997), Bloom and Shenglan (1999); Atim (1999) and Criel et al (1999) have all stated that, willingness to pay is determined by economic characteristics, socio-demographic characteristics and the characteristics of the service or good itself.

For this study, the factors affecting passengers' willingness to pay include the household income level, gender of passengers, household size and the service level. The value passengers place on the proposed payment of urban transport is a continuous variable. However, the yes/no response to the questions were about a specific discrete price. Hence, the observed dependent variable obtained from the bidding game procedure is not the maximum amount passengers are willing to pay but rather, an interval within which the 'actual' willingness to pay falls. The following subsection presents a brief definition of the variables that influence passengers' willingness to pay.

- Household income – the amount of money available to households influence their ability to pay for certain services including transport. Household income as used in this study refers to the amount of money available to households for housekeeping and which can be disposed off;
- Gender of passengers – gender as used in this study refers to the sex of passengers which can either be male or female. The gender of passengers also influences their willingness to pay for urban transport services. The demand of both sexes differ and it is generally expected that, males make more trips, especially to work, than their female counterparts; hence their willingness to pay for trips made;
- Household size – this is the number of people in a household. The number of people in a household influences that household's ability to expend on certain services. This is due to the various competing needs of the household members. In the same vein, the size of the households affect the ability of passengers to pay for urban transport services; and

- Service level – the service being provided in a way influences passengers willingness to pay for urban transport services. The service level as used in the study refers to the improved travel time, less waiting time and safety associated with the services being provided or offered to passengers. For this study, six different service options were presented to passengers. This was to assess if passengers were sensitive to the services being provided.

Having defined the factors that influence passengers' willingness to pay for urban transport services, the next stage is to discuss the various service options and the prices passengers are willing to pay.

5.6.2 Service Options and Prices Passengers are Willing to Pay

In determining passengers' willingness to pay, the various service options from which passengers were expected to choose were presented. The various service options have been presented in Table 5.25. Passengers were to indicate how much they will be willing to pay for the various service options at their disposal. The service options being provided were to assess passengers' perception of the quality of transport services being provided. These service level options have some form of thresholds.

These thresholds were determined after preliminary field surveys which were to test how feasible these thresholds could be achieved with the constraints of vehicle type and age, road space, number of vehicles available along the study roads and possible speed limits within the study area.

Table 5.25: Summary of Service Options used in Assessing Passengers Willingness to Pay

Service Option	Parameters
Option One	Reduced travel time by 25 percent; Reduced waiting time by 25 percent; and Increased level of comfort.
Option Two	Reduced travel time by 30 percent; Reduced waiting time by 30 percent; and Increased level of comfort.
Option Three	Reduced travel time by 45 percent; Reduced waiting time by 45 percent; and Increased level of comfort.
Option Four	Reduced travel time by 25 percent; Reduced waiting time by 30 percent; and Increased level of comfort.
Option Five	Reduced travel time by 25 percent; Reduced waiting time by 45 percent; and Increased level of comfort.
Option Six	Reduced travel time by 30 percent; Reduced waiting time by 45 percent; and Increased level of comfort.

Source: Authors Construct 2006.

From the field surveys, it was realized that, the average mean amount passengers pay for transport services is about ¢3,900 (39 GHp) which is relatively lower than the figures recorded for the various improved service levels. From Table 5.26, it was realized that, passengers were willing to pay about 27 percent more for service option one, than what they are currently paying. The recorded increase in amount passengers are willing to pay for improved service levels is the same for the various service levels. The implication of this is that, passengers put higher premium on the quality of service provided by transport operators and therefore will subsequently pay higher transport fares for better transport services. Details for the various amount passengers are willing to pay for the various service options is presented in Table 5.26.

Table 5.26: Amount Passengers are willing to pay for Service Options (Cedis)

Option	Mean amount	Modal amount	Standard deviation
Current service	3,910 (39GHp)	4,000(40GHp)	2,300(23GHp)
Option One	5,000 (50GHp)	5,500(55GHp)	2,800(28GHp)
Option Two	5,000(50GHp)	5,500(55GHp)	2,800(28GHp)
Option Three	5,000(50GHp)	5,600(56GHp)	2,900(29GHp)
Option Four	5,000(50GHp)	5,700(57GHp)	2,900(29GHp)
Option Five	5,000(50GHp)	5,700(57GHp)	2,900(29GHp)
Option Six	5,100(51GHp)	6,000(60GHp)	3,000(30GHp)

Source: Field surveys, 2006; ***() New Ghana Cedi equivalent***

Having established the amount passengers are willing to pay for the various service levels, the next step was to use the logistic regression in establishing how service levels and other factors influence passengers' willingness to pay for urban public transport services.

5.6.3 Logistic Regression Model for Passengers Willingness to Pay for Urban Transport Services

In establishing passengers' willingness to pay, the logistic regression method was used. This was due to the fact that, the dependent variable is dichotomous while some of the independent variables were categorical; that is, data with a limited number of distinct values or categories (for example, gender or religion). Categorical variables can be string (alphanumeric) or numeric variables that use numeric codes to represent categories (for example, 0 = male and 1 = female). Categorical variables are also referred to as qualitative data. Before proceeding to discuss the results of the regression, the variables have been identified below.

5.6.3.1 Dependent Variable

The dependent variable is dichotomous in nature with two responses. Passengers were asked if they were willing to pay for urban public transport services, for which they were expected to answer 'yes' or 'no'. Passengers who answered 'yes' were coded as 1 while those who answered 'no' were coded 0.

5.6.3.2 Independent Variables

The six independent variables, sex of respondents, income levels, employment status of passengers, household size and transport fares were used in the logistic regression. Two of the independent variables namely: sex of respondents and employment status of passengers are categorical and were subsequently coded in that regard. Sex of respondents were coded as 1= male and 0 = female while for employment status, 1 = employed and 0 = unemployed. These variables were included in the logistic regression model to establish the significance of each of them to the final model.

Table 5.27 presents the summary statistics used to assess the factors that contribute to passengers' willingness to pay. From Table 5.27, the overall percentage prediction of the model is 73.4 percent. The model chi-square for the study is 22.147 which is highly significant at 5 percent significance level or 95 percent confidence interval. The -2 Log likelihood and Nagelkerte R^2 which are some of the Pseudo-R^2s are also presented in Table 5.27. These are generated as part of the models.

Unlike the R^2 in Ordinal Least Square (OLS) models, the Pseudo-R^2 in the logistic regression is not able to determine the proportion of the variance in the dependent variable explained by the variance in the independent variables but serve as an analog to the square contingency coefficient with an interpretation like the R^2. They cannot also be used for comparative purposes but they can be used to compare different specifications of the same model. In other words, results from the model can be used to compare results from different studies where applicable.

Table 5.27: Summary Results of Logistic Regression Relating to Passengers Willingness to Pay for Urban Public Transport Services

Variables	Meaning of variables	B	S.E.	Exp(B)
Service level	Service options	0.093	0.194	1.098
SEX(1)	Sex of respondent	-1.134	0.584	0.322
EmpSTAT(1)	Employment status of respondents	1.108**	0.558	3.029
income	Income of respondents	0.000	0.000	1.000
hhllsd_s	Household size	0.426**	0.144	1.532
Fares	Transport fares	0.000	0.000	1.000
Constant		-0.147	0.895	0.863
Overall Percentage Prediction				**73.4**
-2 Log likelihood				**129.007**
Cox & Snell R^2				**0.164**
Nagelkerke R^2				**0.232**

** Regression is significant at the 0.05 level (2-tailed).

The model for passengers' willingness to pay for urban transport services is presented as follows:

$$\mathbf{Log}\left(\frac{p}{1-p}\right) = -0.147 + (0.093 \times sl) + (-1.134 \times Sex) + (1.108 \times EmpSTAT) + (0.426 \times hhllsd\_s) + error \quad (20)$$

where p = passenger willing to pay;

sl = service level;

Sex = Sex of respondent;

EmpSTAT = Employment status; and

hhllsd_s = Household size

Log likelihood is the basis for tests of a logistic model. The likelihood ratio is a function of log likelihood. Because -2 Log likelihood (-2LL) has approximately a chi-square distribution, -2LL can be used for assessing the significance of logistic regression. From the Table, the -2 Log likelihood is 129.007 which is significant at 5%. This implies that, the model is significant and can be used to predict passengers' willingness to pay for public urban transport services.

Hosmer and Lemeshow's goodness of fit test, which is the chi-square goodness of fit test, is 0.67 which is higher than the 0.05 implying that, well-fitting models show non significance on the H-L goodness-of-fit test. Thus, the test statistic is a chi-square statistic with a desirable outcome of non-significance, indicating that the model prediction does not significantly differ from the observed. This implies that, the model derived provides a realistic view of the factors contributing to passengers' willingness to pay for urban transport services in the study area. The Wald statistic is an alternative test which is commonly used to test the significance of individual logistic regression coefficients for each independent variable; that is, to test the null hypothesis in logistic regression that a particular logit (effect) coefficient is zero. From the analysis, the household size, employment level and fare level are the most significant independent variables. This is shown by a Wald statistic and probability significance of 8.729 and 0.003 for household size, 5.989 and 0.015 for fares and 3.948 and 0.047 for employment status respectively.

5.7 Test of the Study Hypothesis

There are two methods used in testing hypothesis. The first is to compare the value of the test statistic with the rejection point (critical point) while the second is to use the p-value, which measures the weight of evidence against the null hypothesis. Small p-value gives enough reason to doubt the null hypothesis while a large p-value gives enough reason to accept the null hypothesis. For this study, the second method was used due to the large number of observations used in testing the null hypotheses. The criterion of acceptability of the test results is the 0.05 significance probability. Test values with significance probability of ≤ 0.05provide enough evidence against the null hypothesis while those with significant probability of > 0.05 provide enough evidence in favour of the null hypothesis.

Due to the number of observations used in testing the study hypotheses (which is > 30), the z-test statistic should have been the more appropriate method. However, in testing the hypothesis of the study, the t- test sample statistical technique was used. The reason for using the t-test statistic stem from the fact that, the population standard deviation which is needed to calculate the z-test is not know and would require the use of the sampled standard deviation to calculate it. According to Bowerman and O'Connell (2003), if the population standard deviation is not known, then the best method under the circumstance would be to use the t-test than use the sampled standard deviation to calculate the population standard deviation before calculating the z-test statistic. In addition, the calculation of the z-test is done manually, which can result in errors. Hence, the use of the

SPSS software in calculating the t-test statistic. The results have been explained below and the calculations of the tests have been presented in Appendix 4.

Hypothesis One: The fares charged by the different categories of urban mass transportation modes are the same.

Hypothesis one is based on the assumption that, fares charged by the different categories of urban transportation modes are the same. From the analysis, using the mean fare value of all the modes, it was realised that, the mean for all the three modes was 1.73 (refer to Appendix 4) while the mean value of fares for all modes was 786.99. On the basis of computing the paired sample statistics, it was established that, the computed mean was -785.26 with a standard deviation of 505.2. The computation further gave a *t* value of -19.04 with significance probability of 0.000 which provides evidence against the null hypothesis. This implies that, the null hypothesis can be rejected, on the grounds that, on the basis of the sample, transport fares charged by the different category of urban transport modes are not the same.

Hypothesis Two: The fares charged by the different categories of urban mass transportation modes are dependent on the cost of operations.

This hypothesis is based on the premise that, transport operators consider cost of providing urban transport services before arriving at the fare level to charge. This was done using the mean for the fares charged by the various transport operators and the cost incurred in providing the service. From the statistical t-test analysis, it was realised that, the mean value for transport fares and cost of providing urban transport service was approximately 42,277,035.57 and 790.89 respectively. The paired sample statistics gave a *t* value at 95 percent confidence interval of -52.31 with a probability of 0.000 which provides evidence against the null hypothesis. The implication is that, the null hypothesis, suggesting that transport operators do consider the cost of providing their service before fixing transport fares was the case.

This therefore means that, on the basis of the sample, there is enough evidence to reject the null hypothesis; that is, transport fares charged by the different category of urban transport modes are dependent on the cost of operations. This may be due to the fact that, there are no defined means of assessing the cost of operating urban transport services by the vehicle operators.

Hypothesis Three: The fares charged by the different urban transport modes are dependent on impedance factors such as travel time and distance.

a. Travel time

Travel time is one of the impedence factors which influence urban transport operations. This hypothesis was therefore based on the assumption that, fares charged by the different categories of urban transportation modes did depend on travel time. From the analysis, using the mean fares of all the modes, it was realised that, the mean for all the three modes was 786.99 (refer to Appendix 4) while the mean value of travel time for all modes was 9.86. On the basis of computing the paired sample statistics, it was established that, the computed mean was 77.13 with a standard deviation of 502.7. The computation further gave a *t* value of 18.95 with significance probability of 0.000. This implies that, there is enough evidence from the field data against the null hypothesis. This means that on the basis of the sample, we can say that, transport fares charged by the different category of urban transport modes are not dependant on travel time. This result may be due to the zonal fares used in the industry.

b. Distance

This hypothesis is based on the premise that, transport fares charged by urban transport operators do consider the distance covered. This was done using the mean for the fares charged by the various transport operators and the distance covered in providing the service. From the statistical t-test analysis, it was realised that, the mean value for transport fares and distance were 786.99 and 23,219.71 respectively. The sample statistics computed gave a *t* value of - 49.17 with a significance probability of 0.013, implying that, the null hypothesis, suggesting that transport operators do consider the distance of providing their service before fixing transport fares was not the case, but rather, distance travelled was not considered when setting fares. In addition, the mean and standard deviation are 22432.71 and 5587.39 respectively.

This therefore led to the rejection of the null hypothesis on the grounds that, on the basis of the sample, transport fares charged by the different categories of urban transport modes are dependent on distance travelled.

5.8 Summary

This section of the report analyzed and developed models for the demand, supply and pricing of urban transport services and also assessed passengers' willingness to pay for urban transport services in Ghana. This was done using statistical methods such as multiple linear regression and logistic regression. Some of the factors discussed in this chapter include the demand, cost, supply and price analysis. The supply, cost and demand models as well as pricing models were also estimated and discussed. Passengers' willingness to pay has been discussed extensively under this section of the report.

Some of the factors which influence the demand for urban transport services discussed in this chapter include population, fare levels, trip duration and employment status. Key factors which influence the supply of urban transport services discussed in this chapter include profit levels, demand for the service, cost of the vehicles and the cost of providing the service. Demand and supply levels which influence the pricing of urban transport services have been also presented in this section. Having developed the models, the major findings and conclusion of the study in relation to the research questions and objectives are presented in the next chapter.

CHAPTER SIX
FINDINGS, CONCLUSION AND RECOMMENDATION

6.0 Introduction

The main objective of the research was to establish the factors that influence the cost, demand, supply and pricing of urban transport services in Kumasi as well as evolve the appropriate policy recommendations that can help improve the operations within the urban transport service industry. This research comes at a time when the petroleum sector is deregulated and increasing and decreasing price of the petroleum products which always lead to price adjustments of transport fares in the country. It also comes at a time where passengers are gradually becoming responsive to the seemingly indiscriminate increases in transport fares as a result of increases in fuel price. Finally, the research comes at a time when there is the introduction of large capacity buses in the urban transport service industry to complement the activities of the private informal service providers.

One problem in the public urban transport service industry has been the use of fuel price increases and spare parts cost as basis for transport fare increases. However, while in the past, passengers did accept these prices with little or no objections, current developments have shown fierce resistance on their part leading to conflicts between operators and passengers in some instances. While in the past, vehicle operators often translate percentage increases in fuel prices into percentage increases in transport fares, the research has shown that, fuel cost contributes 31.9 percent to the overall variation in cost of providing services. Cost of providing the service also contribute about 16.5 percent to the variability in supply. Ultimately, supply contributes 35 percent to the variability in the price of urban transport services in Kumasi.

The previous chapters of this study have outlined the study overview, discussed relevant literature, study objectives and field data analysis. These chapters include the development of the various models as well as their implications for the urban transport industry. This chapter, which is the final chapter of the study, is in three sections. Section one presents the findings in relation with the study objectives and research questions. These findings emanate from the analysis of field data and the review of relevant secondary literature. Section two of the chapter presents the study conclusion which provides an overview of what the study sought to achieve and what was done. The final section presents the study recommendations. These recommendations emanate from the study findings and aim at providing relevant directions needed to promote the developments within the urban transport industry. In addition, issues with implications for policy formulation as well as questions for future research have been presented in this chapter.

6.1 Study Findings

The major study findings discussed under the study objectives and research questions have been discussed under this sub-section. These findings provide the major highlights of the study and provide the basis for policy formulation and future research.

Objective One

Identify the Factors which affect the Demand for Urban Mass Transportation Services.

Research Question One: What Factors affect the Demand for Urban Mass Transportation Services?

From the review of literature, it was found that, the factors that affect the demand for urban transport services are transport fares, trip duration, population of the community, income of household/commuters, employment status of the inhabitants, access level and the vehicle kilometres operated. However, from the field data analysis, it was found that, the most important factors that affect the demand for urban public transport services in the study area are population level, fare levels, trip duration and employment status.

From the analysis, it was found that population level which refers to the total number of people that are served by public transport services within a geographical area, is the most significant factor that affects the demand for urban transport services. This is supported by the fact that, it contributes about 57.3 percent of the total variation in the demand for urban transport services in Kumasi. This result is expected because, the level of population in any geographical area determines the possibility of the inhabitants generating trips to satisfy their basic activities, both economic and social.

Trip duration comes next, contributing about 10 percent to the total variability in demand. This is the time a passenger takes to undertake a journey from an origin to a destination. It involves the time the passenger spends in waiting for a vehicle, boarding time, journey time and walking time to destination, if applicable. Transport fare, which is the cost passengers incur for using transport service between an origin and destination, and employment status, which refers to the number of people employed within the settlements, contribute 6.1 and 1.6 percent respectively.

From these factors, a demand model aimed at estimating the demand for urban transport services in Ghana was derived. This model can be used to estimate the demand for urban transport services which is critical when pricing transport services. The model from the analysis is given as follows:

$$\mathbf{D = 163093244.02 + 4302756 \times Pop - 72226.23 \times Fl - 5850058.76 \times TD - 77682443.96 \times (1 + \log(empst))^{-1}} \quad \mathbf{(16)}$$

Where D = Demand;

Pop = Population;

Fl = Fare level;

TD = Trip duration; and

empst = Employment status

<u>Objective Two</u>

Identify the factors which affect the Cost of Operating Urban Transport Services.

<u>Research Question Two:</u> What factors affect the Cost of Operating Urban Mass Transportation Services?

Review of literature shows that, the factors that affect the cost of providing urban transport services are tyre cost, insurance cost, fuel cost, trip length, overhead cost, hours worked, lubricant cost and cost of spare parts and maintenance. However, from the analysis of field data, it was found that, seven factors that affect the cost of providing urban public transport services in Kumasi are tyre cost, fuel cost, trip length, overhead cost, hours worked, lubricant cost and cost of spare parts and maintenance excluding insurance cost.

From the analysis, it was found that, tyre cost is the most significant factor that affects the cost of providing urban transport services in Kumasi and, it contributes about 40.4 percent of the total variation in the cost of providing urban transport services in Kumasi.

Fuel cost, the thorniest issue within the industry contributes about 31.9 percent to the cost of providing urban transport services in Kumasi. This implies that, fuel contributes about 32 percent to the overall changes or variations in vehicle operating cost in Kumasi. Overhead cost comes next, contributing about 14.9 percent to the total variability in the cost function. It comprises cost items other than fuel, spare parts, tyre or lubricants. It includes cost items such as tolls, wages of drivers and their assistants, terminal fees, and road worthiness. Trip length contributes about 5.1 percent to the total cost of providing urban transport services in Kumasi. Hours worked, which is the actual number of hours the vehicle is operated and includes time spent loading, unloading and refueling. Lubricant cost, spare parts and maintenance cost, contribute 0.3 percent, 0.6 percent and 2.0 percent respectively to the overall cost of providing urban transport services.

The cost model which was derived after the analysis of field data is aimed at estimating the cost of providing urban transport services in Kumasi. This model can be used to predict the cost to be incurred in providing urban transport services which is critical to the overall supply function in Kumasi and in the pricing of transport services. The model from the analysis is given as follows:

$$\mathbf{Cost = 20161.83 \times Oc + 561.84 \times Tl + 24624.89 \times Tc + 1347.56 \times Fc + 26838.34 \times S/Mcost + 13304.03 \times Lc + 714.79 \times Hw + 2224173.77} \quad \text{.........................(17)}$$

where Oc = Overhead cost;

Tl = Trip length;

Tc = Tyre cost;

Fc = Fuel cost;

S/Mcost	=	Spare parts/Maintenance cost;
Lc	=	Lubricant cost; and
Hw	=	Hours worked

Objective Three

Identify the Factors which affect the Supply of Urban Transport Services.

Research Question Three: What Factors affect the Supply of Operating Urban Mass Transportation Services?

Four main factors affect the supply of urban public transport services in the study area and they include the cost of providing the service, profit levels, price of the vehicle used (cost of vehicle) and the number of passengers to be served by public transport service (demand for the service).

From the analysis, it was revealed that, there is a reasonably strong relationship between the number of vehicular trips per annum as a dependent variable and the following independent variables: cost of vehicle, demand for transport services, cost of providing the service (VOC) and profit level. The most dominant factor is the cost of the vehicles used in the provision of the service. From the analysis, it was revealed that, cost of vehicle contributes about 47.7 percent to variations in the overall supply situation within the urban transport industry. This implies that, for prospective investors, the cost of the vehicle is the most important factor they consider before investing their money within the industry. The next factor is the demand for the service which contributes about 17.1 percent to the total overall variation in the supply of vehicles in the urban transport industry. This is followed by the cost of providing the service (VOC) within the industry, contributing about 16.5 percent. The final factor is the profit levels which contributes 2.2 percent to the overall supply of urban transport services in the study area.

The supply model which was derived after the analysis of field data is aimed at estimating the supply level of urban transport services in study area. This model is expected to be used to estimate the supply levels of urban transport services which are critical to the overall pricing of the service in the study area. The model from the analysis is given as follows:

$$\textbf{Supply} = 59.503 - 8.470 \times D + 507.508 \times Log\_p - 5.6753 \times Cv + 123.76 \times Cs \text{............} \quad (18)$$

where	D	=	Demand for the services;
	Log_p	=	Profit level;
	Cv	=	Cost of vehicle; and
	Cs	=	Cost of providing service

Objective Four

Investigate how the Interest of the various Stakeholders in the Urban Transport Industry can be harmonized through Pricing.

Research Question Four: What Pricing Model should be used to Price Urban Mass Transport Services in the Study Area?

The review of relevant literature and analysis of field data revealed various interests within the stakeholders of the urban transport industry by the stakeholders including government, service providers and passengers. On the part of the government, it was found that, it usually seeks to maximize the 'public interest' when deciding on the pricing of transportation services. In addition, Government tries to ensure cost recovery on the part of the producers during pricing of transport services and affordability on the part of the consumer. Another objective of government is to ensure strong political interest such as to reduce deficits from the importation of crude oil which is one of the major inputs in the transport industry. There is also an objective of government to regulate producer profit if it is at the expense of exploiting passengers. This is done by ensuring gross trading surplus where total revenue exceeds operating cost of the producer, implying that, revenue should at least exceed cost in order for operators to stay in business.

On the part of service providers, it was found that their interests ranged from making the service convenient, comfortable, reliable, efficient, as well as cost effective with profit maximization being the ultimate target. Profit maximization is the traditional motivation of private enterprise undertakings and the actual price level in this case depends upon the degree of competition in the market from each mode, that is, the Minibuses, Taxis and the Metro Mass Transit buses. Passengers in patronizing urban transport services have several yardsticks which they seek to meet. They include speed, accessibility which is measured in lapsed time between the decision to use transport and obtaining access to it, cost of service, level of service offered (travel time, comfort, etc), reliability and frequency of the user's trip, among others.

Based on the various interests highlighted, it was found that, there is the need to choose a pricing technique which aims at harmonizing these interests. The said pricing strategy (combination pricing strategy) should strive to combine the interest of the stakeholders within the urban transport industry when determining transport fares. Even though, this technique uses the cost of providing the service, demand for the service and the competitive factors within the industry as the basis for pricing, there are no meaningful methods used in assessing the cost, demand and competitive factors (supply) for pricing within the industry. However, if these parameters are not well established, the periodic wrangling between passengers and vehicle operators within the industry will continue.

It can therefore be argued that, based on the various interests of stakeholders, the appropriate pricing mode that should be used in pricing within the urban transport industry in Ghana should be a model that considers the cost factors (such as fuel cost, insurance cost, spare parts and maintenance cost, lubricant cost, tyre cost and overhead cost) in providing urban transport services as well as the demand factors (such as population, income of household, employment status, access level and vehicle kilometers operated) that also influence the demand for urban transport services. In addition, the competitive factor that is manifested in the supply level should be considered by the pricing model. By using this approach, the various interests of the stakeholders will be harmonized, hence, reducing the possibilities of conflicts among them.

This implies that, extensive work needs to be done by the Ghana National Transport Coordinating Council in estimating the cost factors, demand factors and competitive factors manifested by the various models. This should be done in consultation with transport unions, government (represented by the Ministry of Transportation) and Trade Union Congress (TUC) representing passengers. This will eliminate any misconception about the end results and will provide a rational basis for price adjustments, if any, as the determinants change. In a nutshell, this approach provides a more reliable and sustainable way of determining urban transport service prices and will help avoid over pricing or under pricing which leads to market distortions.

Having established the interests of stakeholders as well as the appropriate pricing technique needed to ensure sanity within the industry, the pricing model developed after field analysis to help estimate prices of urban transport services have been discussed below.

Pricing Objective

To Develop a Model with which Prices of Urban Transport Services can be determined following review of Prices of Petroleum Products.

The main objective of the study was to develop a model that will help determine transport prices following the review of prices of petroleum products and other factors within the industry. Field data were gathered and analysed with the view of developing the model. The stepwise multiple regression method was used in estimating the model. In estimating the model, two main factors that influence the price of urban transport services in Ghana were considered and they include the demand for the service and the supply level being provided by transport owners. These factors individually contribute to the determination of prices of urban transport services in Ghana.

From the analysis of the field data, it was realized that, the demand for urban transport services contribute about 53 percent to the overall pricing of transport services while supply contributes about 35 percent. This implies that, demand and supply play an important role in the pricing of transport services in the study area and as such subsequent attempts in determining the price of the service should consider them. The model for pricing urban transport services in the study area is given as follows:

$$\textbf{Price} = \textbf{570.34} + \textbf{0.101} \times \textbf{Supply} - \textbf{0.118} \times \textbf{Demand} \;\; \textbf{....... (19)}$$

This model can only be used after the cost, demand and supply have been estimated within the industry at any point in time. This will take care of the periodic changes in any of the elements affecting the supply and demand for the service. For example, the price of fuel adjusted periodically has been taken care of in the models. In a simplified form, the pricing model can be presented as follow:

$$\begin{aligned}\mathbf{Price} = & \mathbf{17723740.27 - 0.855D + 51.26LogP - 0.573Cv} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(21)} \\ & \mathbf{+ 252018.04Oc - 7022.87Tl + 307805.22Tc + 16844.18Fc} \\ & \mathbf{+ 335472.81S/Mcost + 166297.18Lc + 8934.70Hw} \\ & \mathbf{- 507725.21Pop + 8527.69Fl + 690306.93TD - 9166528.39\,Log(employment)^{-1}}\end{aligned}$$

6.2 Study Recommendations

On the basis of the findings, the following recommendations have been made to enhance the operations within the urban transport services industry. The recommendations were made on the operations within the urban transport industry as well as the interest of the various stakeholders. Central in the recommendation has been the use of the various interests of all stakeholders within the urban transport industry as well as policy implications and issues for future research. The following policy options have been proposed with the aim of ensuring sustainable pricing mechanism within the industry:

6.2.1 Policy Options

In light of the happenings within the urban transport service industry in the study area, the following policy implications are presented for critical assessment, basically providing a framework to ensure sustainability in pricing of transport services within the industry. For the purpose of prioritization, these policy options have been grouped under short, medium and long term. Short term recommendations are policy options which require immediate actions and will not require huge financial commitments during their implementation. On the other hand, medium term recommendations are those that will compliment those under the short term in order to promote efficiency in the pricing of urban transport services in the study area. Long term policy recommendations are those that may take some considerable time and resources in their implementation.

Short Term Policy Options

i. Re-definition of State Policies and Objectives in Public Transport Services as well as its Pricing.

The first task required to improve urban public transport services is the redefinition of the state's role. In the past, the state has been a key player in the determination of transport fares which ended up stifling the activities of transport operations and thus giving minimal regard to demand and supply. This further led to the decline in service quality which ultimately has made the industry unattractive for large capacity buses to get involved in the service delivery.

The new role of government should be to draw clear policy boundaries between the Ministry of Transportation, the Ghana National Transport Coordinating Council (GNTCC), Transport Operators and Passengers. The new policy should clearly outline the regulatory, facilitating and monitoring role of the state. The regulatory role will require the state to set overall rules and guidelines within the industry taking into consideration local potentials and challenges. Since public transport services play a crucial role in the economic development agenda of the country, it is the responsibility of the state to set objectives to be achieved.

The facilitative role of the state is to provide road space, parking facilities, bus lanes and the legal framework to encourage both the private and public sector actors to invest in the urban public transport service industry. This can be done through political, market and economic enabling strategies that will ensure fair competition among investors within the industry as well as protect their investments. The provision of bus lanes for example may promote the use of large capacity buses and reduce travel time which will ultimately reduce cost and ensure efficiency.

The monitoring role of the state is to ensure that interest of stakeholders within the industry are protected and not compromised. This will mean that, the state should check for service standard and efficiencies as well as the continuous stay of vehicle operators within the industry.

ii. Cost Recovery during Pricing of Urban Transport Services

According to Viegas and Macario (2003), transport pricing has been a highly debated topic for several years now, and there is a growing awareness that, to achieve a sustainable balance between private and public transport means of mobility and pricing policies have to be able to send the correct signals to induce an adaptive behavior from the users, which in turn will, through demand levels, provide the system with a reliable feedback on the needs for further investment and expansion of transport facilities.

Economic theory suggests that users should pay the full cost of providing transport services through charges and taxes. Thus prices of road transport services should reflect not only private costs such as fuel, wages and depreciation, but also, social costs such as damage to roads and environmental costs. Failure to reflect the cost in prices would constitute a subsidy to road users from taxpayers, who pay for the construction and maintenance of roads. The divergence of private from social costs would be a misallocation of resources.

From the foregoing, it will be prudent to let prices of urban transport services reflect the cost of providing the service. This therefore requires continuous assessment of the cost function of service providers. It is only through this approach that supply of the service will be sustained. In addition, it will attract prospective investors to invest in the industry. This will ultimately improve the urban transport situation and subsequently reduce the dependence of commuters on personal means of transport.

iii. Need to ensure Participation in Transport Services Pricing

The involvement of all stakeholders in the pricing of urban transport services is one of the approaches that should be adopted. Within the industry, there are several stakeholders who seek their respective interests. These interests, in most cases are divergent and often lead to conflicts. It is therefore, important to adopt the participatory framework outlined in Figure 9 in ensuring stakeholders' involvement within the industry.

It is worth noting that, the fairness of the price incidence, that is, the amount paid and who is paying what, as well as the levels of the price, has a major influence on its acceptability. Consequently, computing transport cost using the model derived, which is the basis of fair and efficient price (Viegas and Macario, 2003) is also one of the aspects to consider as of utmost importance and must be participatory.

Medium Term Policy Options

iv. Need to Introduce Fair Competition in Service Delivery

In pursuing investment in the urban transport service industry, efforts should be made to create a platform for fair competition between service providers. This is one of the surest ways of ensuring service quality which was found to be an issue of concern for passengers. For example, it was found that, passengers will be willing to pay about 30 percent more than the current transport prices they are paying if service quality is improved. In addition, specific routes could be given out to companies providing urban transport services using large capacity buses so as to promote the use of large capacity buses. It must be noted however, that non performing service providers could be prevented from route contract renewal so as to ensure sanity and promote competition.

v. Need for Independent Party to enforce Standards

In order to improved service delivery and adherence to standards within the urban transport service industry, there is the need to have an independent body with the requisite skills to undertake periodic studies to enforce standards within the industry. The involvement of this party to protect all stakeholders and in setting performance targets, monitoring and sanctioning has the potential not only to ensure efficiency but also sustainability.

The involvement of an independent party to enforce standards however can lead to the risk of impeding the interest of the private investors within the industry. As the independent party becomes stronger, regulating and monitoring may be taken away from it and given to the Ministry of Transportation. Currently, the GNTCC is the umbrella body for transport operators in the country. This body could be well equipped and restructured to carry out this responsibility effectively. This could be done by giving the GNTCC, the power, logistics and personnel with the requisite skill and understanding of the urban transport service operations to conduct periodic studies and implement the outcomes.

vi. Setting clear Input and Output Indicators to monitor and penalize poor Transport Operation

In order for the independent regulatory body to do its work effectively, there is the need to have established performance input and output indicators to check the operations of transport operators within the country. These indicators can be reviewed periodically through research into the operations within the urban transport industry. This may help in the refining or assessment of the models for the pricing of urban transport services.

The urban transport service industry is a very dynamic one with changing factors which affect the operations within the industry. These changes include increase or decrease in vehicle operating cost, supply of public transport services and in demand for urban public transport services. In view of this, there is the need to periodically undertake studies to determine changes, if any, in the operations within this industry so as to provide a more realistic framework for pricing of the service.

vii. Establishment of Passengers Union

Acceptability of transport service pricing is one of the main obstacles for the implementation of results from transport pricing studies. The reasons behind this position are wide and varied. However, the main reason is the inability to involve all stakeholders in the process. The process of arriving at appropriate urban transport services prices requires the involvement of all stakeholders within the industry. In doing this, there is the need to invite representatives from the public, government and transport operators/owners to discuss and assess issues within the industry and be given opportunities to suggest modifying alternatives. It must be noted that, acceptability from some stakeholders may take some time but will come on board through an open communication process.

One of the main problems experienced in the public transport industry is the low quality and high cost of service to the user. The poor quality of service is most noticeable in Kumasi and is manifested by the lengthy waiting times experienced by travellers, long in-vehicle travel times and poor access to bus service. Since passengers are willing to pay more for improved transport services, there is therefore the need for the Ministry of Transportation and the National Transport Coordinating Council to critically review the operations of urban transport service operators so as to give passengers improved services.

Passengers in most areas are left out in the pricing of urban transport services in Ghana. This has resulted in the near neglect of their interest which includes maximizing their utility at the least cost. However, passengers like any consumers are entitled to know the type of service they are expected to be provided and offered a means of redress if they are not provided. It may involve putting a body in place to represent the passengers, like a regulator or creating and strengthening public bodies and giving them broad powers to ensure compliance and or obtaining redress for passengers.

Long Term Policy Option

viii. Encouraging the use of Large Capacity Buses in Urban Transport Services

Congestion is gradually becoming a major obstacle to efficient urban transport services in the study area. This is also dominant and prominent in the capital city, Accra. This congestion is a result of the increase in the use of small capacity vehicles in these two major cities. The result is the decrease in the expected benefit from public transport services. On the basis of this challenge, there is the need to begin exploring the possibility of encouraging institutions and investors to invest in the provision of urban public transport services using large capacity vehicles. It is important to encourage the use of new vehicles in the operation of public transport services since it is one of the surest ways of reducing the cost of providing the services which may lead to call for higher transport tariffs. This is because the unit price of vehicle operating inputs has direct consequences on vehicle operating cost. This implies that, increase in their taxes constitute a relatively high proportion to unit costs.

The use of large capacity buses is gradually gaining grounds within the inter-urban transport service industry and the same can be done within the intra-urban transport service industry. Currently, the Metro Mass Transit Limited is operating in some of the major cities but due to the demand, there will be the need to seek for more investors to invest in the industry.

6.2.2 Questions and Areas for Future Research

The application of known pricing strategies and stakeholder interest as well as the analysis of field data has provided some interesting revelations that raise issues for further discussions and research. These issues are presented as follows:

i. Will the use of new vehicles help reduce the Cost of Providing Urban Transport Services and Subsequently Make Their Services Affordable?

Public transport systems may be characterised as a combination of 'formal' bus (and rail) services, which are planned and regulated and 'paratransit', which is sometimes called 'informal' transport and is often unregulated and may operate illicitly. In many cities supply is provided by a range of services. Some are formal, that is, they run scheduled services while others are informal, running unscheduled, often flexible and use small vehicles. In an increasingly large number of cities, paratransit services are a major, or the dominant mode, and these pose particular challenges for the development of the use of large capacity buses.

Paratransit is about as close to laissez-faire transportation as can be found. Through the invisible hand of the market-place, those who are willing-to-pay for transport services make deals with those who are willing-to-provide. This informal transport involves commercial transactions. The public transport system therefore often comprises two elements: big buses, which are regulated because they can be regulated and there is a will to regulate them, and paratransit that is in many respects unregulated. The bus operators view this as an unlevel playing field, and society should have cause to be concerned in some circumstances, because paratransit can itself create major externalities, in congestion for other road users, air pollution and safety (DFID, 2000).

Bus operations may be improved by traffic management measures or by bus only lanes, either operating full time or part time and either with-flow or contra-flow. A bus-based mass transit system requires a network of busways as its fundamental feature. It is in line with these discussions that, further research needs to be carried out to establish how large capacity buses can reduce cost of operations and subsequently reduce transport fares. This will ascertain whether the use of these large capacity buses will ultimately reduce transport operating cost and subsequently make urban transport services affordable.

ii. What will be the prospect within the Urban Transport Industry if DAs are empowered to license, regulate and monitor vehicle operators operating under their jurisdiction?

Public mass transport services require a well defined regulatory framework to monitor and provide the legal atmosphere for the sustainable development of the industry. This presupposes that, the regulatory body should be abreast with the operations within the industry. According to the World Bank (2000), the responsibility for urban transport is being decentralized in many countries. Sometimes this is merely a by-product of the failure of traditional central fiscal sources. Frequently, where specialized skills are scarce, decentralization reduces the availability of expertise at the local level.

In undertaking this supervising and regulatory role effectively, the Kumasi Metropolitan Assembly is expected to undertake the following initiatives:

- Develop metropolitan/district-scale transport planning and financing arrangements;
- Prepare human resource development plans for their new responsibilities;
- Develop integrated urban transport funding arrangements; and
- Develop integrated road use and public transport charging strategies to make the urban transport sector financially sustainable.

Based on these huge responsibilities required of the Kumasi Metropolitan Assembly in promoting urban transport services and its primary role in the development of the country, there is the need to further investigate what the prospect will be for the study area to chart this course in line with the country's decentralisation policy.

iii. What accounts for the seemingly non-interest in the use of large capacity buses for Urban Transport Services in the Study Area?

The growing incidence of the use of the taxis and minibuses in the urban transport system and the periodic seemingly non-competitive nature of the operations of the large capacity buses within the urban transport service industry is an area worth investigating further. Efficient urban transport service requires adequate infrastructure including the use of large capacity buses. The use of large capacity buses in inter urban transport industry is very prominent with companies such as Intercity STC, M-Plaza, O&A, and individual owners under the GPRTU providing transport services. In spite of their continuous presence in inter urban transport service operations, these companies seem not interested in investing in intra urban transport services. This therefore provides an area for further research since that may provide the possible lead to ways of involving the private sector in the investments of large capacity buses in the urban transport service industry.

iv. Should government pursue the policy of subsidy in an effort to encourage the use of large capacity buses in the urban transport service industry? If yes, how should it be handled to achieve its target?

Public transport is critical to the welfare of the urban poor and a crucial element in any poverty oriented city development strategy. Urban transport services are usually the mode used by the urban poor and in most cases, are unable to afford the high transport tariffs. In order to reduce the burden of the urban poor as well as not compromising on the economic efficiency of service providers, there are arguments for the provision of subsidies so as to help defray the cost incurred by service providers. This is manifested in the provision of subsidies in some cities. In another breath, there are arguments that, the provision of subsidies replaces the inefficiencies of service providers and as such, leads to drain of the tax payers' money, which could have been used in providing other social benefits such as health care and education.

The question which then arises is, should subsidies be provided if we intend encouraging the use of large capacity buses? If yes, then when and how these subsidies should be managed? These questions, among others, are issues that need to be delved further into in order to help stakeholders within the industry.

6.2.3 Contribution of study to Knowledge

One of the major reasons for undertaking this research was to contribute to knowledge within the urban transport service industry. The output of this study was to help provide some useful findings and recommendations for urban transport service operations. From the analysis and discussions, it was realised that, the study has contributed to the following within the urban transport service industry:

i. Identifying the main factors that influence the cost of providing urban transport services and the contribution of each of them to the overall cost of providing urban transport services. These factors include fuel, spare parts and maintenance, overheads, tyres and lubricants. This goes to confirm the earlier studies undertaken by Litman (2001), Mitric (2002) and Department of Urban Roads (2005);
ii. Identifying the main factors that influence the demand for urban transport services and the contribution of each of them to the overall demand for urban transport services. The results of the study confirms an earlier study on demand for public transport by TRL (2004);
iii. Identifying the main factors that influence the supply of urban transport services and the contribution of each of them to the overall supply of urban transport services;
iv. Identifying the main factors that influence the pricing of urban transport services and the contribution of each of them to the overall pricing of urban transport services; and
v. Developing models for estimating the demand for urban transport services, cost of providing urban transport services, supply of urban transport services and pricing of urban transport services.

6.3 Conclusion

The study has documented the factors affecting the pricing of urban transport services in Kumasi. The major objective was to formulate a model that will be used by policy makers in estimating prices of urban transport services in the study area as well as in other parts of Ghana. This model is expected to factor the interest of all stakeholders in the pricing of urban transport services. The study also aimed at investigating the factors that affect the pricing of urban public transport services in the study area as well as the contribution of each of them to operations within the industry. In addition, the determinants of demand for urban transport services, supply of urban transport services and the vehicle operating cost in the study area have been identified. The contributions of each of the independent variables to their respective dependent variables were also estimated. In addition, recommendations have been made to enhance the operations within the urban transport service industry through the pricing of the services.

Key to this study is the contribution of factors such as fuel and spare parts which determine the cost of providing urban transport services in the study area. In addition, the factors which influence passengers' willingness to pay for urban transport services in the Kumasi Metropolitan Area have been identified and discussed. The study has outlined key issues for further research. These issues are based on the findings from the analysis of field data. In addition to this, the study has come out with key findings that will contribute significantly to the urban transport service industry in the study area and Ghana as well as to knowledge in general.

In concluding, it must be noted that, urban transport services serve majority of the urban population in the study area and as such, efforts must be made to continuously improve the service as well as review periodically, the importance of the determinants of pricing urban transport services.

LIST OF REFERENCES

Adarkwa, K. K and J. Post (Eds) (2001): **The Fate of the Tree: Planning and Managing the Development of Kumasi, Ghana**, Accra: Woeli Publishing Services.

Adarkwa, K. K., and Tamakloe, E. K. A (2001): Urban Transport Problems and Policy Reforms in Kumasi. In Adarkwa, K. K and Post, J (Eds); **The Fate of the Tree: Planning and Managing the Development of Kumasi, Ghana,** Accra: Woeli Publishing Services.

Amos, P (2004): **Public and Private Sector Roles in the Supply of Transport Infrastructure and Services.** New York: Transport Papers, TP-1, Washington D. C. The World Bank Group

Agyedu, G. O, F. Donkor and S. Obeng (1999): **Teach Yourself, Research Methods**. Winneba, University College of Education. Home-Link Business Services.

Atim, C. (1999): 'Social movements and health insurance: a critical evaluation of voluntary, non-profit insurance schemes with case studies from Ghana and Cameroon'. **Social Science and Medicine** 48, 881-896.

Binam J. N, A. Nkama and R. Nkendah (2006): **'Estimating the Willingness to Pay for Community Health Prepayment Schemes in Rural Area: A Case Study of the Use of Contingent Valuation Surveys in Central Cameroon'**. Retrieved: August 25, 2006 from: http//www.csae.ex.ac.uk/conferences/2004-GPRaHDiA/papers/4h-Bina-CSAE2004.pdf.

Benmaamar, M (2003): **Urban Transport Services in Sub-Saharan Africa: Improving Vehicle Operations**. SSATPP, Washington D. C. The World Bank and Economic Commission for Africa.

Bennathan, E and A. A. Walters (1979): **Port Pricing and Investment Policy for Developing Countries.** New York: Oxford University Press.

Black, A (1995): **Urban Mass Transportation Planning.** New York: McGraw-Hill.

Bloom, G., and Shenglan, T. (1999): 'Rural Health Prepayment Schemes in China: Towards a More Active Role for Government'**. Social Science and Medicine** 48, 951-960.

Blonk, W. A. G. (Ed) (1979): **Transport and Regional Development**. Farnborough Hampshire, Saxon House Aldershort. ISBN 0566 00285X.

Booz-Allen and Hamilton Inc. (1999): **California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C)—Technical Supplement to User's Guide**. California Department of Transportation. Retrieved on the 22nd of September, 2006 from: http://www.dot.ca.gov/hq/tpp/planning_tools/tech_supp.pdf.

Bowerman, L. B. and Richard T. O'Connell (2003): **Business Statistics in Practice**. Third Edition. McGraw-Hill/Irwin, New York.

Button, K. J., (1982): **Transport Economics**. Surrey: Biddles Ltd, Guildford.

Chambers, R (1997): **Whose Reality Counts? Putting the First Last**. London: Intermediate Technology Publication Limited.

Criel, B., P. Van der Stuyft, and W. Van Lerberghe (1999): 'The Bwamanda Hospital Insurance Scheme: Effective for Whom? A Study of Its Impact on Hospital Utilization Patterns'. **Social Science and Medicine** 48, 897-911.

Daily Graphic, Thursday February 17, 2005. No. 149358, Page 29

Daily Graphic, Friday January 28, 2005. No 149341, Page 18.

Daily Graphic, Friday February 25, 2005. No 149365, Page 15.

DFID (2000): **Mass Rapid Transit in Developing Countries.** (World Bank Urban Transit Strategy Review, Final Report). Washington, DC. Halcrow Group Limited.

Department of Urban Roads (2005): **Bus Rapid Transit Options Identification and Pre-feasibility Study** (Draft Final Report). Accra, Government of Ghana, Ministry of Transportation.

Department of Urban Roads (1997): **Land Use Forecast and Traffic Volume Growth Trends in Accra, Tema, Kumasi, Sekondi – Takoradi and Tamale**. Accra, Government of Ghana/ Ministry of Roads and Highways.

Evans, J. R. and B, Berman (1997): **Marketing**. (Seventh Edition), Prentice Hall, Upper Saddle River, NJ 07458.

Field, A (2005): **Discovering Statistics Using SPSS** (Second Edition). London. Sage Publications Limited.

Fouracre, P. R, E. A. Kwakye, and D. Silcock (1994): 'Public Transport in Ghanaian Cities - A Case of Union Power'. **Transport Reviews**. Vol. 14 No.1 pp 45 - 61.

Flores, N.E. and T. C. Richard (1997): 'The Relationship Between the Income Elasticities of Demand and Willingness to Pay'. **Journal of Environment Economics and Management** 33(3), 287-95.

Frank, Robert and Ben Bernanke (2003): **Principles of Economics.** New York, McGraw-Hill Irwin.

Fromm, G. (1965): **Introduction: An Approach To Investment Decisions**. (Transport Investment and Economic Development). Washington: Brookings Institute.

Garson, D (2006): **Multiple Regression**. Retrieved: December 5, 2006 from http//www2.chass.ncsu.edu/garson/pa765/regress.htm.

Ghana Statistical Service (2000): **Ghana Living Standard Survey IV**. Accra, Ghana Statistical Service.

Gwilliam, M. K (1996): **Transport in the City of Tomorrow: The Transport Dialogue at Habitat II.** New York: United Nations. TWU Series No.23.

Gwilliam, M. K (2000): **Urban Transport Strategy Review (Draft).** Washington DC: World Bank.

Hamilton, A. B (2003): **Fare-Setting Approaches for Private Bus Services.** New South Wales: The Independent Pricing and Regulatory Tribunal of New South Wales.

Hanssens, D. M, J. Leonard, S Parsons and R. L. Schultz (1990): **Market Response Models: Econometric and Time Series Analysis.** Boston: Kluwer Academic Publishers.

Hensher, A. D (2002): **Urban Public Transport Delivery in Australia: Issues and Challenges in Retaining and Growing Patronage**. New South Wales. Institute of Transport Studies, the University of Sydney.

Independent Pricing and Regulatory Tribunal of New South Wales, (2003): **Review of Fares for Taxis in New South Wales in 2003**. New South Wales: Report to the NSW Ministry for Transport Services.

Kageson, P (2003): **Efficient Charging of Heavy Goods Vehicles.** Stockholm, Swedish Institute for Transport and Communications Analysis.

Korboe, D. (1996): **Poverty Profile of KMA: Report on the Aboabo and Appiadu Communities**. Accra: Save the Children Fund (UK).

Kotler, P (2000): **Marketing Management**, **the Millennium Edition**. Prentice Hall, Upper Saddle River.

Kotler, P and G. Armstrong, (1998): **Principles of Marketing, Eighth Edition**. Prentice Hall, Upper Saddle River.

Koutsoyiannis, A (1979): **Modern Micro Economics, (Second Edition)**. Hong Kong: Macmillan Press Limited.

Kumasi Metropolitan Assembly (2004): **Development Plan Kumasi Metropolitan Area (2001-2004)**. Kumasi: Kumasi Metropolitan Assembly.

Kwakye, E. A, J. Turner and M. Grieco, (1994): **A Tale of Two Cultures: Ethnicity and Cycling Behaviour in Urban Ghana**. Record 1441. Washington D.C: Transportation Research Board.

Kwakye, E. A. and P. R. Fouracre, (1998): **Urban Transport Policy Reform in Ghana**. Cape Town, South Africa: CODATU VIII Conference.

Lee, D (1997): **"Uses and Meanings of Full Social Cost Estimates," The Full Costs and Benefits of Transportation**. Berlin: Springer, pp. 113-148.

Litman, T (2002): **Socially Optimal Transport Prices and Markets**, Victoria, British Columbia. Victoria Transport Policy Institute

Litman, T (2003): **London Congestion Pricing; Implication for Other Cities.** Victoria, British Columbia. Victoria Transport Institute.

Mitric, S (2002): **Urban Public Transport: Getting the Prices Right.** Discussion Paper for the World Bank Institute at European and Central Asia Urban Management Workshop.

Mitric, S and R. Prudhomme (2002): **Urban Transportation**. Paper presented to the World Bank. Retrieved on December 15th, 2005 from www.http/.infor.worldbank.org/etools/docs/library/168018/Russia/docs/7-prud.pdf.

Nagle, T. T and R. K. Holden, (1995): **The Strategy and Tactics of Pricing: A Guide to Profitable Decision Making**. Second Edition. Prentice Hall, Upper Saddle River.

Okoko, Eno (2006): **Urban Transportation Planning and Modelling**. Akure, Nigeria. Millennium Publishers,

Okoko, Eno (2003): Tenants' Willingness to Pay for Better Housing in Targeted Core Area Neighbourhoods in Akure, Nigeria. **Habitat International** 28 (2004), 317-332.

Poku-Boansi, M (2003): **'Pricing of Urban Transport Services in Ghana. A Case Study of the Trotro Services in Kumasi'**. (Unpublished Thesis submitted to the Department of Planning of the Kwame Nkrumah University of Science and Technology, KNUST).

Rodrigue, J. P (2003): **Geographical Challenges Facing Urban Transportation.** Hempstead: Department of Economics and Geography, Hofstra University, New York.

Ross, C (2006): **Trotro: Transport for the People by the People**. Retrieved on 17th February, 2006 from: www.ghanaweb.com/GhanaHomePage/fun/trotro.php

Rostow, W. W (1960): **The Stages of Economic Growth**. Cambridge: Cambridge University Press.

Sinai, I (1998): **Using the Home for Income Generation: The Case of Ghana Cities, Kumasi**: In Adarkwa, K. K and Post, J (Ed); ***The Fate of the Tree: Planning and Managing the Development of Kumasi, Ghana***, Accra: Woeli Publishing Services.

Single, E., D. Collins, B. Easton, H. Harwood, H. Lapsley, P. Kopp and E. Wilson (2001): **International Guidelines for Estimating the Cost of Substance Abuse.** Retrieved on June 15th, 2006 from: http:// www.cssa.ca/cost/Guidelines/intguide.htm.

Schwartz, J. D (1981): **Marketing Today: A Basic Approach, (Third Edition).** New York: Harcourt Brace Jovanovich.

Tamakloe, E. K. A. (1975): Urban Mass Transportation in Ghana. **The Environ.** Magazine of Faculty of Architecture, KNUST, Kumasi. Volume 1, Number 1.

Tamakloe, E. K. A. (1989): **'Transportation, The Future of Our Cities.** Proceedings of the Ghana Academy of Arts and Sciences, Vol. XXVIII, 1989. Page 31 – 37.

TATA Energy Research Institute (2002): **Restructuring Options for Urban Public Transport in India.** India: Final Report, TERI Project Report No. 2001 UT 41.

Transport Research Laboratory (2004): The Demand for Public Transport: A Practical Guide, TRL Report, TRL 593. Crowthorne, UK.

Transport Demand Management (TMD) Encyclopedia, (2004): **Evaluating Pricing Strategies.** Victoria, British Columbia. Victoria Transport Policy Institute.

Viegas, J. M and R. Macario (2003): 'Acceptability of Price Changes in Urban Mobility'. In Schade, J and B. Schlag (eds) **Acceptability of Transport Pricing Strategies** Oxford, Elsevier.

White P (2002): **Public Transport: Its Planning, Management and Operation** (Fourth Edition). London: E and FN Spon.

Whittington, D., J. Briscoe, X. Mu, and W. Barron (1990): 'Estimating the Willingness to Pay for Water Services in Developing Countries: A Case Study of Contingent Valuation Surveys in Southern Haiti'**. Economic Development and Cultural Change. Vol. 38 Issue 2 Pages 293 – 311.**

Whyte, W. F and K. K. Whyte (1984): **Learning From the Field. A Guide From Experience**. London: Sage Publications.

World Bank (2000): **Cities on the Move**. A World Bank Urban Transport Strategy Review. Washington, D.C., The World Bank.

World Bank (2004**): Urban Transport Overview**. Washington D.C., The World Bank.

LIST OF APPENDICES

Appendix 1: Traffic Zones for the Study and their Descriptions

Traffic Zones	Description	Areas Covered by the Study
1	The core of Kumasi	Central Market (CBD)
2	An intensed Commercial Area	Adum (CBD)
3	An intensed Commercial Area	Bompata
4	Contains the Doctors' Flats. Population Density is medium.	Cultural Centre, Doctors' flats, Zoo, (CBD)
5	Contains a Military Camp and Teaching Hospital	4BN and Komfo Anokye Hospital
6	Government-built sector: estates built by government agencies and run as rental or hire purchase	Kwadaso Estate
7	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Bantama
8	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Ashanti New Town
9	Tenement sector: areas dominated by large compound houses of two or three storeys and blocks of walk-up flats	Akwatia Line
10	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	New Amakom, Asokwa
11	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Ridge, Denyame
12	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Anloga
13	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Asawasi, Aboabo
14	Tenement sector: areas dominated by large compound houses of two or three storey's and blocks of walk-up flats	Dichemso, Krofrom

15	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Bomso, Sisaso
16	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Ayigya West
17	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Old Ayigya
18	Tenement sector: areas dominated by large compound houses of two or three storey's and blocks of walk-up flats	Akrom
19	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Asokore Mampong
20	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Moshie Zongo, Sepe
21	Government-built sector: estates built by government agencies and run as rental or hire purchase	Buokrom Estate
22	Government-built sector: estates built by government agencies and run as rental or hire purchase	Ahinsan Estate
23	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Adiebeba
24	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Kyirapatre, Kyirapatre Estate
25	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Nhyiaso, Ahodwo
26	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Fankyenebra, Santasi
27	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the	Kwadaso

	ethnicity of the occupants has little effect on the type of housing	
28	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen.	Kwadaso Extension, Asuoyeboa, Brigade, Prempeh College
29	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Suame, Abrepo, Anumanye, Maakro
30	Indigenous Sector: areas of tradition. Mainly single storey compound houses including villages developed by or still separate from the city areas. The zongos are included in the sector as the ethnicity of the occupants has little effect on the type of housing	Old Tafo
31		KNUST
32	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Boadi
33	High cost sector: Areas dominated by low density bungalows and flats occupied by senior government and company employees and wealthy businessmen. Usually in single household occupancy	Kentikrono, Nsenie, Odium
34	Government-built sector: estates built by government agencies and run as rental or hire purchase	Asuoyeboah SSNIT Flats

Source: Department of Urban Roads, 1997

Appendix 2: Summary of Correlation of Independent Variables used in Estimating the Demand Model

		Annual number of passenger kilometers	Fares	Income of household	Population	Trip duration	Access to transport	Employment level	Vehicle kilometers operated
Annual number of passenger kilometers	Pearson Correlation	1	-.186(**)	-.031	.757(**)	-.183(**)	.104(*)	-.020	.094
	Sig. (2-tailed)		.000	.532	.000	.000	.038	.697	.060
	N	400	400	400	400	400	400	400	400
Fares	Pearson Correlation	-.186(**)	1	.089	-.013	.482(**)	-.726(**)	-.031	-.449(**)
	Sig. (2-tailed)	.000		.076	.801	.000	.000	.533	.000
	N	400	400	400	400	400	400	400	400
Income of household	Pearson Correlation	-.031	.089	1	-.026	.095	-.087	-.055	-.033
	Sig. (2-tailed)	.532	.076		.598	.059	.083	.270	.507
	N	400	400	400	400	400	400	400	400
Population	Pearson Correlation	.757(**)	-.013	-.026	1	-.026	-.007	.051	-.046
	Sig. (2-tailed)	.000	.801	.598		.600	.884	.312	.354
	N	400	400	400	400	400	400	400	400
Trip duration	Pearson Correlation	-.183(**)	.482(**)	.095	-.026	1	-.288(**)	-.013	-.499(**)
	Sig. (2-tailed)	.000	.000	.059	.600		.000	.801	.000
	N	400	400	400	400	400	400	400	400
Access to transport	Pearson Correlation	.104(*)	-.726(**)	-.087	-.007	-.288(**)	1	.118(*)	.281(**)
	Sig. (2-tailed)	.038	.000	.083	.884	.000		.019	.000
	N	400	400	400	400	400	400	400	400
Employment level	Pearson Correlation	-.020	-.031	-.055	.051	-.013	.118(*)	1	.136(**)
	Sig. (2-tailed)	.697	.533	.270	.312	.801	.019		.007
	N	400	400	400	400	400	400	400	400
Vehicle kilometers operated	Pearson Correlation	.094	-.449(**)	-.033	-.046	-.499(**)	.281(**)	.136(**)	1
	Sig. (2-tailed)	.060	.000	.507	.354	.000	.000	.007	
	N	400	400	400	400	400	400	400	400

** Correlation is significant at the 0.01 level (2-tailed)., * Correlation is significant at the 0.05 level (2-tailed).

Appendix 3: Summary of Correlation of Independent Variables used in Estimating the Cost Model

		Estimated cost	Spare parts/ maintenance	Tyre	Insurance	Overheads	Fuel	Hours worked	Trip length	Lubricant
Estimated cost	Pearson Correlation	1	.426(**)	.635(**)	.395(**)	.568(**)	.332(**)	.144	.273(**)	.482(**)
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.080	.001	.000
Spare parts/ maintenance	Pearson Correlation	.426(**)	1	.422(**)	.358(**)	.408(**)	-.222(**)	.066	-.220(**)	.498(**)
	Sig. (2-tailed)	.000		.000	.000	.000	.006	.423	.007	.000
Tyre	Pearson Correlation	.635(**)	.422(**)	1	.195(*)	.326(**)	-.048	-.071	-.088	.536(**)
	Sig. (2-tailed)	.000	.000		.017	.000	.563	.387	.286	.000
Insurance	Pearson Correlation	.395(**)	.358(**)	.195(*)	1	.304(**)	-.008	.134	.042	.383(**)
	Sig. (2-tailed)	.000	.000	.017		.000	.923	.102	.606	.000
Overheads	Pearson Correlation	.568(**)	.408(**)	.326(**)	.304(**)	1	-.387(**)	.349(**)	.335(**)	.649(**)
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000	.000
Fuel	Pearson Correlation	.332(**)	-.222(**)	-.048	-.008	-.387(**)	1	-.225(**)	.600(**)	.378(**)
	Sig. (2-tailed)	.000	.006	.563	.923	.000		.006	.000	.000
Hours worked	Pearson Correlation	.144	.066	-.071	.134	.349(**)	-.225(**)	1	-.060	.197(*)
	Sig. (2-tailed)	.080	.423	.387	.102	.000	.006		.468	.016
Trip length	Pearson Correlation	.273(**)	-.220(**)	-.088	.042	.335(**)	.600(**)	-.060	1	-.391(**)
	Sig. (2-tailed)	.001	.007	.286	.606	.000	.000	.468		.000
Lubricant	Pearson Correlation	.482(**)	.498(**)	.536(**)	.383(**)	.649(**)	.378(**)	.197(*)	-.391(**)	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.016	.000	

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 4: Results of Hypotheses Test

Hypothesis One: The fares charged by the different categories of urban mass transportation modes are the same.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	vehicle mode	1.73	150	.76	.062
	fares/km	786.99	150	504.56	41.20

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	vehicle mode and fares/km	150	-.839	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	vehicle mode - fares/km	-785.26	505.20	41.25	-866.77	-703.75	-19.04	149	.000

Hypothesis Two: The fares charged by the different categories of urban mass transportation modes are dependent on the cost of operations.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Estimated cost	42277035.57	149	9865218.49	808190.19
	fares/km	790.89	149	504.00	41.29

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Estimated cost and fares/km	149	-.411	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Estimated cost - fares/km	42276244.68	9865425.48	808207.15	40679128.36	43873361	52.31	148	.000

<u>Hypothesis Three</u>: The fares charged by the different urban transport modes are characterized by impedance factors such as travel time and distance.

a. Travel time

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	fares/km	786.99	150	504.56	41.20
	trip duration/km	9.86	150	4.88	.40

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	fares/km and trip duration/km	150	.475	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	fares/km - trip duration/km	777.13	502.27	41.01	696.10	858.17	18.95	149	.000

b. Distance

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	trip length	23219.71	150	5347.24	436.60
	fares/km	786.99	150	504.56	41.20

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	trip length and fares/km	150	-.439	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	trip length - fares/km	22432.71	5587.39	456.21	21531.24	23334.19	49.17	149	.000

Appendix 5: Logistic Regression for Passengers Willingness to Pay for Urban Transport Services

Case Processing Summary

Unweighted Cases(a)		N	Percent
Selected Cases	Included in Analysis	124	100.0
	Missing Cases	0	.0
	Total	124	100.0
Unselected Cases		0	.0
Total		124	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Categorical Variables Codings

		Frequency	Parameter coding
			(1)
employment status	Unemployed	28	1.000
	Employed	96	.000
sex of respondents	Female	24	1.000
	Male	100	.000

Block 0: Beginning Block

Iteration History (a,b,c)

Iteration		-2 Log likelihood	Coefficients
			Constant
Step 0	1	151.215	.806
	2	151.154	.855
	3	151.154	.855

a Constant is included in the model.
b Initial -2 Log Likelihood: 151.154
c Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Classification Table (a,b)

Observed			Predicted		
			Willing to pay		Percentage Correct
			No	yes	
Step 0	Willing to pay	No	0	37	.0
		yes	0	87	100.0
	Overall Percentage				70.2

a. Constant is included in the model.
b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.855	.196	18.977	1	.000	2.351

Variables not in the Equation (a)

			Score	df	Sig.
Step 0	Variables	service level	.193	1	.661
		SEX(1)	3.637	1	.057
		EmpSTAT(1)	.404	1	.525
		income	1.057	1	.304
		hhllsd_s	7.706	1	.006
		fares	8.622	1	.003

a. Residual Chi-Squares are not computed because of redundancies.

Block 1: Method = Enter

Iteration History (a,b,c,d)

Iteration		-2 Log likelihood	Coefficients						
			Constant	service level	SEX(1)	EmpSTAT(1)	income	hhllsd_s	fares
Step 1	1	130.676	.019	.065	-.854	.933	.000	.300	.000
	2	129.041	-.117	.089	-1.087	1.090	.000	.406	.000
	3	129.007	-.146	.093	-1.133	1.108	.000	.426	.000
	4	129.007	-.147	.093	-1.134	1.108	.000	.426	.000
	5	129.007	-.147	.093	-1.134	1.108	.000	.426	.000

a. Method: Enter
b. Constant is included in the model.
c. Initial -2 Log Likelihood: 151.154
d. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.147	6	.001
	Block	22.147	6	.001
	Model	22.147	6	.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	129.007(a)	.164	.232

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	14.098	8	.079

Contingency Table for Hosmer and Lemeshow Test

		Willing to pay = No		Willing to pay = yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	7	8.670	5	3.330	12
	2	7	6.124	5	5.876	12
	3	9	5.026	3	6.974	12
	4	3	3.755	9	8.245	12
	5	3	3.222	9	8.778	12
	6	1	2.779	11	9.221	12
	7	0	2.459	12	9.541	12
	8	2	2.106	10	9.894	12
	9	2	1.529	10	10.471	12
	10	3	1.330	13	14.670	16

Classification Table (a)

Observed			Predicted		
			Willing to pay		Percentage Correct
			No	yes	
Step 1	Willing to pay	No	12	25	32.4
		yes	8	79	90.8
	Overall Percentage				73.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1(a)	Service level	.093	.194	.231	1	.631	1.098	.751	1.605
	SEX(1)	-1.134	.584	3.765	1	.052	.322	.102	1.012
	EmpSTAT (1)	1.108	.558	3.948	1	.047	3.029	1.015	9.037
	income	.000	.000	.026	1	.871	1.000	1.000	1.000
	hhllsd_s	.426	.144	8.729	1	.003	1.532	1.154	2.033
	fares	.000	.000	5.895	1	.015	1.000	1.000	1.000
	Constant	-.147	.895	.027	1	.870	.863		

a. Variable(s) entered on step 1: service level, SEX, EmpSTAT, income, hhllsd_s, and fares.

Correlation Matrix

		Constant	Service level	SEX (1)	EmpSTAT(1)	income	hhllsd_s	Fares
Step 1	Constant	1.000	-.538	.072	-.293	-.371	-.623	-.311
	Service level	-.538	1.000	-.016	.019	.002	.022	-.020
	SEX(1)	.072	-.016	1.000	-.357	.044	-.224	-.047
	EmpSTAT (1)	-.293	.019	-.357	1.000	.093	.291	-.049
	income	-.371	.002	.044	.093	1.000	.181	-.104
	hhllsd_s	-.623	.022	-.224	.291	.181	1.000	-.130
	fares	-.311	-.020	-.047	-.049	-.104	-.130	1.000

Appendix 6: Willingness to Pay Questionnaire

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

My name is Michael Poku-Boansi, a PhD student of the department of planning of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Your assistance in answering or completing the questionnaire will be very much appreciated.

DEMAND FOR PUBLIC TRANSPORT SERVICES

1. How many people make up your household? ..
2. Complete the table below.

Number of member	Relation to household head	Age	Sex	Employment status

3. Does your household own a car? Yes [ ] No [ ]
4. How many cars do you have?
5. How many motorized trips do all the members of your household together make in a day? [a] 1 [b] 2 [c] 3 [d] 4 [e] Others .
6. How long does it take you to get a car (waiting time) if your household do not own a car? [a] less than 5 minutes [b] 5 – 10 minutes [c] 11 – 15 minutes [d] 16 – 20 minutes [e] Others .
7. How long does it take you to get to your destination (travel time)? .
8. What is the distance between the origin and destination? .
9. How much do you pay per trip (round trip)? .

WILLINGNESS TO PAY

10. How much more are you willing to pay if the following services are provided?

Reduced travel time by 25 percent

Reduced waiting time by 25 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

11. How much more are you willing to pay if the following services are provided?

Reduced travel time by 30 percent

Reduced waiting time by 30 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

12. How much more are you willing to pay if the following services are provided?

Reduced travel time by 45 percent

Reduced waiting time by 45 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

13. How much more are you willing to pay if the following services are provided?

Reduced travel time by 25 percent

Reduced waiting time by 30 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

14. How much more are you willing to pay if the following services are provided?

Reduced travel time by 25 percent

Reduced waiting time by 45 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

15. How much more are you willing to pay if the following services are provided?

Reduced travel time by 30 percent

Reduced waiting time by 45 percent

Increased level of service

[ ] none

[ ] less than 10 percent of what you are paying now

[ ] more than 10 percent but less than 20 percent of current what you paying now

[ ] more than 20 percent but less than 30 percent of current what you paying now

Appendix 7: Interview Guide for Road Transport Coordinating Council

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Mr. Michael Poku-Boansi is a PhD student of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Hope your assistance will be very much appreciated.

Office of Respondent ..

Name and objectives of your Council ..

1. Is your outfit responsible for determining transportation fares in the country?

Yes [ ] No [ ]

2. If No, who is responsible?...

3. If Yes, can you explain the process used in arriving at transport fares?

4. What elements do you use in arriving at the vehicle operating cost?

5. What mechanism do you use in adjusting fares if any of the above cost elements changes?

6. Are there any problems with the current mechanism for pricing transport services?

7. What problems does your outfit encounter in determining fares for your members?

8. How do you think these problems can be overcome in order to make your work easier?

Appendix 8: Interview Guide for Road Transport Unions

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Mr. Michael Poku-Boansi is a PhD student of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Hope your assistance will be very much appreciated.

Name of Respondent .

Date of Interview

Name of Union ..

Location of Union ..

Objectives of your Union ..

1. Is your outfit responsible for determining transportation fares in the country?

Yes [ ] No [ ]

2. If yes, what inputs do you provide?..................................

3. If No, why and what inputs can you provide?

4. Can you explain your role in determining transport fares in Ghana if it is not done by your outfit?

5. How do you communicate the outcome to your members?

6. Does your office have any problem with the current mechanism for pricing transport services? Yes [ ] No [ ]

7. If Yes, How?...

Appendix 9: Interview Guide for Ministry Of Road Transport

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Mr. Michael Poku-Boansi is a PhD student of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Hope your assistance will be very much appreciated.

Office of Respondent ..

Name and objectives of your Council ..

1. Is your outfit responsible for determining transportation fares in the country?

Yes [ ] No [ ]

2. If No, who is responsible?..

3. If Yes, can you explain the process used in arriving at transport fares?

4. What elements do you use in arriving at the vehicle operating cost?

5. What mechanism do you use in adjusting fares if any of the above cost elements changes?

6. Are there any problems with the current mechanism for pricing transport services?

7. What problems does your outfit encounter in determining fares for your members?

8. How do you think these problems can be overcome in order to make your work easier?

Appendix 10: Questionnaires for Passengers

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Mr. Michael Poku-Boansi is a PhD student of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Hope your assistance will be very much appreciated.

<u>Please tick or provide your own answer where necessary.</u>

Place of Residence: ..

Place of Work Distance to Work ..

Place of Market Distance to

Market

1. Where do you normally commute to during week days?

a) Work [ ] b) Market [ ] c) Social [ ]

2. Where do you normally commute to during weekend?

a) Work [ ] b) Market [ ] c) Social [ ]

3. What is the dominant mode used in commuting in the metropolis?

Private Car [ ]
Taxis [ ]
Trotro (Mini Bus) [ ]
Metro Mass Transit [ ]

4. How many round trips do you make per day?:

5. How long does it take you to reach your destination?

Destination	Distance	Time	Transport Fare
Work			
Market			
Social			

6. What proportion of your income do you actually spend on transportation per month?.......................

7. What proportion of your income are you willing to spend on transportation per month?: .

8. Income of respondent per month?: ..

Appendix 11: Questionnaire for Vehicle Operators

DEPARTMENT OF PLANNING
KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Mr. Michael Poku-Boansi is a PhD student of the Kwame Nkrumah University of Science and Technology, Kumasi undertaking a research on the topic "Pricing of Urban Public Transport Services in Ghana. Case Study of the Kumasi Metropolitan Area". Hope your assistance will be very much appreciated.

Please tick or provide your own answer where necessary.

A. DRIVER AND VEHICLE INFORMATION

Number of Respondent

Type of training acquired: Driving school [ ] Apprenticeship training [ ]

2. Which of the transport unions do you belong to? Please specify:
3. Station of operation/local:
4. On what route do you operate your vehicle? ..
5. What type of vehicle do you use in your operation?
6. What is the number of persons of your vehicle?
7. Registration number of vehicle: ..
8. Which year was the vehicle purchased?...
9. Was it purchased new or used?...
10. What was the cost of the vehicle?

B. VEHICLE OPERATION / MAINTENANCE COST

(Fuel, Oil, Tyres, Parts, etc.)

10. How often do you maintain your vehicle?

a) Weekly [ ] b) Every 2 weeks [ ] c) Every 3 weeks [ ]

d) Every 4 weeks [ ] e) Others (*specify*) ::

11. How much does it cost you each time you maintain the vehicle?

Activity	Cost (¢)

12. How many gallons of fuel do you use per day?

a) One gallon [ ]   b) Two gallons [ ]

c) Three gallons [ ]   d) Four gallons [ ]

e) Others ..

13. How many times do you change oil per month?

a) Once [ ]   b) Twice [ ]   c) Thrice [ ]   Four times [ ]

14. How much do you spend each time you change oil?

15. How often do you change your tyres?...

16. How much do you spend each time you change tyre?

17. How many round trips do you make per day?:

18. How many hours do you work per day?:

19. What is the distance between your origin and destination?...........................

20. What is the average travel time used from origin to your destination of your route?.....

21. Complete the table below

Component for overheads	Amount spent (¢)	Frequency of payment
Insurance		
Maintenance facility cost		
Booking toll		
Road Worthiness		
Washing of Vehicle		
Terminal operating expenses (Toll)		
City Plate (Payments to City Authority)		
Spare parts (excluding tyres)		
Others (Specify)		

22. How much do you receive as salary for the month?

23. How much does your mate receive as salary for the month?

24. What is the total number of passengers carried per trip?

Appendix 12: Questionnaire for Vehicle Count

DEPARTMENT OF PLANNING
COLLEGE OF ARCHITECTURE AND PLANNING
FACULTY OF PLANNING AND LAND ECONOMY

TOPIC: *PRICING OF URBAN MASS TRANSPORT SERVICES IN GHANA. A CASE STUDY OF THE KUMASI METROPOLITAN AREA.*

TRANSIT BOARDING AND ALIGHTING COUNT
(Field Sheet)

Route Vehicle Number

Origin Destination .Time

Arrival Time	Departure Time	Location of stop	Passenger Boarding	Passenger Alighting	Passenger On board	Fares charged	Remarks

Date: Recorder:
Indicative Distance/ Trip Length

Appendix 13: T-Test of Results between HDM IV and Manual Calibration for VOC

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	HDM IV	39324418.12	149	7535724.306	617350.590
	Manual Calibration	42277035.57	149	9865218.489	808190.189

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	HDM IV and Manual Calibration	149	.829	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	HDM IV and Manual Calibration	-2952617.450	5549310.329	454617.216	-3850996.756	-2054238.143	-6.495	148	.000