AN ECONOMIC ANALYSIS OF TRAFFIC CONGESTION AND EFFECTIVENESS OF DECONGESTION MEASURES IN NAIROBI, KENYA

BY

CHARLES CHONJO CHAMA NZAI

B. A. (ECONOMICS), M. A. (ECONOMICS), (UoN)

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN ENVIRONMENTAL STUDIES (ENVIRONMENTAL ECONOMICS), SCHOOL OF ENVIRONMENTAL STUDIES, UNIVERSITY OF ELDORET.

OCTOBER 2014

DECLARATION BY THE CANDIDATE

This thesis is my original work and has not been presented for a degree award in any other University.

CHARLES CHAMA NZAI

REG. NO. SES/D.Phil/37/2005

Sign……Date……..

DECLARATION BY THE SUPERVISORS

This thesis has been submitted for examination with our approval as University supervisors.

Prof. Wilson K. Yabban

Sign…….…….Date…….…….

Dr. Anderson Kipkoech

Sign…….……..Date…….……...

DEDICATION

To my wife Tatu; Son, Nzai; and, Daughters, Farida and Mose.

ABSTRACT

Traffic congestion is a wasteful phenomenon to businesses, society, environment and the economy as a whole. Its effects include delayed travel times, reduced productivity and business opportunities, accidents, frustrations, stress and pollution. This study analyzed the economic impacts of traffic congestion and effectiveness of different decongestion measures in Nairobi city, Kenya. Identification of study variables relied on theories and principles from welfare economics, congestion management; stakeholder participation; measuring impacts of traffic congestion; and, Contingent Valuation Method (CVM). Data was collected through questionnaires administered to the city's motorists, interviews with key informants, observations and secondary data sources. Descriptive statistics, mathematical computations and counterfactual analysis were used to analyze the data. Regression analysis was used to model the relationship between motorists' Willingness-to-Pay (WTP) for traffic decongestion program and their socio-economic characteristics. Results showed that the city's congestion is due to continuously increasing number of vehicles without effective corresponding long-term congestion management strategies. Its related wastages were estimated as Ksh 146.5 billion and Ksh 16.7 billion annually in terms of delays and wasted fuel respectively. CVM results showed an average monthly motorists' WTP of Ksh 1387 totaling to Ksh 8.3 billion annually interpreted as the total value of some benefits of reducing congestion in the city. Regression results also showed that motorists' income, cost of running cars, price of cars and their perceptions on Government's role in infrastructural projects were statistically significant at 5% in explaining their WTP bids. Bypass roads were found to minimally have a 7.5% impact in curbing congestion. The expansion of Thika Road and Syokimau commuter train service was estimated to have saved motorists Ksh 80 billion and Ksh 117.03 billion annually, respectively in terms of delays and wasted fuel. Phasing out of 14-seater PSV per se is ineffective in alleviating congestion and has potential of crippling the city's public transport. With an effective payment machinery, the WTP values show the potential of funding the expensive decongestion programs using Nairobi city's own resources. Decongestion programs should entail amongst others redesigning of the city's land use policy in relation to congestion management strategies and parking management policy; introduction of congestion pricing schemes; development of new and modification of road infrastructure; encouraging use of public transport through introduction of consultative BRT systems; improving traffic operations; and, establishing a single agency that shall manage and coordinate efforts on the problem instead of relying on numerous government institutions with disjointed roles. There is need to cascade such research in other growing towns within the county to share experiences and develop national statistics on the problem.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ACRONYMS

AWTP	Average Willingness to Pay
BRT	Bus Rapid Transit
BTRE	Bureau of Transport and Regional Economies
CBA	Cost Benefit Analysis
CBD	Central Business District
CP	Perceptions by motorists on severity of traffic congestion
CPS	Congestion Pricing Scheme
CS	Compensating Surplus
CV	Compensating Variation
CVM	Contingent Valuation Method
EA	East Africa
ECOPASS	Traffic Pollution Charge
ECTM	European Conference of Transport Ministers
EO	Household Expenditure on other goods
ES	Equivalent Surplus
EV	Equivalent Variation
GaWC	Globalization and World Cities
GDP	Gross Domestic Product
GLM	General Linear Model
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
ICT	Information Communication Technology
INTP	Integrated National Transport Policy
JKIA	Jomo Kenyatta International Airport

KENCOM	Kenya Commercial
KIPPRA	Kenya Institute for Public Policy and Research Analysis
KR	Kenya Railway
LCCS	London Congestion Charging Scheme
LOS	Level of Service
LTA	Land Transport Authority
MOA	Matatu Owners Association
MWA	Matatu Welfare Association
NCC	Nairobi City Council
NMR	Nairobi Metropolitan Region
NMT	Non-Motorized Trasport
NSE	Nairobi Stock Exchange
ODOT	Oregon Department of Transport
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
PM	Price of Cars
PSV	Public Service Vehicles
SES	School of Environmental Studies
SPSS	Statistical Package for the Social Sciences
SD	Sustainable Development
TCEA	Transport Canada Environmental Affairs
TDM	Transport Demand Management
TfL	Transport for London
TLB	Transport Licensing Board
TTI	Texas Transport Institute

TWTP	Total Willingness to Pay
UNON	United Nations Office in Nairobi
VIF	Variance Inflation Factor
VTPI	Virginia Technical Polytechnic Institute
WCED	World Commission for Environment and Development
WTAC	Willingness to Accept Compensation
WTP	Willingness to Pay

DEFINITION OF TERMS

Bus Rapid Transit – Is a high performance public transport bus service which aims to combine bus lanes with high-quality bus stations, vehicles, amenities and branding to achieve the performance and quality of a light rail or metro system, with the flexibility, cost and simplicity of a bus system.

Bypass Road – Is a road or highway that avoids or bypasses a built-up area, town, or village, to let through traffic flow without interference from local traffic, to reduce congestion in the built-up area, and to improve road safety.

Central Business District – Is the commercial and often geographic heart of a city. Also referred to as downtown (USA) or city centre (Canada).

Compensating Surplus – Is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility (U_0) throughout the change of provision for public commodities.

Congestion Pricing – Is a system of surcharging users of public goods that are subject to congestion through excess demand such as higher peak charges for use of bus services, electricity, metros, railways, telephones, and road pricing to reduce traffic congestion.

Contingent Valuation Method – Is a survey-based economic technique for the valuation of non-market resources, such as environmental preservation or the impact of contamination.

Cost Benefit Analysis – Is a systematic process for calculating and comparing benefits and costs of a project, decision or government policy to determine if the project is a sound investment or to provide a basis for comparing projects.

Counterfactual Analysis – Comparison between what actually happened and what would have happened in the absence of the intervention.

Descriptive Statistics – Is the discipline of quantitatively describing the main features of a collection of data, that is, aim to summarize a sample, rather than use the data to learn about the population that the sample data of data is thought to represent.

Economic Analysis – Involves analysis of behavior of economic agents and stability of equilibrium of economic systems including the theory of index numbers and generalized welfare economics.

Effectiveness – Is the capability of producing desired result.

Heteroscedasticity – In regression analysis, heteroscedasticity mean a situation in which the variance of the dependent variable varies across the data which complicates analysis because many methods in regression analysis are based on an assumption of equal variance.

Hypothesis – Is a proposed explanation for a phenomenon which still has to be rigorously tested.

Inductive Statistics – Is the branch of statistics dealing with conclusions, predictions, and estimations based on data from samples.

Matatu – 14-Seater and mini-buses that are privately owned in Kenya and neighboring nations which ply set routes, run from termini, and are used for both inter and intra-city travel.

Multicollinearity – Refers to a situation in which two or more explanatory variables in a multiple regression model are highly correlated where there is perfect multicollinearity if the correlation between two independent variables is equal to 1 or -1.

Program Impact Evaluation – The processes of determining whether or not a given public policy or program is in fact achieving the intended impact as visualized by the various policy actors who either supported or opposed the given policy.

Protest Bids – Occurs whenever individuals who oppose or do not approve of the survey fail to respond, give invalid but positive bids or place a zero value on a good that they actually value.

Regression Analysis – Is a statistical technique for estimating the relationships among variables. That is, understanding how the typical value of the dependent

variable changes when any one of the independent variables is varied, while the other independent variables are held fixed.

Stakeholder – Is an individual or group influenced by and with an ability to significantly impact (positively or negative) the topical area of interest.

Statistically Significant – The probability that observations as extreme as the data would occur by chance in a given single null hypothesis.

Traffic Congestion – Is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing.

Valuation Theory – Is a major topic in environmental economics that is deals with assessing the economic value of the environmental resources.

ACKNOWLEDGEMENT

I acknowledge my profound gratitude to my supervisors Prof. Wilson K. Yabban and Dr. Anderson Kipkoech for their patience and constant guidance including the Head of Department, Applied Environmental Social Sciences for support and encouragement to me to soldier on. I would also not forget my friends for their incisive and candid comments and suggestions that have helped shape the Thesis immensely. I also salute the teaching fraternity in the School of Environmental Studies for their contribution especially during the defense of my proposal and thesis and the non-academic staff for their facilitation on various issues related to this study. I would also like to thank officials at the Ministry of Nairobi Metropolitan Development, Nairobi City Council, Ministry of Transport and KIPPRA for their encouragement and for providing me with data used in this study.

I would also like to express my sincere gratitude to my family, especially my wife (Tatu) for her patience and endurance during my frequent absence at home. At most times she bore the sole responsibility of caring for our three young children. Not forgetting my mother and late father for their prayers to me to succeed including my sisters and the extended family for their enthusiasm which motivated me to excel.

My sincere gratitude goes to all my three colleagues, Omondi, Akala and Kotut in the class of Doctor of Philosophy (Regular Programme), Environmental Economics at the Moi University, School of Environmental Studies, Academic Year 2005 for their encouragement throughout the programme.

CHAPTER ONE

INTRODUCTION

1.0 Background

Transport forms a key component of creating a competitive business environment as well as means through which various socio-economic and environmental objectives can be achieved (Nairobi Metro 2030 Strategy). Traffic congestion has frustrated the realization of such objectives in many cities across the world. Congestion prevents us from moving freely and it slows and otherwise disrupts the conduct of business within urban areas. Congestion involves queuing, slower speeds and increased travel times, which impose costs on the economy and generate multiple impacts on urban regions and their inhabitants. Sao Paulo, Brazil has the world's worst traffic jams according to Time Magazine. Congestion also has a range of indirect impacts including political and the marginal environmental and resource impacts of congestion, impacts on quality of life, stress, safety as well as impacts on non-vehicular road space users such as the users of sidewalks and road frontage properties (Transport Canada, 2006). In 83 cities across USA the costs of wasted time and fuel due to traffic congestion was estimated (2005) at $60 billion, Jonathan I. Levy, et al (2007). It is predicted that annual economic loss due to traffic congestion will reach $15 billion by 2031 in Canada, Clear Air Commute (2014).

Traffic congestion may be classified as recurrent – generally the consequence of factors that act regularly or periodically on the transportation system, such as daily commuting or weekend trips. Non-recurrent congestion on the other hand is the effect of unexpected, unplanned or large events (e.g. road works, crashes, special

events and so on) that affect parts of the transportation system more or less randomly and, as such, cannot be easily predicted (OECD, 2002). About half of USA traffic congestion is recurring and is attributed to sheer weight of traffic; most of the rest is attributed to traffic incidents, road work and weather invents, Wikipedia (2014).

However, though Governments all over the world understand that measuring congestion is a necessary step in order to deliver better congestion outcomes, the subject is shrouded in lots of controversies (Transport Canada, 2006). There is no single, broadly accepted definition of traffic congestion according to Organization for Economic Co-operation and Development (OECD) and European Conference of Transport Ministers (ECMT) report of 2007 including methodology of estimating the related costs and benefits associated with it. One of the principal reasons for this lack of consensus is that congestion is both a physical phenomenon relating to the manner in which vehicles impede each others' progression as demand for limited road space approaches full capacity. A relative phenomenon relating to user expectations vis-à-vis road system performance. The two cannot be separated in addressing the problem (OECD, 2007). The causes, nature and frequency of traffic congestion may therefore vary between areas, cities and roads within a city due to the differences in the physical transportation infrastructure and the perceptions of the area's people on the problem.

Urban congestion must therefore be understood in the wider context of city dynamics and agglomeration benefits. Ideally, urban transport policies should be developed on the basis that congestion is related to both the behavior of traffic as it

nears the physical capacity of the road system and the difference between road users' expectations of the system's performance and how the system actually performs. In dealing with the problem, policy makers and planners around the globe have been proposing strategies from congestion pricing schemes, expansion of road networks and development of alternative modes of transportation such as rail networks to traffic regulations but with little or no success at all (VTPI, 2007).

In Nairobi, Kenya, traffic congestion is now considered a major growing epidemic. Drivers and commuters in Nairobi suffer the impacts of traffic congestion such as delays, reduced productivity and business opportunities, accidents, increased fuel costs, stress and frustrations though the nature, severity and frequency of the problem vary from area to area within the city (Irungu, 2007). Kenya incurs losses amounting to Ksh 17 billion a year due to traffic jam in Nairobi city alone, equivalent to two percent of the Gross Domestic Product (GDP) that year according to a study done by Kenya Institute for Public Policy Research and Analysis (KIPPRA) in 2006. Reduced traffic congestion has therefore, become a strategic objective of transportation authorities in the city and a commodity desired by many of Nairobi's residents because of the debilitating effect it has on the quality of their lives.

This research was an attempt to investigate the economic impacts surrounding traffic congestion in Nairobi and effectiveness of intervention measures and was motivated by the Ministry of Nairobi Metropolitan Development under its Nairobi Metro 2030 Strategy that it wants to develop an efficient transportation system that minimize

travel times as well as reduce externalities in the city of Nairobi mainly through the promotion of public transport.

1.1 Transportation in Nairobi

In preparation for adequate assessment and examination of traffic congestion in Nairobi in accordance with the study's objectives, this section analyses the city's CBD in terms of its population, the existing various classifications of the roads, the modes of transportation in the city and transportation statistics and information. The section also looks at the various government agencies involved in the transportation sector as the impacts of their operations are directly correlated with the problem of congestion in the city. It is also important to highlight on the various anti-congestion measures that transportation authorities in the city have undertaken in the past or plan to initiate. It is part of this study's objective to assess the impacts of these measures in curtailing the problem of congestion in the city. In particular, of much importance was the Nairobi Metro 2030 Strategy developed by the Ministry of Nairobi Metropolitan Development as a long term measure to address the problem. The strategy was the motivation of this study and the commodity that was offered for sale to the CVM respondents.

1.1.1 Overview of Nairobi's CBD

Nairobi is the capital city of Kenya and also the capital of the Administrative area of Nairobi. Nairobi has the highest urban population in East Africa, estimated at between 3 and 4 million (Wikipedia, 2011). According to the 2009 Government of Kenya Census, in the administrative area of Nairobi, 3.375 million inhabitants lived within 684$km^{2.}$. Nairobi is now one of the most prominent cities in Africa politically and financially. It is home to thousands of Kenyan businesses and over 100 major

international companies and organizations, including the United Nations Environmental Programme (UNEP). Nairobi is an established hub for business and culture. The Nairobi Stock Exchange (NSE) is one of the largest in Africa and the second oldest exchange on the continent. It is ranked 4th in terms of trading volume and capable of making 10 million trades a day (Wikipedia, 2011).

In the day, Nairobi serves the neighboring districts of Thika, Kiambu, Murang'a, Kajiado and Machakos where people from these districts come to Nairobi on daily basis to work, school, business, trading and so on which has created an impact on traffic flows in the city (Wikipedia, 2011). The Nairobi Central Business District (CBD) takes a rectangular shape, around the Uhuru Highway, Haille Selasse Avenue, Moi Avenue and University Way. Almost all Government Ministries and most private companies and businesses are located in the CBD.

Nairobi's workers travel using public and private means. The design of Nairobi city required that workers and general public from various parts of Nairobi and traveling to other commercial areas around the CBD such as Community, Westlands, Industrial Area, River Road, etc have to pass through the CBD which adds congestion experienced in the CBD roads (Irungu, 2007). It is estimated that the vehicle population in Nairobi stands at above 300,000 vehicles in the year 2008 and has been increasing at 5,000 vehicles per month, (Ministry of Roads 2013). The major link roads to the CBD are the Mombasa Road which connects residential areas such as Embakasi, South C, South B, Nairobi West; Ngong Road connecting areas such Ngong, Dagoreti, Karen, Adams Arcade; Uhuru Highway just about the CBD connecting Westlands, Uthiru; Jogoo Road which connects residential areas of

Buruburu, Eastlands; Langata Road connecting areas of Ongata Rongai, Langata, Karen, Southlands; and Thika Road which connects Thika, Ruiru, Parklands. Generally, the roads within and around the city are classified into (Government of Kenya, 2011):

1. International Trunk Roads such as the Thika Highway, Mombasa Road;
2. Arterial Roads such as Forest Road, Murang'a Road, Ring Road, etc;

Matatus – privately – owned minibuses – which are allocated numbers for specific routes are the most popular form of local road transport, and generally transport up to 14 people. Most of the link roads to the CBD are also served by various sizes of company and individually owned buses with a carrying capacity of about sixty passengers. *Manyangas*, a form of minibuses though larger than *matatus* but relatively smaller than the normal bus also ply many roads in Nairobi (Jennifer, 2007). The most common and used type of buses authorized to enter the CBD at KENCOM Stage are the City Hopper, Kenya Bus Service and Double M. However, majority of the vehicles entering and passing through the CBD are privately owned saloon cars. Of all the 500,000 vehicles that enter the city center each day, only 27% are *matatus* (JamboNairobi, 2007). Matatus and manyangas that park within the CBD have been reserved specific areas and do not reach most parts of the CBD.

1.1.2 Government Agencies involved in Road Transport in the City

The following government agencies in Table 1.1 below are involved in road transport in the country and their operations have a direct or indirect impact on traffic congestion in the city:

Table 1.1: Government Agencies involved in Transportation Sector

Government Agency	**Mandate**
Ministry of Roads.	Charged with the responsibility of providing basic infrastructure facilities to the public. These include development, maintenance and rehabilitation of Road networks in the country.
Ministry of Transport.	Mission is to facilitate safe, efficient, accessible and sustainable transportation services. The Ministry ensures development of regulatory framework, which is enforced through various regulatory bodies. For example, currently the Transport Licensing Board (TLB) established by an Act of Parliament ensures harmony in the provision of road transport services. TLB has the powers to debar vehicles from entering the CBD.
Ministry of Nairobi Metropolitan Development.	Development of integrated Nairobi Metropolitan Areas Growth and Development Strategy covering among other things: integrated roads, bus and rail infrastructure for Metropolitan area, efficient mass transport system for Nairobi metropolitan area. Has developed the Metro 2030 Transport Strategy for the city.
Ministry of Finance.	The Ministry is charged amongst other functions with the responsibility of formulating financial and economic policies. The Ministry coordinates government ministries/departments in the preparation of the annual

	national budgets. Ensures that government expenditure is within the revenue collected to reduce domestic borrowing which tends to cause negative ripples in economic management.
Nairobi City Council.	Is charged with the mandate to provide basic services to the community in the city including: water and sanitation; health; education; general infrastructure (roads; security; and employment); and, other economic services.
Kenya National Highways Authority.	A state corporation under the Ministry of Roads. It was set up under the Kenya Roads Act, 2007 and is charged with the mandate to manage, develop, rehabilitate and maintain national roads such as Mombasa Road, Thika Road, Uhuru Highway which are primary link roads to the city's CBD.
Kenya Urban Roads Authority.	Also a state corporation under the Ministry of Roads and established under the Kenya Roads Act, 2007 is mandated with the responsibility for the development, maintenance, rehabilitation and management of urban roads in Kenya including those in Nairobi.
Kenya Traffic Police Department.	The roles of traffic police department amongst others is to prevent road accidents; provision of free flow of traffic along the roads; enforcement of traffic laws and regulations; etc.

(Source: Government of Kenya Reports, 2011)

Though all these agencies are government bodies, it may be very difficult and time consuming to coordinate the operations of such a large number of offices to address a single problem like traffic congestion particularly where none of them has been assigned the specific mandate to deal with it.

1.1.3 The Nairobi Metro 2030 Transport Strategy

The Ministry of Nairobi Metropolitan Development under the Nairobi Metro 2030 Strategy has developed "Optimization of Mobility and Connectivity through Effective Transportation" – a long term strategy that envisages developing an efficient transportation system that minimize travel times as well as reduce externalities in the city. The key components of the strategy include promotion of public transport flexibility and freedom of movement in the region and leveraging the Jomo Kenyatta International Airport (JKIA), Wilson Airport and the Central Railway Station as transport and logistics hubs. Other interventions include Metropolitan Road Transport Infrastructure Measures; Public Transport; Traffic Management Strategies; Traffic Law Enforcement; Central Business District Access Strategy; Logistics and Supply Chain Management; Land Use Measures; and Information and Communication Technology in Transport Measures.

These strategies would imply modernization of existing transport networks and building on new ones, employment of well trained traffic managers, restriction of access to Central Business District (CBD), development of traffic laws, introduction of various access charges and introduction of Information Communication Technology (ICT).

This study was motivated by the strategy to address the problem of traffic congestion and public transport in general in the city where it was sold as the commodity to the study's CVM respondents. The strategy is however long term slated for the year 2030 within Kenya's Vision 2030 Strategy aimed at transforming the country into an industrialized middle income country.

1.2 Organization of Thesis

The thesis is organized into five chapters. Chapter One provides a background on the study; an overview of the study site, Nairobi; statement of the problem; objectives of study; research questions; justification of study; study hypotheses; and, limitations of the study. Chapter Two reviews literature on traffic congestion; the CVM; and, programmes for decongesting traffic such as congestion pricing schemes. Chapter Three provides the study's conceptual frameworks and methodology; planning and organization of the study; estimating costs of traffic congestion; CVM to estimate benefits of reducing traffic congestion; methodologies of investigating the other study's objectives; managing the study's data; and, appraisal of CVM results. Chapter Four is about results and discussions on the factors considered to contribute to traffic congestion in Nairobi; behavior and characteristics of personal motorists; costs of traffic congestion; CVM results; testing of study's hypotheses; etc. Lastly, Chapter Five provides a summary of the study; conclusions; recommendations; policy implications; and, areas for further research.

1.3 Statement of the Problem

Traffic jams are a major problem in Nairobi with a debilitating effect on the quality of life of people. Drivers and pedestrians in the city continuously suffer the negative

impacts of traffic jams which include delays, lost opportunities, higher costs of living, increased accidents, reduced competitiveness, frustrations and pollution, Transport Canada (2006). Kenya incurs losses amounting to Ksh 17 billion a year due to traffic jam in Nairobi alone, equivalent to two percent of the Gross Domestic Product (GDP) according to a study done by Kenya Institute for Public Policy Research and Analysis (KIPPRA 2006). Though traffic congestion cannot be eradicated, transport authorities in Nairobi must manage the problem to acceptable levels for drivers and residents in the city to realize the benefits that come with an effective and efficient transportation system, Irung'u (2007).

Plate 1.1: Traffic Congestion in Nairobi, Haille Selasse Avenue.
(Source: Author, 2011)

The complex nature of traffic congestion explained above has posed serious challenges to efforts aimed at dealing with the problem. There has been lack of consensus on what traffic congestion is including the frameworks of measuring its impacts. Research in United States (U.S.) and Europe has demonstrated that an understanding of congestion, what it means, how it can be measured is fundamental to being able to allow urban authorities to develop solutions to congestion (Transport Canada, 2006). Transport authorities in Nairobi have not been able either to come up with a working definition of traffic congestion nor developing a methodology to measure its impacts. There are neither any mechanisms to collect data regularly on the problem that will be useful in tracking congestion trends.

Research in the problem has also been very minimal or has not been able to collect relevant statistics to monitor the evolution of the problem with time. An understanding of the costs of congestion, the manifestation of congestions' impacts on travelers and on society at large allows potential solutions to be developed in the full context of urban goals, such as improved quality of life and increased productivity.

The absence of a single agency charged with sole responsibility of monitoring and dealing with traffic congestion has led to confusion and overlaps in intervention measures against the problem in the city. Several agencies within the city carry out operations that are directly or indirectly intended to address the problem. The Ministry of Roads is responsible for the by-pass roads program; the City Council of Nairobi regulates entry of cars into the CBD through parking fees; the Kenya Urban Roads Authority is responsible for rehabilitation of Roads within the city's urban

areas; the Kenya National Highway Authority is responsible for rehabilitation of the Thika and Uhuru Highways which are major feeder-roads to the city; and, the Traffic Police regulates the flow of vehicles in virtually all the city's roads. There is need to assign these intervention measures under a single docket to effectively tackle traffic congestion in the city.

Due to the twin nature of traffic congestion, there may not be a one-off solution to it. Therefore emphasis on infrastructural development alone as evidenced in Table 4.10 may not adequately address traffic congestion in the city. Though expansion of road networks may ease congestion, it is in the long term constrained as the city grows and demand for vehicles particularly personal cars increase. Besides, there is a limit to how a city's roads can be expanded. Such projects are equally expensive and may be very difficult to finance even if approved as measures of taming traffic congestion.

Further, though traffic regulations have been widely used to manage traffic jams in many cities around the world, they have not always produced optimal outcomes in the long run (Madibana 2009). For many planners, traffic regulations are not seen as being sufficient to cope with the future demand in traffic. A resident in Nairobi had the following comment regarding the Government's strategy to phase out matatus in the CBD to control traffic jam: *'No scientific research has been conducted to show that the solution to Nairobi's notorious grind lock is to force 14-Seater matatus out of business. So, how do we know their removal is the right decision'?* (Daily Nation, 25/7/2006).

Lastly, traffic congestion is positively correlated with economic growth of a city, OECD (2007). Therefore, as Nairobi grows economically a large section of its population shall be transformed into middle class with varied consumer demands including the desire for personal cars. This poses a long-term challenge to the city's Authority in dealing with traffic congestion. It is the intention of the Government in Nairobi to make the country a middle income country by the year 2030 through its economic blue print, the Vision 2030. There is therefore need to plan for a potential explosion of personal cars in the

city's roads.

1.4 Objectives of Study

The general objective is to study the problem of traffic congestion in Nairobi to understand the economic impacts surrounding it to facilitate determination of amicable decongestion strategies. The specific objectives were:

1. To investigate for contributory factors to traffic congestion in the city.
2. To investigate the behavior and characteristics of personal motorists in the city.
3. To estimate the costs of excess fuel and time lost due to traffic congestion.
4. To use Contingent Valuation Method to estimate the benefits of reducing traffic congestion in the city.
5. To assess the effectiveness of decongestion measures implemented in the city to reduce traffic congestion.

1.5 Research Questions

The following research questions facilitated the implementation of the study's objectives:

1. What are some of the causes of traffic congestion and perceptions of the people regarding traffic congestion in Nairobi?
2. What are the costs of traffic congestion and the benefits of reducing it?
3. Is there a 'standard' methodology/approach to estimate the quantitative costs of traffic congestion and the benefits of reducing it?
4. How unique is the CVM in estimating the benefits of reducing traffic congestion and should its results be relied upon for policy purpose?
5. Is data available in Kenya to estimate the costs of traffic congestion and benefits of reducing it?
6. Are there studies that have attempted to estimate the costs of traffic congestion and the benefits of reducing it in Nairobi and elsewhere?
7. How significant are the costs of traffic congestion and benefits of reducing it to individuals and society at large?
8. Have authorities in Nairobi done enough to deal with the problem of traffic congestion in the city?
9. What is the status of the bypass program and the policy of facing out 14 seater matatus from the CBD in Nairobi?
10. Are there other approaches that have been used to mitigate the problem of traffic congestion in Nairobi and in other parts of the world?

1.6 Justification of Study

The increasing debilitating effect of traffic congestion on the quality of life of motorists and the people of Nairobi in general calls for concern by scholars. There is an evident demand for a less-congested environment from motor traffic by both pedestrians and motor vehicle owners in Nairobi – a traffic decongested city that protects personal freedom, choice and mobility; enhances access to opportunity; enables economic prosperity; and, a city that protects the community and the natural environment. It is for this reason traffic congestion was specifically chosen for study.

The study also intends to discover possible solutions that may be applied to address the problem. In the past, decongestion intervention measures have been arbitrarily decided by the city's transport authorities and have mainly focused on infrastructural development and expansion but not soliciting for preferences and opinions from the city's motorists about reducing the problem. In instances where stakeholders have been involved in addressing the problem, individual motorists have not been directly engaged.

An economic analysis approach was specifically selected because the costs of traffic congestion on the society are enormous and equally the benefits that accrue with reduced congestion are significant in enhancing the life of the people in this city. Despite the complication entailed in getting quantitative estimates on the costs and benefits of the problem, there is need to get a working estimate on them to facilitate policy formulation and implementation on the problem. Irungu (2007) recommended

the need for stated preference surveys in obtaining perceptions of various transport users on transport issues.

CVM surveys have also the potential of engaging various stakeholders on a problem thereby making its results politically feasible. Though the study did not come across a study of traffic congestion in Nairobi using CVM survey, internationally however, I came across one CVM study to reduce traffic congestion carried out in Oregon USA (Kreg and Robert, 1997). Therefore, the success of this study is unique additional knowledge to the methods of anti-traffic congestion in the city and an increased input towards resolving the controversies surrounding the CVM approach.

1.7 Study Hypotheses

The study tested the following hypotheses to justify its significance:

1. That performance of congestion management strategies in the city is less than 40%.
2. About 80% of the motorists in Nairobi agree that traffic congestion is a problem affecting their quality of life.
3. That the annual total cost of excess fuel and time wasted from traffic congestion is about Ksh 100 billion (2011).
4. That motorists in the city were WTP about Ksh 2,000 per month for the proposed traffic decongestion program by the Ministry of Nairobi Metropolitan Development.
5. It is expected that the bypass programs reduced traffic congestion by 5%.

1.8 Limitations of the Study

Lack of consensus on common definition of congestion and a framework to measure the costs and benefits associated with the problem posed the greatest challenge to the study. The study devised an operational definition based on existing theories and literature on the subject to facilitate estimation of these costs and benefits.

Lack of data in Kenya on traffic congestion trends and other relevant statistics that would have facilitated the computational requirements of the study also created difficulties to the researcher. The researcher relied mainly on primary data for certain variables through administration of questionnaires, own observations and interviewing key resource persons. This created other challenges of managing data collection processes so that the ultimate data is reliable. However, relevant secondary data and statistics related to traffic congestion from other parts of the world facilitated the computational requirements of the study.

The practical problems associated with the CVM technique also posed a challenge. Since the technique is hypothetical in nature, some of the respondents might have misunderstood the scenario presented to them and hence gave biased responses. Because of the natural human behavior of benefit acquisition and cost or penalty avoidance (moral hazard behavior), we expected the respondents to behave strategically, which might have led to biased results. These and many other problems inherent in the nature of the CVM study might have hampered the reliability of the study results. However, a pilot survey was carried out to assess the levels of understanding of respondents about the traffic congestion problem in the city and to determine the appropriate CVM construct. In that regard, this effort

facilitated the researcher to design an appropriate survey instrument that minimized various biases associated with the CVM technique.

Lastly, lack of adequate funds and time to collect adequate data particularly on traffic congestion in Kenya is very minimal frustrated the study. Lack of support and absence of various resource persons earmarked for interviews and discussions posed challenges to the study as well. However, the researcher ensured that necessary data that facilitated the investigation of the study's objectives was collected.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The chapter reviews literature on traffic congestion – its definition, impacts and estimation of those impacts; various environmental valuation techniques, direct and indirect techniques; review of literature on both theoretical and empirical applications of the CVM technique, the problems associated with these environmental valuation techniques; review of literature on various traffic decongestion programs like congestion pricing strategies which are widely applied in many cities across the world today and the problems faced by these programs; and, review of economic methodologies.

2.1 Traffic Congestion, Impacts and Measurement of the Impacts

There is no single accepted definition of traffic congestion according to Organization for Economic Co-operation and Development (OECD) and European Conference of Transport Ministers (ECMT) report of 2007. One of the principal reasons the report explains for this lack of consensus is that congestion is both a physical phenomenon relating to the manner in which vehicles impede each others' progression as demand for limited road space approaches full capacity; and, a relative phenomenon relating to user expectations vis-à-vis road system performance.

The following are some definitions of traffic congestion proposed by the report on the subject:

Congestion is a situation in which demand for road space exceeds supply.

Congestion is the impedance vehicles impose on each other, due to the speed-flow relationship, in conditions where the use of a transport system approaches capacity.

Congestion is essentially a relative phenomenon that is linked to the difference between the roadway system performance that users expect and how the system actually performs.

According to the report, urban congestion must therefore be understood in the wider context of city dynamics and agglomeration benefits. Ideally, urban transport policies should be developed on the basis that congestion is related to both the behavior of traffic as it nears the physical capacity of the road system and the difference between road users' expectations of the system's performance and how the system actually performs.

Congestion may be classified as recurrent – generally the consequence of factors that act regularly or periodically on the transportation system, such as daily commuting or weekend trips. Non-recurrent congestion on the other hand is the effect of unexpected, unplanned or large events (e.g. road works, crashes, special events and so on) that affect parts of the transportation system more or less randomly and, as such, cannot be easily predicted, BTRE, 2007.

Congestion prevents people from moving freely and it slows and otherwise disrupts the conduct of business within urban areas. Congestion involves queuing, slower speeds and increased travel times, which impose costs on the economy and generate

multiple impacts on urban regions and their inhabitants. Congestion also has a range of indirect impacts including the marginal environmental and resource impacts of congestion, impacts on quality of life, stress, safety as well as impacts on non-vehicular road space users such as the users of sidewalks and road frontage properties, MPC, 2008.

The OECD/ECMT report explains that though measuring congestion is a necessary step in order to deliver better congestion outcomes, congestion should not be described using a single metric for policy purposes. Such an approach is sure to obscure either the quantitative aspects of congestion or its relative and qualitative aspects. These two aspects cannot be disassociated and progress in managing congestion should be based on sets of indicators that capture both of these aspects.

It further argues that good indicators can be based on a wide network of roadway sensors but simple indicators based on less elaborate monitoring can sometimes adequately guide policy. What is important is to select metrics that are relevant to both road managers (e.g. speed and flow, queue length and duration, etc.) and road users (e.g. predictability of travel times, system reliability, etc.). Other studies categorize these estimation techniques into engineering and economic approaches. The engineering approach focuses on the direct and physical characteristics of congestion based on engineering principles that link vehicle flow/traffic speed to road capacity (measures as vehicles per hour). The economic approach estimates the cost of congestion as the “deadweight loss” or loss to society associated with excessive road use – due to the absence of proper pricing of the road infrastructure use that reflects the social cost of congestion, including the environmental and

external costs of congestion. The economic approach recognizes that there is an "optimal" amount of delay (i.e. economically efficient level of congestion) caused by impeding users, and that some congestion is already internalized for some users.

However, indicators should be neutral in that they do not contain implied policy goals. In this context, others suggest that the use of free-flow speeds should not be used as a direct benchmark to measure congestion policy outcomes as such an approach implicitly suggests that successful policies deliver free-flow speeds – an unaffordable goal for peak hour traffic in most OECD/ECMT cities.

Practical examples of estimating congestion costs include a study by the Transport Canada Environmental Affairs in 2006 on recurrent cost of urban congestion in Canada which estimated that the total cost of congestion (in 2002 dollars) ranged from $ 2.3 billion to $ 3.7 billion for the major urban areas in Canada. More than 90% of this cost represented the value of the time lost to auto travelers (drivers and their passengers) in congestion. Around 7% represented the value of fuel consumed. The research used the engineering approach and required the development of common means to measure congestion and extract the requisite data for the indicators from each urban area's travel demand forecasting models. Although the models all produced the same outputs (i.e. simulations of vehicle trips), there were structural and methodological differences among them. Some of the differences were obvious – such as the definition of expressways and arterials – while others were subtle, such as the methods used to calibrate the urban models.

The Bureau of Transport and Regional Economics (BTRE) of Australia conducted a study to estimate urban traffic and congestion cost trends in Australian cities and published its report in 2007. Aggregate congestion estimates gave a total of about $9.4 billion for the 2005 social costs of congestion (on the basis of potentially avoidable costs, calculated from the deadweight losses associated with current congestion levels across the Australian capitals). This total is comprised of approximately $ 3.5 billion in private time cost (losses from trip delay and travel time variability), $3.6 billion in business time costs (trip delay plus variability), $1.2 billion in extra vehicle operating costs, and $1.1 billion in extra air pollution damage costs.

Kenya incurs losses amounting to Ksh 17 billion a year due to traffic jam in Nairobi city alone, equivalent to two percent of the Gross Domestic Product (GDP) that year according to a study done by Kenya Institute for Public Policy Research and Analysis (KIPPRA) in 2006.

2.2 The Contingent Valuation Method

The Contingent Valuation Method (CVM) is one of the most widely used valuation techniques. The contingent valuation method first came into use in the early 1960's when economist Robert K. Davis (1963 a & b, 1964) used questionnaires to estimate the benefits of outdoor recreation in Maine backwoods area. Earlier Ciriacy-Wantrup (1947) had suggested the use of the 'direct interview method' to measure the values associated with natural resources Mitchell and Carson (1989).

Generally, economic valuation methods are divided into two categories, the direct and the indirect valuation (OECD, 2002; Faucheux & Noel, 1995). While direct valuation of environment means that its value is estimated on the basis of economic agents' preferences, as expressed on the market in the form of a demand curve, indirect valuation, seeks to reconstruct the demand curve of the good, to give a monetary value to environment. Direct valuation relies mostly on observation of the behavior of agents in real or hypothetical markets and will thus, reflect the preference of the economic agent. Table 2.1 presents the sub-groups of each of the valuation techniques (Lescuyer 2007).

Table 2.1: Direct and Indirect Valuation Techniques

<table>
<tr><th colspan="3">Direct Valuation</th><th>Indirect Valuation</th></tr>
<tr><th colspan="2">Revealed Preferences</th><th>Stated Preferences</th><th rowspan="2">No Preference</th></tr>
<tr><th>On Real Market</th><th>On Substitute Market</th><th>On Fictitious Market</th></tr>
<tr><td>Change in Productivity</td><td>Hedonistic Prices</td><td rowspan="3">Contingent Valuation Method</td><td>Dose Effect Method</td></tr>
<tr><td>Expenditure on Protection</td><td rowspan="2">Transport Costs</td><td>Replacement Costs</td></tr>
<tr><td>Substitutable Goods</td><td></td></tr>
</table>

(Source: Lescuyer, 2007).

The CVM has its roots in Consumer Theory and WTP and WTC are the main theoretical constructs underlying non-market valuation of private and public goods

like reduced traffic congestion. The CVM approach, in eliciting explicit statements of how much income consumers are WTP to ensure that a welfare gain occurs (or prevent a welfare loss occurring) or how much income they are WTC to ensure a welfare loss (or forgo a welfare gain), is, in theory, directly estimating the true Hicksian welfare measures of these changes.

The Hicksian approach evaluates welfare change as the money income adjustment necessary to maintain a constant level of utility before and after change of provision of environmental goods/services. Four approaches using the WTP/WTC constructs for such welfare change measures are feasible: One, compensating variation (CV) is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility (U_0) throughout the change of provision. Two, equivalent variation (EV) is the money income adjustment (welfare change) necessary to maintain an individual at his final level of utility (U_1) throughout the provision change. These variation measures (CV and EV) only strictly apply where the consumer is free to vary continuously (i.e. non-discreetly) the quantity of the good consumed.

Three, compensating surplus (CS) is the money income adjustment (welfare change) necessary to keep an individual at his initial level of utility (U_0) throughout the change of provision for public commodities. Four, equivalent surplus (ES) is the money income adjustment (welfare change) necessary to maintain an individual at his final level of utility (U_1) without changing the provision of the commodity. These surplus measures (CS and ES) apply where the consumer is constrained to consume only discrete or fixed quantities (as for most environmental public goods)

of the commodity. Because compensating surplus and equivalent surplus assume that households are entitled to their current levels of satisfaction and because public resources management policies typically deal with potential benefits relative to current levels of satisfaction, the surplus measures are more relevant to policy analysis than are the variation measures.

An equivalent theoretical way to define this compensating surplus measure is in terms of the expenditure function, Prato (1998). The expenditure function indicates the minimum expenditure or minimum amount of income needed to achieve a particular level of utility when quality of service is at certain level. Therefore, the solution to the consumer's expenditure minimization problem, subject to a utility constraint, can be represented by the expenditure function:

(1) $$e(p, q, U) = Y.$$

where, p was a vector of prices for private and public goods available to the consumer; q is the quality of the public good. Y is expenditure and U is desired utility level. Based on the expenditure function, CS can be presented by the following equation:

$$CS = e(p, q_1, U_1) - e(p, q_2, U_1) = Y_1 - Y_2$$

The contingent valuation method (CVM) has been used to estimate economic values for all kinds of ecosystem and environmental services, (Abala 1987). It can be used to estimate both use and non-use values and it is the most widely used method for

estimating non-use values. It is called ‘contingent’ valuation, because people are asked to state their willingness to pay (WTP) or willingness to accept compensation (WTA), contingent on a specific hypothetical scenario and description of the environmental service. Though people are willing to pay for non-use, or passive use, environmental benefits, these benefits are likely to be implicitly treated as zero unless their dollar value is somehow estimated. Since people do not reveal their willingness to pay for them through their purchases or by their behavior, the only option for estimating a value is by asking them questions.

The format of the questions used to elicit valuations may be continuous (or open-ended), that is, asking respondents to state WTA or WTP without any prompts concerning possible answers or discreet (or dichotomous) i.e. presenting the respondent with a single buying price or selling price which must be accepted or rejected. Many intermediate formats are also possible, e.g. bidding games. These differences in format can produce systematically different responses, (Mkenda 2003). It is theoretically expected that the WTP and WTA results shall be similar. The challenge in statistical analyses of WTP/WTA values relates to the treatment of zero willingness and whether the values stated are consistent with the socio-economic characteristics of the individuals surveyed and economic theory.

The conceptual, empirical and practical problems associated with developing dollar estimates, of economic value on the basis of how people respond to hypothetical questions about hypothetical market situation are debated constantly in the economics literature. CV researchers are attempting to address these problems, but they are far from finished. Meanwhile, many economists, as well as many

psychologists and sociologists for many different reasons, do not believe the dollar estimates that result from CV are valid. More importantly, many jurists and policy-makers will not accept the results of CV, (Harris and Brown 1992).

There is considerable theoretical literature on the CV method by various scholars. Willig (1976) claimed that WTP and WTA measures should in the absence of strong income effects produce estimates of monetary value that are fairly close (within 5%). However, since 1976 strong evidence has been accumulated which shows that, for given environmental goods, WTA is significantly greater than WTP (over 40% - divergence). In addition, WTA valuations seem to have greater variance than WTP ones and are less accurate predictors of actual buying and selling decisions.

There may be income effects, as predicted by Hicksian Consumer theory. Hanemann (1991) argued that income effects could account for some observed WTP /WTA differences for public goods. He has calculated that a WTA measure five times greater than WTP can be justified in cases where the elasticity of substitution is low and/or the WTP/Income rate is high, i.e. for unique, irreplaceable environmental assets about which individuals care a great deal.

Eberle and Hayden (1991); Bishop and Heberlein (1979), say that a psychological phenomenon, loss aversion, may be important especially in the case of potential losers in a resource change when WTA questions are related to giving up things, rights or privilege. Valuations may be made relative to reference points, losses being weighted more heavily than gains. Such effects, which could account for some WTP/WTA differences have been found experimentally. Similarly anchoring effects

(or starting point bias) may cause differences between responses to discreet and continuous formats Green and Tunstall (1991).

Hoehn and Randall (1987) assert that WTA questions may be less readily understandable than WTP ones, since most people have more experience of buying goods, paying taxes etc. than of selling. Similarly, continuous questions may be less readily understandable than discreet one, since most people have more experience of choosing whether or not to pay stated prices than of stating valuations.

Harris and Brown (1992) say that overall, it is likely that merely identifying gainers and losers in some resource change situation will be insufficient to determine whether WTP or WTA is the most appropriate indicator of value. We need to know more about the motives of the valuer. Economics has much to learn from psychological research in this context. In fact, some of CVM's strongest critics are to be found outside the economics profession, in the ranks of philosophers, psychologists, and political scientists.

Sagoff (1988) has argued that economics makes a 'category mistake' in its approach to environmental valuation because it is not preferences but attitudes that determine people's environmental valuations. Thus people may not be willing to consider market-like transactions (assumed by CVM) involving public resources. CVM surveys pick this effect up into the form of refusals and protests bids. Some combination of individual preferences and public (collectively held) preferences will be held by any given individual who by necessity has to operate in daily life as both

a consumer and a citizen. Thus the environment can be both a purchase commodity and a moral or ethical concern (Turner 1988a, 1988b).

According to Sagoff, environmental economics has no role to play in the determination of the goals of environmental policy. Environmental protection standards are determined by political, cultural and historical factors not by preference-based values. If economics has a role it is restricted to revealing the costs (social opportunity costs) of the pre-emptive environmental standards. But if action is taken on the basis of the opportunity cost analysis then an implicit valuation has been made. Nevertheless, from this viewpoint, there is no role for direct monetary valuation (preference -based) of the benefits of environmental protection policy.

Methodological issues most pertinent to the CVM can be roughly divided to validity, reliability and bias categories. Validity refers to the degree to which the CVM evaluation correctly indicates the true value of the assets under investigation, bias being a common cause of low validity. According to Smith and Desvousges (1986) and Kristrom (1990), conventional classification partitions bias into general, procedural and instrumental types. Reliability refers to the consistency or repeatability of CVM estimates. Bateman et al (1991) consider reliability and validity in terms of a standard generalized linear model (GLM):

$$Y = aX + b + e$$

Where: Y= the measured value of the variable, X= the true value of the variable, a,b = constants, e = residual error.

The reliability of the CVM instrument can then be measured by e, while a and b reflect validity; the instrument being absolutely valid if a=1; b=0 and e is a random variable. Where e is a non-random variable then a bias is likely to be present.

The contingent valuation method has been widely used for the past two decades to assign dollar values to various non-use values of the environment such as biodiversity, water, forestry, transportation amongst others. However, as a matter of necessity, this study will only focus on empirical CVM studies related to the transportation sector.

In the 1970's, facing an oil embargo and sudden increase in energy prices the U.S. Department of Transportation initiated a study to increase the use of public transportation. This was a watershed of transportation planning in the U.S. This policy called for discouraging people driving to work and was the first Transportation Demand Management (TDM) in the U.S.

One of the first applications of CVM was the study carried out by Weitzman and Reinhardt (1973). They modeled an optimal Pigouvian tax to illustrate the effects of externalities on road crowding (congestion). An additional car that enters an overcrowded highway adds to the congestion and imposes a time loss on everyone else. The driver's entry thus generates a marginal social cost that exceeds the marginal private costs. In this case, every driver is both a generator of these externalities and a victim of the same externalities produced by other drivers. Optimality requires the imposition upon each driver of a toll equal to the marginal

social damage resulting from his presence, with no compensation to him for the damage he suffers from the presence of others.

Besides other limitations and weaknesses of this model, the real test is on estimating the social damage function especially those costs related to non-use values (for example, loss of freedom, congestion related frustrations, etc). It is here that the input of CVM may be required and considered necessary. Conceptually, the driver should not be considered only as a cause of externality, but as a consumer too with absolute rights to choice and enjoyment of driving own car.

The other study on application of CVM on congestion was that by Lindberg et al (1997) created CV scenarios for programs that would (a) reduce traffic congestion on Highway 101 by 25% or 50% during busy periods (each respondent was presented either the 25% or the 50% reduction scenario), (b) reduce noise and minor crime by 30% during summer and holiday periods, or (c) provide low-income housing for all qualifying families in the community. The dichotomous choice referendum method was used to elicit valuation responses, where each respondent was given a scenario with a specific payment amount and asked whether they would vote “yes” or “no” for the program. Each survey contained all three scenarios (the order was randomized). In each scenario, respondents were presented with a bid that was randomly selected from a group of 16 values in the range of $5 to $1,000 per household per year.

Two models were developed for each scenario. The first is the policy model, which values the mitigation program (i.e., the reduction in congestion and the method for

achieving it). The second model is for the commodity, which reflects the value of the good (e.g., a reduction in congestion) independent of the method for achieving it. This model uses the traditional method of excluding protest "no" votes. However, the system of follow-up questions used in this study was unusually thorough. For example, all respondents who voted "no" for the congestion scenario were asked a first follow-up question. Theoretically this was modeled as a consumer's expenditure minimization problem (Mitchell and Carson 1989). The linear specification of the logit model was chosen after exploring the fit of alternative models, including probit and logarithmic specifications. In dichotomous choice referendum CV, a statement of maximum WTP is not obtained directly, but rather inferred through a discrete indicator variable I (Cameron 1988, 1991).

The initial set of independent variables was selected based on economic theory (e.g., the bid and household income variables) and social psychological theory (Eagly and Chaiken 1992). Variable selection and model evaluation also followed previous CV analyses (Loomis, Gonzalez-Caban, and Gregory; Whittington et al. 1990). Model variables were based on responses to items in both the telephone and mail surveys. For example, the CV scenarios, and thus the "yes" or "no" votes, were contained in the telephone survey, while demographic and several attitudinal variables were contained in the mail survey.

Several categorical variables, such as education, gender, etc were modeled either as interval variables or as sets of dummy variables. Models were evaluated with each alternative, including logarithmic and exponential transformations of the interval form. In order to achieve parsimonious specification, insignificant variables (at the

0.10 level) were dropped (variable exclusion did not substantially affect WTP estimates). Insignificant variables excluded from the final models included employment status (whether employed and whether in tourism or retail sector), desired level of growth in tourism, length of residence, education, and gender.

Results for the final logit models were computed where goodness-of-fit measures for these models were relatively high for CV analyses. The logit models were then converted to WTP equations (Cameron 1988). The logit models and resulting WTP equations generally were consistent with factors thought to affect WTP. WTP should increase with increase in ability to pay and increases in the importance of the problem and, thus, benefit from mitigation.

The annual household willingness to pay (WTP) to reduce traffic congestion was $186. While there was no evidence of scope effects (at 0.05 level), results indicated that conclusions regarding sensitivity to scope may be dependent on the test used. WTP estimates were substantially less with the mail versus telephone survey mode.

2.2.1 Practical difficulties of Valuation Techniques

In theory, valuation methods can be applied to the environment, in this case, the traffic jam, in order to calculate the total economic value, that is, the contribution to human well-being. In practice, however, this exhaustive approach faces many obstacles (Lescuyer, 2000). Thus, although the concept of total economic value seems valid theoretically, in the real world it provides only partial and often subjective information on the benefits that can be expected from traffic congestion control. The total economic value of an environmental good can be estimated directly only by using the contingent valuation method, and this technique is

difficult to apply in contexts having a low level of monetization (Lescuyer, 1998). Although values may attempt to aggregate all benefits when estimating total economic value they end up aggregating only certain values that the analyst was able to quantify in monetary terms (Lampietti & Dixon, 1995; Nunes & van den Bergh, 2001). The concept of total economic value thus corresponds to the sum of a few economic values selected subjectively by the analyst, rather than to the sum of all the values that actually constitute total value.

2.3 Programs for Traffic Decongestion

While there are many possible measures that can be deployed to "treat" or mitigate congestion, there is no single perfect solution (OECD, 2007). Congestion mitigation actions are part of the broad and complex land use, urban planning and general transport master planning process unique to each urban region. Roadway congestion impacts not only road users but all urban inhabitants. Congestion management requires an integrated strategy equal to the scope and scale of the challenge. OECD (2007) suggested three strategic congestion management principles that should guide policies in the field.

- Ensure that land use planning, and the community objectives it embodies, is coordinated with congestion management policies,
- Deliver predictable travel times (e.g. planning and coordination of road works, speedy response to defective traffic signals and to disruptions caused by accidents and debris).
- Manage highly trafficked roadways to preserve adequate system performance (e.g. access policies, parking policies and road pricing policies).

2.3.1 Coordinating Land Use Planning with Congestion Management Policies

Many urban regions have found that strongly coordinated transport and land use policies allow them to proactively and beneficially manage the scope and nature of urban travel demand and thus reduce the incidence and severity of congestion. These two fields are quite closely linked in reality – land uses gives rise to trip generation and the interplay between spatially distant origins and destinations gives rise to regional trip patterns.

Well thought out land use policies that explicitly link community expectations relating to the long-term development of the city to transport outcomes can have a positive impact on a number of outcomes – including traffic and congestion management.

2.3.2 Building New Road Infrastructure

The decision to invest in new road capacity (or parking capacity) should be motivated by a through cost-benefit exercise that addresses the wide range of congestion impacts. These should include costs such as environmental costs and impacts on non-road users. When the benefits of providing new infrastructure outweigh the costs of not providing it, then an argument exists for new construction. However, when the cost-benefit exercise is limited in scope (e.g. internal to the roads authority), other less-costly policies that could potentially deliver the same or greater benefits may be overlooked.

Building new road infrastructure is often constrained by a lack of space in dense urban cores and is nearly always an expensive proposition even in the outlying peripheries of urban areas. Many cities now view infrastructure expansion only as a

last resort. The effectiveness of providing new road capacity as a congestion management solution is oftentimes eroded by new traffic demand.

2.3.3 Modifying Existing Infrastructure

There are many approaches that can squeeze additional infrastructure. These include adding lanes, re-allocating road space, modifying intersections, modifying the geometric design of roads or creating one-way streets. These approaches can benefit either car users or public transport; however as with operational management policies – these interventions should not seek to bring traffic flows so close to the maximum capacity of the roadway that the probability of sudden traffic breakdowns becomes unacceptable. While these types of measures are ideally suited for treating bottlenecks, care should be given to consider the downstream impacts of releasing greater traffic flows through previously contained bottlenecks.

Bypass roads are one example of such approaches. The wide range of highway bypass studies carried out around the world provide a general consistent story. They indicate new highways bypassing the central business district of a community are seldom either devastating or the savior of the area. The locational shift in traffic can cause some existing businesses to close up or relocate, but it can also create some new business opportunities. Net economic impacts on the broader community are usually relatively small (positive or negative).

Bypasses do not necessarily result in a reduction in total traffic volume in the downtown area. Often, the removal of most truck movements and other pass-through highway traffic encourages more local traffic, which had previously avoided the downtown area due to heavy traffic. The result is often little or no change in total

traffic levels, which is often associated with improved travel opportunities for local residents and access for downtown businesses (Margaret and Glen, 2000).

2.3.4 Encouraging use of Public Transport

Public transport has the potential to transport more people than individual cars for a given amount of road space (in the case of on-street systems such as buses and trams) or without consuming any road space at all (in the case of off-road systems such as metros and surface rail systems). The promotion of public transport remains a fundamentally important congestion management strategy. When public transport provides a quality of service that approximates which car drivers have previously been used to, it can maintain a high level of access throughout urban areas with a drop in overall car usage.

For the congestion mitigation potential of public transport to be realized, travelers must feel that the extent and quality of service provided are sufficient for them to forego using their cars for certain trips – especially those in peak periods. Thus, actions taken to encourage a mode shift to public transport should address the perceived costs by the user, ease and comfort of traveling by public transport as well as its reliability, safety and security.

Many cities across the world have adopted the Bus Rapid Transit (BRT) Systems. BRT is a broad term given to a variety of transportation systems that, through improvement to infrastructure, vehicles and scheduling, attempt to use buses to provide a service that is of a higher quality than an ordinary bus line (Arrive Alive South Africa, 2010). A BRT system is a high quality, customer oriented transport system which will deliver fast, comfortable, and low cost urban mobility with a

modern, efficient and comfortable service to public transport users. The system must be accessible, affordable and attractive to a broad range of people across society for it to work. Some of the expected benefits of the BRT system include efficient, reliable and frequent public transport services; affordable fares; a safe and secure public transport system; accessible public transport for people with disabilities and mothers with children; a decrease in traffic congestion, energy consumption and vehicle emissions; an enhanced urban environment; recapitalization of the public transport fleet; amongst others.

2.3.5 Improving Traffic Operations

Proactive traffic operations management has much potential. Road traffic information systems, pre-trip guidance, coordinated traffic signal systems and the implementation of dynamic speed and incident management policies have often proven to be cost-effective ways to deliver better travel conditions, allowing users to reschedule their trips away from traffic peaks and/or select other travel modes. These strategies all allow road managers to get more out of roads – e.g. to allow for greater flows than could otherwise be realized. They should not be deployed with an eye to bringing traffic up to the limit of the physical capacity of the roadway as this inherently leads to major instabilities in traffic flow and increased probabilities of sudden breakdowns.

2.3.6 Parking Management

Parking management and control is important because it has the potential to modify demand on an area-wide basis yet, despite being readily available to authorities, often seems under-utilized to tackle traffic congestion. Like road-pricing and other demand-side approaches, parking management and control can assist the task of

tackling traffic congestion by reducing the demand for travel to the area encompassed. Due to the considerable policy and operational; flexibility available, parking control can also be quite specifically targeted, in the sense that it can be applied on the basis of location and time.

Controlling parking may be very effective in restricting terminating traffic demand but any capacity on the roads that is freed-up will likely be filled by through traffic attracted from alternative routes by the improved travel conditions. Parking control will be of little assistance in circumstances where the current demand is to drop off or pick up passengers – e.g. parents taking children to and from school. For these reasons, parking management as a tool for tackling traffic congestion needs to be supplemented by other measures (e.g. access control or pricing) to ensure desired outcomes. It is also important that clear incentives and dis-incentives exist to ensure the effective enforcement of parking policies.

In terms of public acceptability, parking control to tackle traffic congestion is not likely to be universally supported. Parking control is likely to be seen as a restriction of current rights and entitlements by some parties, such as private property owners – and a threat to the commercial viability of businesses currently dependent on convenient customer parking.

2.3.7 Adequate Institutional Arrangements in Managing Congestion

Typically, congestion cuts across jurisdictional boundaries and therefore the design and implementation of congestion management policies will require collaboration between different authorities. Implementation of a congestion management strategy

requires the collaboration of many actors. Achieving consensus, commitment and public support for the formulation of the strategy requires even wider.

Tackling congestion requires an integrated multi-level approach and therefore a multi-level framework of planning and decision making. The more complex the congestion problem, the higher the levels that need to be incorporated and the broader the scope of planning and decision making required. There is no single approach best-suited to addressing congestion. But when the scope of institutional decision-making is well-matched to the region's travel to work area, vision or plan-led approaches work well.

There are pitfalls to be avoided. A consensus-led approach may lead to delay and inaction unless agreement can be realized quickly and sustained. A plan-led approach can become unduly dependent on professional planners, who may lose sight of the needs of politicians and some stakeholders. And a vision-led approach is critically dependent on the individual with the vision. If he or she leaves office, it may prove very difficult to avoid abandoning the strategy.

2.3.8 Congestion Pricing Schemes

The application of congestion pricing on urban roads is limited to a small number of cities, including London, Stockholm, Singapore, and Milan as well as a few smaller towns (Robin 2006). This variable pricing strategy regulates demand, making it possible to manage congestion without increasing supply. Market economic theory, which encompasses the congestion pricing concept, postulates that users will be forced to pay for the negative externalities they create, making them conscious of the costs they impose upon each other when consuming during the peak demand,

and more aware of their impact on the environment. Its economic rationale is that, at a price of zero, demand exceeds supply, causing a shortage, and that the shortage should be corrected by charging the equilibrium price rather than shifting it down by increasing the supply.

Nobel-laureate William Vickrey is considered by some to be the father of congestion pricing, as he first proposed it for the New York City Subway system in 1952. In the road transportation arena these theories were extended by Maurice Allais, Gabriel Roth who was instrumental in the first designs and upon whose World Bank recommendation the first system was put in place in Singapore, and Reuben Smeed, the deputy director of the Transport and Road Research Laboratory whose ideas presented in his report to the British government were rejected by successive governments since the 1960s.

Four general types of congestion pricing systems are in use: a cordon area around a city center, with charges for passing the cordon line Button (1993); area wide congestion pricing, which charges for being inside an area, a city center toll ring, with toll collection surrounding the city, and, and the corridor or single facility congestion pricing, where access to a lane or a facility is priced.

Congestion pricing in the form of variable tolls by time-of-the-day have also been implemented in bridges and tunnels providing access to the central business districts of several major cities. In most cases there was a toll already in existence. In January 2009, variable tolls were implemented at Sydney Harbor Bridge, two weeks after upgrading to 100% free-flow electronic toll collection. The highest fees are charged

during the morning and afternoon peak periods; a toll 25% lower applies for the shoulder periods; and a toll lower than the previously existing is charged at nights, weekends, and public holidays. This is Australia's first road congestion pricing scheme.

In a road network congestion can be considered a specific measure of the time delay in a journey or time lost through traffic jams. Delays can be caused by some combination of traffic density, road capacity, and the delaying effects of other road users and traffic management schemes such as traffic lights, junctions, and street works. This can be measured as the extra journey time needed to traverse a congested route when compared to the same route with no such interference. However, this technical definition of congestion as a measurement of delay can get confused and used interchangeably with traffic density in the public mind.

Thus some congestion charging schemes have been claimed a "success" because they have achieved a significant reduction in traffic volumes, even though there was little effect on actual journey times. These reduced traffic volumes may yield a reduction in the environmental impact of those vehicles, including emissions, noise, parking, and public transport benefits.

To measure the true effects of any traffic management scheme it is normally necessary to establish a baseline, or "do-minimum" case, which estimates the effects on the network without any changes other than normal trends and expected local changes. Notably this was not done for the London Congestion Charging Scheme, which has led to claims that it is not possible to determine the extent of the actual

influence of the scheme. Regardless of the scheme's impact, in a retrospective analysis Transport for London estimated there would have already been a significant reduction in traffic as a consequence of parking policies and increased congestion due to traffic management and other interventions that had the effect of reducing highway capacity. In 2006, the last year before the zone was expanded, TfL observed that traffic flows were lower than in any recent year, while network traffic speeds were also lower than in any recent year. Others have noted that changes in fuel pricing and taxation may also have an effect on measurements of any congestion pricing scheme.

2.3.9 Debate and Concerns about Congestion Pricing Systems

Both in the academic literature and in practice, the implementation of congestion pricing for urban road travel has raised several concerns, and has been subject of debate and controversy. Even the transport economists who advocate congestion pricing have anticipated several practical limitations, concerns and controversial issues regarding the actual implementation of this policy.

Both Button and Small (1993) have identified the following issues: One, the real-world demand functions for urban road travel are more complex than the theoretical functions used in transport economics analysis. Congestion pricing was developed as a first-best solution, based on the assumption that the optimal price of road space equals the marginal cost price if all other goods in the economy are also marginal cost priced. In the real world this is not true, thus, actual implementation of congestion pricing is just a proxy or second-best solution. Based on the economic principles behind congestion pricing, the optimal congestion charge should make up for the difference between the average cost paid by the driver and the marginal cost

imposed on other drivers (such as extra delay) and on society as a whole (such as air pollution). The practical challenge of setting optimal link-based tolls is daunting given that neither the demand functions nor the link-specific speed-flow curves can be known precisely. Therefore, transport economists recognize that in practice setting the right price for the congestion charge becomes a trial and error experience.

Second, there are inequality issues. A main concern is the possibility of undesirable distribution repercussions because of the diversity of road users. The use of the tolled road depends on the user's level of income. Where some cannot afford to pay the congestion charge, then this policy is likely to privilege the middle-class and rich. The users who shift to some less-preferred alternative are also worst off. The less wealthy are the more likely to switch to public transit. Road space rationing, is another strategy generally viewed as more equitable than congestion pricing. However, high-income users can always avoid the travel restrictions by owning a second car and users with relatively inelastic demand (such as a worker who needs to transport tools to a job site) are relatively more impacted.

Lastly, there are difficulties in deciding how to allocate the revenues raised. This is a controversial issue among scholars. The revenues can be used to improve public transport (as is the case in London), or to invest in new road infrastructure (as in Oslo). Some academics make the case that revenues should be disposed as a direct transfer payments to former road users. Congestion pricing is not intended to increase public revenues or to become just another tax; however this is precisely one of the main concerns of road users and taxpayers.

A more acceptable alternative to avoid inequality and revenue allocation issues, is to implement a rationing of peak period travel through mobility rights or revenue-neutral credit-based congestion pricing. This system would be similar to the existing emissions trading of carbon credit. Metropolitan area or city residents, or the taxpayers, would be issued mobility rights or congestion credits, and would have the option of using these for themselves, or trading or selling them to anyone willing to continue traveling by automobile beyond their personal quota. This trading system would allow direct benefits to be accrued by those users shifting to public transportation or by those reducing their peak-hour travel rather than the government.

2.3.10 Public Controversy about Congestion Pricing

Experience from the few cities where congestion pricing has been implemented shows that social and political acceptability is key. Public discontent with congestion pricing, or rejection of congestion pricing proposals, is due mainly to the inequality issues, the economic burden on neighboring communities, the effect on retail businesses and the economic activity in general, and the fears that the revenues will become just another tax.

Congestion pricing remains highly controversial with the public both before and after implementation. This has in part been resolved through referendums, such as after the seven-month trial period in Stockholm; however this creates a debate as to where the border line for the referendum should go, since it is often the people living outside the urban area who have to pay the tax, while the external benefit is granted those who live within the area. In Stockholm there was a majority in the referendum within the city border (where the votes counted), but not outside.

Some concerns have also been expressed regarding the effects of cordon area congestion pricing on economic activity and land use, as the benefits are usually evaluated from the urban transportation perspective only. However, congestion pricing schemes have been used with the main objective of improving urban quality and to preserve historical heritage in the small cities.

The effects of a charge on business have been disputed; reports have shops and businesses being heavily impacted by the cost of the charge, both in terms of lost sales and increased delivery costs in London, while others show that businesses were then supporting the charge six months after implementation. Reports show business activity within the charge zone had been higher in both productivity and profitability and that the charge had a "broad neutral impact" on the London wide economy, while others claim an average drop in business of 25% following the 2007 extension.

Other criticism has been raised concerning the environmental effects on neighborhoods bordering the congestion zone, creating "parking lots" and add more traffic and pollution to those neighborhoods, and the imposition of a regressive tax on some commuters. Other opponents argue that the pricing could become a tax on middle-and lower-class residents, since those citizens would be affected the most financially. The installation of cameras for tracking purposes may also raise civil liberties concerns.

In New York advocate groups proposed non-intrusive, low-cost (almost no cost) traffic mitigation measures as an alternative to the city's congestion pricing scheme

that would also qualify for the federal grant. Other claim the charge would transfer a significant percentage of commuters to switch to public transportation, and most likely for all of their commute; thus cars would be taken off the road outside the Central Business District as well within it.

2.4. Economic Methodology

According to Hardwick, Bahadur and Langmead (1986), the term "economic methodology" refers to the way in which economists go about the study of their subject matter. Broadly, they have followed two main lines of approach: positive economics and normative economics.

Positive economics is concerned with the investigation of the ways in which the different economic agents in society seek to achieve their goals. For example, positive economists may analyze how a firm behaves in trying to make as much profit as it can or how a household behaves in trying to reach the highest attainable level of satisfaction from consumption. Positive statements are therefore concerned with *what is, was or will be* and are statements whose validity can be tested against the available evidence.

Normative economics is concerned with making suggestions about the ways in which society's goals might be more efficiently realized. From the stand point of policy recommendations, this approach involves economists in ethical questions of what *should or ought to be*, so much so that they take up strong moral positions on the propriety of goals themselves. For example, the statement, 'the present high level

of unemployment and inflation in Kenya *ought to be* reduced' and 'the distribution of income in Kenya *should be* made more equal' are normative statements.

It must be pointed out that it is not always easy to draw a clear line of demarcation between the two. For instance, if the goal is to eliminate poverty, then the question of whether to give cash or help in kind (like free medical care or free school meals) to low-income families is an issue of both positive and normative economics.

Deduction and empirical testing – The process of deduction and empirical testing is the most important method of approach followed by modern economists. The starting point is an *a priori* proposition or theory. A priori proposition is one which seems reasonable to the investigator and is based on innate ideas and not derived directly from statistical evidence. The a priori proposition are then followed by assumptions; logical; reasoning deriving the theory from model; predictions or testable hypotheses; and, empirical tests of predictions. There has been much debate among economists about how realistic the assumptions upon which a theory is based should be. In a sense, then, in testing a theory, the assumptions upon which the theory is based are also being tested.

Induction – This involves, first, the collection, presentation and analysis of economic data and then the derivation of relationships among the observed variables. In other words, the available statistics are closely examined in the search for general economic principles. A major problem with this approach is that economic statistics are so complex that it is often difficult to disentangle them and, of course, economists cannot perform laboratory experiments in the same way as the

physical scientists can. Another difficult is that some economic variables cannot be directly measured or are extremely difficult to measure accurately – for example, the 'satisfaction' that a household derives from consuming a good cannot be measured. None the less, the collection and analysis of data is of crucial importance in economics, and plays a large role in the empirical testing of predictions derived from the deductive method.

Use of diagrams – All branches of economics make use of diagrams and it is important to be able to interpret them correctly. The most frequently used diagrams (a) graphs which depict relationships between two variables, usually on the assumption that some other variables remain unchanged (b) graphs which show the combinations of two variables at which some condition is achieved; and, (c) time-series graphs.

Econometrics – The main concern of econometrics is the investigation of the direction and strength of relationships among economic variables. A serious problem, though, is that economic relationships can never be precisely quantified. Econometrics makes particular use of the statistical methods of regression and correlation analysis to estimate the equation of the line or curve of 'best fit' through the points and to measure the closeness of the points to the line. A common measure of the strength of the relationship between variables is the correlation coefficient (r). More commonly used is the square of the correlation coefficient, known as the coefficient of determination (r^2) which measure the fraction of the variation in one variable which is explained by the variation in another. It has to be emphasized here that a high degree of correlation does not necessarily imply causation: in other

words, just because two variables tend to move in the same direction does not necessarily mean that changes in one are causing changes in the other. Statistical techniques are available, making use of probability theory, to enable us to test the significance of any relationships.

2.5 Summary of Literature Review

From the foregoing, there is no universally accepted definition of traffic congestion, neither is there a common approach to measuring its impacts. At large, there is no one 'miracle' solution to managing the problem of traffic congestion. However, there is consensus that policies on managing the problem shall not be effective unless we are able to identify the impacts of traffic congestion within a region, understand its manifestations including getting crude estimates of those impacts emanating from it.

This study attempted to devise a working definition of traffic congestion in Nairobi to facilitate the estimation of some impacts associated with the problem within the city and understanding its manifestations and causes. The application of CVM also provided a unique opportunity in examining the problem through different approaches because the method cannot be currently classed as a non-expert technique. The widely held notion that free-rider problems or strategic bias form a fatal Achilles' heel is poorly founded in fact. In fact, it is a concern amongst many researchers that many of the items valued via the CVM have indeed traditionally been ignored by decision-markers.

While cautious though, the analysis of CVM should attempt to highlight the major pitfalls of empirical application and seek to show how, by their avoidance, the technique can provide evaluations of environmental goods which are sufficiently valid and accurate. This will enhance significantly the economic analysis and appraisal of projects which in some way impact upon these goods.

CHAPTER THREE

THEORETICAL FRAMEWORK AND RESEARCH METHODOLOGY

3.1 Introduction

The chapter details the various methodological concepts, instruments and techniques that were employed to facilitate investigations on the study's objectives in terms of data collection, managing and analysis of the data. In particular, the chapter details the planning and organizational processes involved in carrying out the study; principles related to managing traffic congestion; various perceptions and characteristics of the city's motorists; methodology to estimate fuel and delay costs due to traffic congestion; empirical application of CVM to estimate the benefits related to traffic congestion including the use of regression in data analysis and aggregation and appraisal of the CVM results; and, methodologies of assessing the effectiveness of decongestion measures that have been implemented in Nairobi.

3.2 Planning and Organization of Study

The key preparatory work involved the establishment of specific activities and resource requirements in terms of personnel and finances for each respective objective of the study. But this was after having reviewed adequate literature on traffic congestion not only about Kenya but from other parts of the globe as well to clearly understand the subject. Data collection tools such as survey questionnaires were designed and key informants to be engaged for interviews were also identified. Logistical details such as which roads would be involved in the surveys were also determined, for example, the Langata Road was chosen for collecting data on estimating the cost of delay as a result of traffic congestion. Appointments for

interviews with key informants were sought and arranged in advance as necessary for the convenience of the parties. A detailed work plan was developed with clear timelines on when each activity was to be undertaken and by whom. Several research assistants were employed to carry out the various tasks that were identified.

3.3 Theoretical Framework of Study

Welfare economics is the theoretical basis within which the study is anchored. According to Koutsoyiannis (1985), welfare economics is concerned with the evaluation of alternative economic situations (states, configurations) from the point of view of the society's well-being. Society's well-being or social welfare refers to the overall welfare of society, that is, the summation of the welfare of all the individuals in the society. To evaluate alternative economic situations there is need for some criterion of social well-being or welfare. The measurement of social welfare requires some ethical standard and interpersonal comparisons, both of which involve subjective value judgment. Objective comparisons and judgments of the deservingness or worthiness of different individuals are virtually impossible. Various criteria of social welfare have been suggested by economists at different times such as, cardinalist criterion, Pareto optimality criterion amongst others.

In the same analogy, the state of traffic congestion as it exists currently in Nairobi which is investigated through the study's third objectives is negatively affecting the well-being of not only motorists but the people of Nairobi in general. The study's fourth and fifth objectives explore the potential improvement in the residents' welfare when traffic congestion is mitigated. The first and second objectives investigated the circumstances surrounding traffic congestion and interpersonal

perceptions of the city's motorists on traffic congestion which though subjective, facilitated judgments on various potential decongestion configurations that can be implemented to improve the well-being of the city's motorists and residents.

3.4 Conceptual Framework of Study

Within the theoretical frameworks of welfare economics, the Figure 3.1 conceptualizes the conduct of the research to investigate the study's objectives:

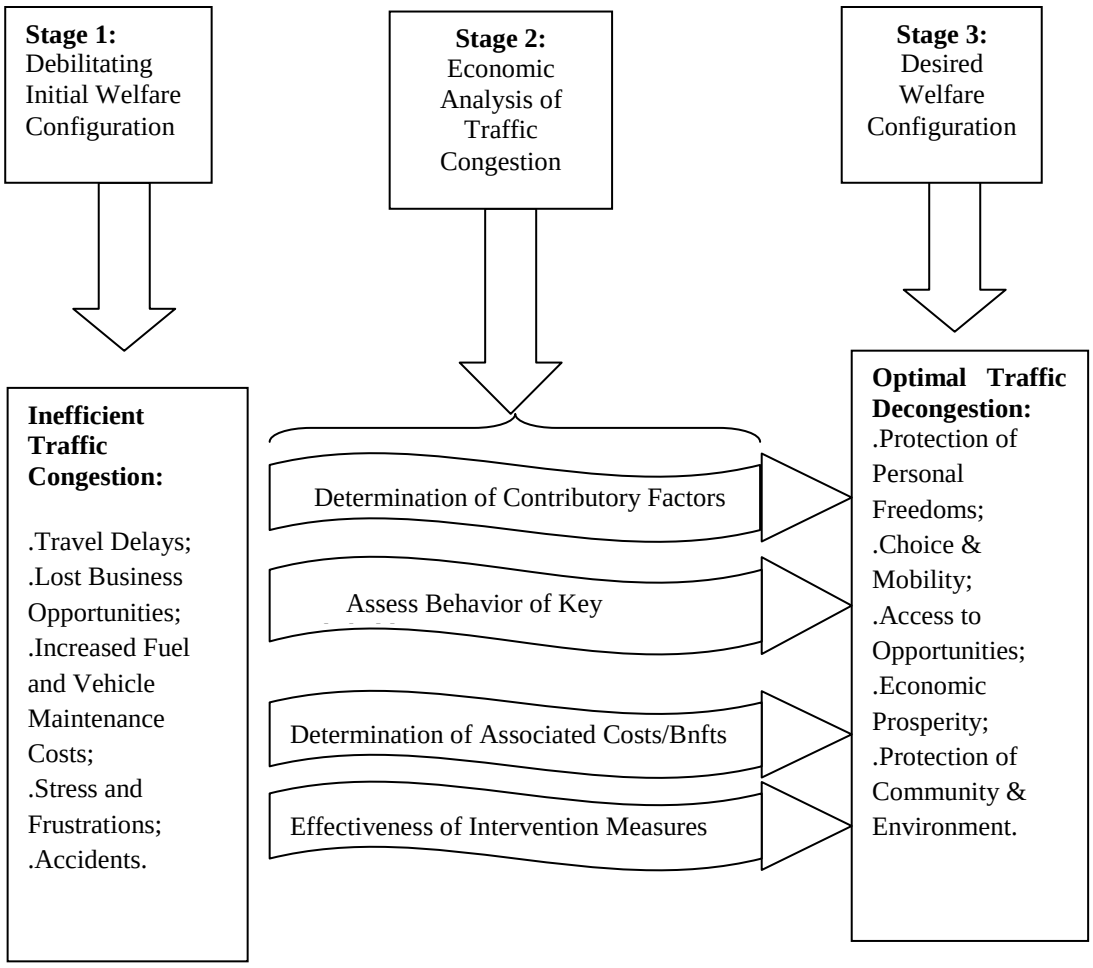

Figure 3.1: Conceptual Framework of Study

(Source: Koutsoyiannis, 1985)

In Stage 1, traffic congestion is conceptualized as an inefficient welfare configuration with debilitating effects such as travel delays, lost business opportunities, increased fuel and vehicle maintenance costs, stress, frustrations and accidents to the society in Nairobi. In Stage 2, the study conducts an economic analysis of the problem to determine the contributory factors of this cause of disequilibrium to transportation system; assess the behavior of key stakeholders (economic agents); determine the associated costs and benefits to inform policy decisions; and, lastly assess the effectiveness of decongestion measures to guide determination of amicable interventions. An economic analysis will inform policy formulation and decision making leading to determining lasting solutions to attainment of optimal traffic congestion levels with the accruing benefits envisaged in Stage 3 of the figure – protection of personal freedoms; choice and mobility including economic prosperity in general. The specific and detailed study variables on the four aspects subjected to economic analysis and hypotheses are explained below.

3.5 Investigating Contributory Factors to Traffic Congestion in the City

The study investigated the strategic congestion management principles prescribed by OECD/ECTM (2007) and the Nairobi Metro 2030 Transportation Strategy to determine their level of contribution to traffic congestion in the city. Though there is no miracle solution to traffic congestion these principles are universal and equally apply in Nairobi. The theoretical arguments on these strategies is discussed in Section 2.3 above and is not therefore repeated in this part. However, the theoretical arguments above provided adequate guidance in identification of the various

variables or data requirement for each respective strategy necessary to investigate them as indicated below.

3.5.1 Coordinating Land Use Planning Policies with Congestion Management Policies

Based on the theoretical arguments on the strategy detailed in Section 2.3 above, the following data was collected:

- The development plan of Nairobi would be studied to assess if it provided for congestion management strategies as far back as during the historical establishment of Nairobi as Kenya's capital city in terms of projections of the city's growth of motor vehicle numbers in relation to planned infrastructural developments and car parks.
- The size of Nairobi's CBD was considered in relation to the extent of the services that the city was expected to provide or provides to the city's residents and the rest of the country as a capital city; the location and business opportunities available in Nairobi in relation to other parts of the country; and, the potential of employment opportunities in the city against other parts of the country.
- Policies towards development of the surrounding areas to the CBD.

3.5.2 Building New Road Infrastructure

The following data was collected on this strategy:

- The number of new road(s) constructed from the year 2001.
- The Ministry of Roads' and NCC's plans for new road infrastructure in the city.
- The reasons why new roads were constructed or not in the city since 2001.

- The assumption based on the theoretical arguments on the principle was that since the number of motor vehicles has been rising over the years at a rate of 5,000 vehicles per month from 2008, Irungu (2007), lack of new roads would not have mitigated the current levels of congestion in the city's roads.

3.5.3 Modifying Existing Infrastructure

The following data on the strategy was investigated:

- Additional lanes.
- Re-allocating road space.
- Modifying intersections.
- Modifying the geometric design of roads or creating one-way streets.
- Construction of bypass roads.
- These approaches can benefit either car users or public transport.

3.5.4 Encouraging use of Public Transport

The promotion of public transport remains a fundamentally important congestion management strategy. For the congestion mitigation potential of public transport to be realized, travelers must feel that the extent and quality of service provided are sufficient for them to forego using their cars for certain trips – especially those in peak periods. In that regard, the following data or information was solicited from the city's motorists.

- Motorists' perceptions on problems associated with public transportation system in the city.
- The factors that make them prefer using their personal cars other than public transport vehicles.
- Their level of willingness to use public transport.

3.5.5 Improving Traffic Operations

The following data was collected:

- Road traffic information systems.
- Pre-trip guidance.
- Coordinated traffic signal systems.
- Implementation of dynamic speed, and.
- Incident management policies in the city as strategies supporting managing traffic congestion.

3.5.6 Parking Management

Parking policy in the city was investigated on its intentions to allow or restrict vehicles into the city during peak hours and its adequacy in terms of capacity to accommodate expected vehicles demand into the CBD.

3.5.7 Adequate Institutional Arrangements in Managing Congestion

- Data involved identification of the number of actors undertaking operations that have direct or indirect impacts in traffic congestion.
- The number of times these agencies meet to discuss, deliberate or resolve issues of traffic congestion.
- Which agency is specifically mandated on traffic congestion matters?
- The potential for coordinating the various actors in planning and making decisions on the problem taking into consideration that the more complex the congestion problem, the higher the levels that need to be incorporated and the broader the scope of planning and decision making required.

3.5.8 Congestion Pricing Schemes

This strategy involved investigating whether the city has established any types of congestion pricing schemes and their performance at the time of the study. The types of such schemes are: a cordon area around a city center charges for passing the cordon line Button (1993); area wide congestion pricing, which charges for being inside an area, a city center toll ring, with toll collection surrounding the city, and, and the corridor or single facility congestion pricing, where access to a lane or a facility is priced. The plans the city has about these schemes in case they are not there including any views related to them.

3.5.9 Data Collection and Analysis

Data on all the eight strategies investigated above under this first objective was collected through interviewing key informants at the Nairobi City Council; Ministry of Roads; Ministry of Public Works; Ministry of Lands; Ministry of Transport; and, the Ministry of Nairobi Metropolitan Development. The questionnaire (Appendix A) that was used for the CVM survey also had questions for this variable as well in particular encouraging the use of public transport. Secondary sources, mainly policy documents on the above related issues under investigation were major sources of data and information. Data was also collected through the researcher's own observations.

Counterfactual analysis was mainly used to analyze data. A mathematical model on a scale of 0 to 10 was developed to score the performance of each of the eight principles to facilitate hypothesis testing on the objective.

Where:

0 (0%) = No Performance
1 – 4 (10%-40%) = Low Performance
5 (50%) = Medium/Average Performance
6 – 9 (60%-90%) = High Performance
10 (100%) = Excellent Performance.

3.6 Investigating the Behavior and Characteristics of Personal Motorists

While relying on stakeholder analysis theories, Rachel (2012) and Glicken (2000) including other statistics that personal vehicles amount for about 80% of the vehicles entering Nairobi's CBD, JamboNairobi (2011) and Irungu (2007), personal motorists in the city were mapped as influential stakeholders in determination of strategic decongestion solutions. Influential stakeholders are people who have power over a project. They may control what decisions are made or how it is implemented, or exert some other influence which affects the project negatively. They may be able to coerce or persuade others into making decisions about it, Glicken (2000).

The study therefore hypothesized that understanding the perceptions of personal motorists in the city regarding traffic congestion would be the basis for determining a lasting solution to this problem. The study therefore sought for various perceptions from the motorists about traffic congestion in the city as follows:

- Whether they perceive traffic congestion as a problem or not.
- The type of roads they use into the CBD.
- The problems they associate with traffic congestion.
- The attributes of the personal car or why they prefer using their personal cars.

- Their perceptions about problems with public transport in the city; and,
- Perceptions on their wiliness to leave their cars at home if public transport is improved to their tastes.

3.6.1 Data Collection and Analysis

Data was collected through the CVM questionnaire that was administered randomly to 150 personal motorists who were targeted at car parks or in their offices. Motorists were interviewed randomly on a first encounter basis either in their offices or parking places. The first criteria for selection for the interview was that one needed to be the owner of the vehicle and working within the city. This criteria was chosen because it was both the most practical and cheap option in our circumstances. It was not possible to get respondents while on the roads driving since there wasn't adequate time to have them fill the questionnaires or agree on how the questionnaires would be delivered for those who opted to go with them home.

Options like random numbers or listing of all items and systematically or randomly picking the sample out of it would not only be impractical but also expensive in our case. The practical complication was in determining the items to be numbered. Giving numbers to all the motorists would not be a problem since it is known how many vehicles enter the city. But how would one track them after sampling because motorists park in different slots in different days for instance. Numbering parking slots would also be faced with the complication that some of the motorists parking in those slots would just be passing by on their way to destinations outside Nairobi.

And again different vehicles park in the same parking slot in different days. Which day would then be appropriate to interview the motorists in such slots?

These practical problems necessitated that motorists were to be interviewed in their offices or they be given questionnaires while on the parking slots. Those that were not able to fill the questionnaires were allowed to carry them home and were followed the next or any other convenient day to get them back. Some few motorists did not however return back the questionnaires. This is one reason why questionnaires should be detailed but simple to allow respondents fill them even when alone.

A total of 150 respondents were interviewed. There is no specific theory which stipulates what sample size is representative or adequate. However, statistical theory prescribes that a sample of 30 items or more is adequately representative for statistical estimation and analysis.

Data analysis was done using descriptive statistics to compute percentages of the outcomes and draw bar charts to show the outcomes. Logical reasoning was used to draw conclusions on the various outcomes for policy purposes.

3.7 Estimating Costs of Traffic Congestion

It is very difficult to estimate an event which one cannot define. In that regard, and based on the fact that there isn't an agreed universal definition of traffic congestion, OECD (2007), the study devised the following definition to estimate costs of time lost and excess fuel consumed as a result of recurrent traffic congestion:

"Traffic Congestion is the condition on a road for a period of not less than 1 hour where several willing and able transiting vehicles covering a distance of at least 1 km and spaced about 1 meter from each other are either stationary or move at less than 20 km/hr due to lack of space ahead", (Chama, 2011).

The definition is based on the Engineering approach which defines congestion in terms of the direct and physical characteristics of congestion linking vehicle flow/traffic speed to road capacity (measured as vehicles per hour), VTPI (2005). However, during the empirical processes of estimating these costs, perceptions and expectations of the road users on the performance of the road systems were equally considered. As is argued in literature cited above, these two aspects cannot be separated.

The study estimated costs associated with delay and excess fuel consumption related to recurrent congestion, that is, costs as a result of congestion caused by regular or periodical factors, mainly lack of adequate space to accommodate the vehicles demanding space. Costs related to congestion caused by non-recurrent factors such as accidents, bad weather, traffic police interruptions, etc were not estimated. On the day of data collection if such causes did occur the congestion on that particular day was considered as normal (regular) recurrent congestion. The rationale for this decision is that non-recurrent causes of traffic congestion are short-lived and their costs may be misleading if they are relied upon on matters of policy on the subject.

3.7.1 Cost of Time Lost (Delay)

Cost of delay meant measurement of all traffic delay in relation to "free-flow" or unimpeded conditions, an approach used by the Texas Transportation Institute (TTI). Free flow is defined as the condition of traffic when there is no interference from other vehicles on the road and drivers can move freely at the speed they wish. Though free-flow speed may seem an impractical policy ideal particularly in cities, motorists in Nairobi witness free-flow speeds on the same congested roads at certain hours of the day. This was the rationale for using "free-flow speed" as the standard against which delay costs due to traffic congestion were measured.

The delays were those that occurred during peak hours only; week days; and, in the morning when people were travelling to the CBD. Peak hours were those that the researcher was informed by Traffic Police since they were key informants on matters of traffic congestion – virtually all the main roads to the CBD are manned by Traffic Police during peak time to manage traffic congestion.

One other important scenario was that the survey was carried out when schools were opened because it is a general perception by people in Nairobi that traffic congestion is severe during this period.

The roads studied were those that enter the CBD only, that is, Mombasa Road, Langatta Road, Jogoo Road, Ngong Road and Waiyaki Way/Uhuru Highway. Thika Road was excluded due to the ongoing construction. The points where congestion starts building during peak hours in these roads was the starting point of measuring the time taken to enter the CBD, that is, Barracks to Agip (Langata Road); Ngong

Hills Hotel to GPO (Ngong Road); Posta to Commercial (Jogoo Road); and, Westlands Round-About to Commercial (Waiyaki Way/Uhuru Highway). These points were identified through key informants, the Traffic Police, regular users of those roads and by the researcher through observations.

Practically, the measurement entailed starting the journey at the identified points at the exact hour of peak and travel to the CBD then record the number of minutes/hours it has taken. The entry point to the CBD was also identified. This was not to be a problem because the map of the CBD was available. Two week's average was the time taken to enter the CBD. A free-flow speed of 80km/hr was considered as the standard and a monthly earning for workers in Nairobi was considered as the value of time in the city. The rest of the computations were basically mathematical.

Multiplying the delayed time (minutes) by the number of week days in a year give us the total time lost by one motorist in one year. Multiplying this by the value of time in Nairobi will give us the cost of delay in a year for one motorist. Multiplying this by the number of motorists in the city gives the total social cost of delay as a result of traffic congestion.

3.7.2 Cost of Excess Fuel Consumed

The study applied a simplified fuel calculation model without distinction by vehicle type, that is, taking all motor vehicles in the model assignment as a single class of vehicles. Though different vehicle types have varying fuel consumption rates, this would not limit the workings of the model as the applied fuel consumption rates did not require that distinction – the distance covered by the vehicle was the key determinant in the model. The fuel consumption rates applied were those developed

by the Virginia Polytechnic Institute (VIP) which constitutes the most recent and state-of-the-art fuel consumption and emissions models categorized as either macroscopic or microscopic which notes that fuel consumption rates vary depending on the type of vehicle (gasoline-powered automobile versus diesel truck) and driving environment (urban versus freeway travel, un-congested versus congested travel).

The rates were derived for various service levels from on-road vehicle testing of light duty gasoline-powered vehicles only. These rates were given as ml/veh-km for an approximate average speed (LOS). For example, for Freeway LOS-G for an approximate of average speed of 20km/h, the fuel consumption rate is 113.13 ml/veh-km. These data indicate that fuel consumption tends to increase with increased congestion (optimal fuel consumption is seen to be achieved between 85km/h and 105km/h).

The study used these rates to calculate the costs of wasted fuel because Kenya does not have this data while assuming that they were representative of the Kenyan scenario. The study's results are therefore reported based on the scenario of lack of our own data in the country which is equally a policy statement to the relevant government agencies that there are missing gaps which need to be filled.

From the survey data on delay above, since the distance from the point of measurement and time it took to enter the CBD is known, it is without difficulty to calculate the average speed at which the vehicle was moving. Once this is available, the respective rate to use as per the foreign published data mentioned above shall be identified. Using the rate in ml/veh-km and the distance the wasted fuel as the

product of the distance and the quantity in ml of fuel (distance x ml of fuel) shall be calculated. Given that during traffic jam the speed is very low or the vehicles are stationary and within the study's definition of traffic congestion stated above, the rate of 20km/hr was used for the necessary computations. The average of the quantity of wasted fuel of the morning trips was used. Multiplying that quantity by the number of week days in a year we get the fuel wasted by one vehicle annually.

Multiplying that annual figure by the estimated number of vehicles entering the CBD everyday (since all these vehicles entering the city face the jam) we get the total fuel wasted by all vehicles in the city. Multiplying this by the unit price of fuel (gasoline) in Nairobi in the year 2011 without taxes because we are looking at social costs and not private costs, we get the cost of fuel wasted by vehicles annually in Nairobi.

3.8 Using CVM to Estimate Benefits of Reducing Traffic Congestion

The WTP construct of CVM and compensation surplus measure was the appropriate technique for this study because, one, individual motorists (the study's respondents) in Nairobi are not entitled property rights to less congested environment as implied by WTC; two, reduced traffic congestion is a public good which motorists cannot vary freely; three, motorists are entitled to their current levels of satisfaction; and, four, benefits of operating in such an environment are potential.

The hypothetical market was that since the individual motorist did not have the right to less congested city from traffic, reducing traffic congestion provided welfare gains and was implied by their WTP for the proposed decongestion program by the

Ministry of Nairobi Metropolitan Development. This program was therefore the commodity being sold to the motorists in the city.

An equivalent theoretical way to define this compensating surplus measure is in terms of the expenditure function, Prato (1998). The expenditure function indicates the minimum expenditure or minimum amount of income needed by a motorist to achieve a particular level of utility when quality of traffic congestion is at certain level. Therefore, the solution to the motorist's expenditure minimization problem, subject to a utility constraint, was represented by the expenditure function:

(1) $$e(p, q, U) = Y.$$

where, p was a vector of prices for private and public goods available to the motorist; q was the quality of the public good, reduced traffic congestion. Y was expenditure and U was desired utility level. Based on the expenditure function, CS for reduced traffic congestion from q_1 to q_2 is as shown on the figure below.

$CS = e(p, q_1, U_1) – e(p, q_2, U_1) = Y_1 – Y_2$

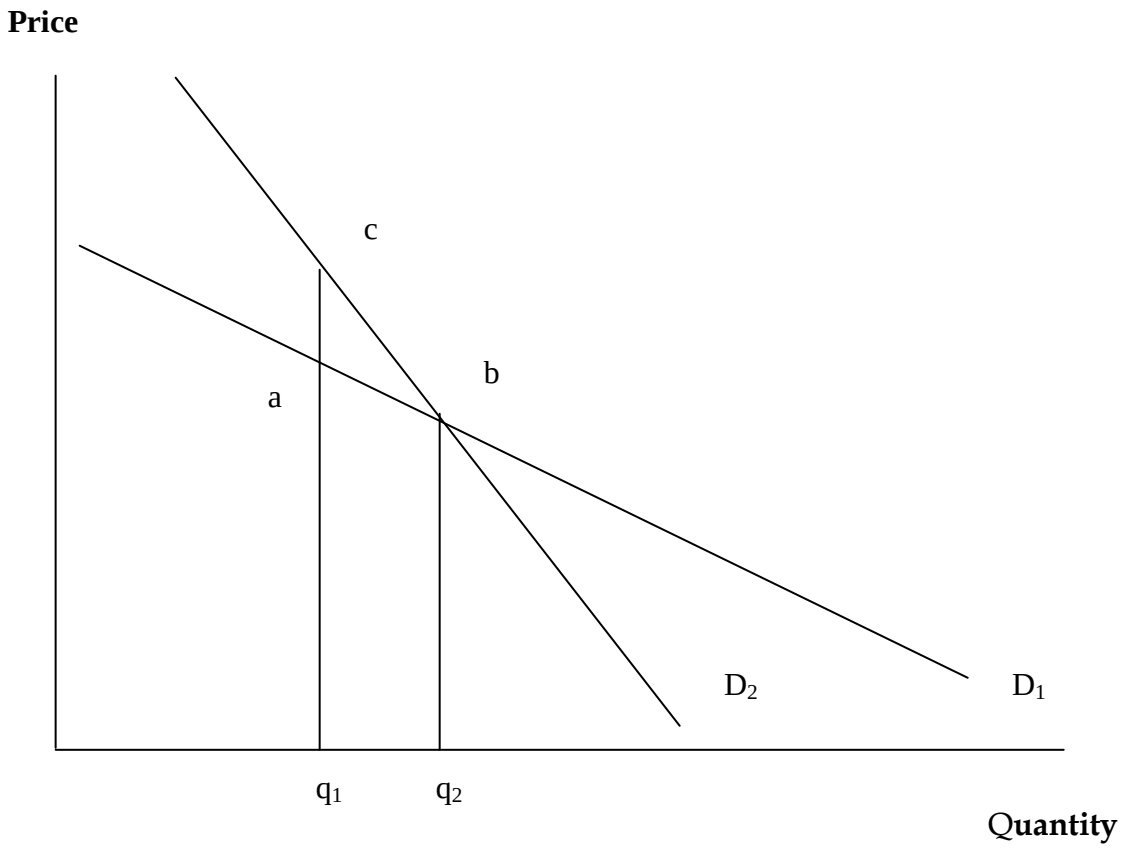

Figure 3.2: Hicksian Compensation Surplus and Equivalent Surplus
(Source: Prato, 1998).

The household is entitled to q_1. Because an increase from q_1 to q_2 makes the household better, the only way utility could be held constant at U_1 was for the household to reduce total expenditures. Therefore, $Y_1 > Y_2$ which implied $CS > 0$. $Y_1 - Y_2$ equaled the maximum willingness to pay for the increased quality of the public good, that is, reduced traffic congestion.

3.8.1 The Payment Vehicle

The payment vehicle is significant in influencing the WTP bids. In that regard respondents were explained that the money they were willing to pay would be managed as a private fund where they would be actively involved in budgeting and

spending. They were explained that they would be required to deposit the money directly in an account run by renowned international audit firms such as KPMG, Pricewaterhouse Coopers, Deloite and Touch, etc. Management of the funds by a public body may create biases towards the motorists' WTP particularly when they have little confidence in public bodies (Whittington 1990). They were explained that even if the money they suggested would not be collected, given that this was mainly an academic endeavor, true expressions of their WTP bids would indicate the magnitude of the demand for a traffic decongested city through an adequate public transport system with characteristics that are proposed by them. Their WTP bids would be very useful guides to the Ministry on matters of policy to decongest the city from traffic.

It was also proposed to the respondents that they were automatic members of an Anti-Traffic Congestion Lobby to spear head and monitor the implementation of the findings of this study to possibly guarantee them an adequate public transport system as an alternative mode of transport so that they may leave their cars at home.

3.8.2 Study Respondents

The study's respondents were motor vehicle owners in Nairobi, especially those that necessarily have to enter the CBD everyday whether because of work or other reasons. That is, motorists who have the historical understanding of congestion and prove ownership of cars or appropriate reasons to enter the CBD. This was advantageous in two ways: one, it distinguish potential from effective demand of the commodity (a less-congested city); two, it minimized the hypothetical bias since

those interviewed have at least full or some knowledge about what is being asked (Knetsch and Davis, 1966).

Public Transport vehicles like matatus or buses were not included as respondents since these do not contribute very much to the problem of congestion in the city roads and public transport would be the alternative means of transport to the CBD when personal motorists leave their cars at home. Again, although pedestrians in Nairobi are also affected by the traffic jams, they really do not have a direct contribution to the motor traffic congestion unlike the personal motorists.

3.8.3 Sampling and Data Collection

Data on the identified study variables was collected through administration of a questionnaire. Despite the fact that this was a hypothetical scenario, respondents were explained that the WTP question, the last in the questionnaire, would be very important in informing policy makers at the Ministry in coming up with an appropriate traffic decongestion program. The WTP question for the purposes of this CVM study was designed appropriately to facilitate the valuation process. The question was open-ended to produce continuous bids variables and to take care of outliers effectively.

Specific questions in the questionnaire asked for information about identified study variables that were thought to influence the WTP bids of the motorists. These ranged from socio-economic information such as gender, levels of income, and levels of education amongst others to questions related to the traffic congestion problem, for example, the road used by the respondent while driving into the CBD, why motorists

prefer using personal cars instead of public transport, possible problems related to traffic congestion, etc.

Respondents were also requested to provide their names and contacts in form of telephone numbers or email addresses. This was necessary for future facilitation of the study results if approval for implementation is granted by authorities in Nairobi. All the respondents provided this information which is an indication of the confidence motorists had in this study. Several respondents informed us that they are looking forward to the results of the study and they keep asking about this until now.

Other elicitation methods such as payment cards, referendum choice formats and bidding games with suggested starting points were not used. Several studies have noted that the suggestion of an initial starting point in a bidding game can significantly influence the final bid-for example, the choice of a low (high) starting point leads to a low (high) mean (Desvousges et al 1983; Boyle et al 1985; Navrud 1989; Green et. al 1990; Green and Tunstall 1991).

Likewise, an approach that allow the respondents to choose a bid from a range shown on a payment card produces anchoring of bids within the range given on the card, with most respondents assuming that such a range contains the correct valuation and outliers being effectively ignored (Kahneman and Tversky 1982; Roberts and Thompson 1983; Kahneman 1986; Harris et. al 1989). Dichotomous or referendum choice formats, also called take-it-or-leave-it choice formats may be open to anchoring bias according to the level of bid asked to respondents and as such

they were avoided. Referendum choice formats have complications in determining protest bids.

The summary of respective questions in the survey questionnaire that were designed to elicit information on the identified study variables is as indicated in Table 3.1:

Table 3.1: Study Variables matched with respective Question in Questionnaire.

Study Variables		Appropriate Question in Questionnaire
Dependent Variable	**WTP** = Willingness-to-Pay (Ksh) by motorists for the proposed traffic decongestion program in Nairobi by the Ministry of Nairobi Metropolitan Development.	Qs20
Independent Variables	**CP (Dummy)** = Perceptions on severity of the congestion problem by respondents, that is, traffic congestion is/is-not a problem that affects him/her, where 1 = strong and 0 = Weak.	Qs7, Qs8, Qs9, Qs10 and Qs11
	I = Income (Ksh) levels of motor vehicle owners.	Qs5
	E = Education (Years) of respondents.	Qs4, Qs10
	PT (Dummy) = Perceptions by respondents that an adequate Public Transport System like that envisaged by the Ministry of Nairobi Metropolitan Development would be a preferred alternative mode of transport, where 1 = strong and 0 = not-strong.	Qs17, Qs18 and Qs19
	G = Gender category of respondents, where 1 = Male and 0 = Female.	Qs2
	RC = Costs (Ksh) of running a car in terms of fuel, maintenance costs and parking fees.	Qs12, Qs13, Qs14 and Qs15
	PM = Price (Ksh) of motor vehicles.	Qs6
	GF (Dummy) = Perceptions by respondents that the government should fund the proposed decongestion program, where 1 = strong and 0 = not-strong.	Qs20

(Source: Author, 2011).

Motorists were interviewed randomly on a first encounter basis either in their offices or parking places within the CBD. The first criteria for selection for the interview was that one needed to be the owner of the vehicle and working within the city. This criteria was chosen because it was both the most practical and cheap option in our circumstances. It was not possible to get respondents while on the roads driving since there wasn't adequate time to have them fill the questionnaires or agree on how the questionnaires would be delivered for those who opted to go with them home.

Options like random numbers or listing of all items and systematically or randomly picking the sample out of it would not only be impractical but also expensive in our case. The practical complication was in determining the items to be numbered. Giving numbers to all the motorists would not be a problem since it is known how many vehicles enter the city. But how would one track them after sampling because motorists park in different slots in different days for instance. Numbering parking slots would also be faced with the complication that some of the motorists parking in those slots would just be passing by on their way to destinations outside Nairobi. And again different vehicles park in the same parking slot in different days. Which day would then be appropriate to interview the motorists in such slots?

These practical problems necessitated that motorists were to be interviewed in their offices or they be given questionnaires while on the parking slots. Those that were not able to fill the questionnaires were allowed to carry them home and were followed the next or any other convenient day to get them back. Some few motorists did not however return back the questionnaires. This is one reason why

questionnaires should be detailed but simple to allow respondents fill them even when alone. A total of 150 respondents were interviewed.

Secondary data was used as well and was obtained from books, various Publications, City Council of Nairobi, Ministry of Transport, Environment, Traffic Police Department, United Nations Environmental Programme (UNEP) in Nairobi, etc. There is lots of literature on CVM but its application on traffic congestion problem was minimal, almost non-existent. We were able to find only one application of the CV method on traffic congestion. The interviews, discussions and the questionnaires covered the appropriate sample of the men and women above 18 years.

3.8.4 Identified Study Variables

Dependent Variable – The Willingness-to-pay (WTP) by motorists for the proposed traffic decongestion program by the Ministry of Nairobi Metropolitan Development was the endogenous variable in this study. The question was open-ended to produce continuous bid variables and to take care of outliers effectively. It was the last question in the study questionnaire.

Eight independent variables thought to explain the WTP bids were identified as shown below. They were based on economic theory, for example, income is thought to influence WTP bids of respondents. There were four quantitative and four qualitative (dummies) variables. Detailed hypotheses about these variables are discussed below. The survey questionnaire designed specific questions to elicit information about these variables as well. The variables are as follows:

CP (Dummy) – Perceptions on severity of the congestion problem by respondents, that is, traffic congestion is/is-not a problem that affects/does-not affect him/her, where 1=strong and 0= weak. The abbreviation CP was chosen arbitrarily simply to denote the variable; otherwise it does not have any theoretical connotation. Questions were designed to provide information regarding the respondent's perception whether congestion was a problem or not. For example, respondents were directly asked whether they think their behavior was a cause to the traffic congestion problem.

It is hypothesized that motorists' perceptions about the severity of traffic congestion in the city and the envisaged success of the decongestion program will be positive correlated with their WTP bids for the decongestion program. The motorists with strong perceptions about the severity of traffic congestion in the city will be willing to pay high amounts of money and vice versa.

Income – Income (Kshs) levels of motor vehicle owners. The questionnaire required respondents to indicate the range of their monthly net income. Five ranges were designed; the first was a range for respondents with incomes below Ksh 40,000 and the highest range for respondents with incomes above Ksh 160,000. These ranges were constructed on the basis of data and information that was elicited during the pilot study as regards motorists' levels of income.

Despite the severity and understanding of traffic congestion as perceived by the motorists, plus the expected success of the decongestion program, there WTP bids will mainly be determined by their levels of income. It is expected that the motorists

with higher Income levels will be willing to pay more than those with lower incomes for the traffic decongestion program. However, increased incomes raises the purchasing power of individuals to purchase personal motor vehicles and therefore, enjoy the attributes of personal cars (convenience, safety, flexibility, etc) thereby escaping the hustles and frustrations that go with public transport systems. This variable will therefore be tested for autocorrelation with the variables on attitude about owning personal cars and attitudes about public transport system in the city.

PT (Dummy) – Perceptions by respondents that an adequate Public Transport System like that envisaged by the Ministry of Nairobi Metropolitan Development would be a preferred alternative mode of transport, where 1 = strong and 0 = not strong. Questions such as: "Are you willing to forgo all the benefits of using your personal car if Public Transport System was improved in the city", were asked to respondents to determine their strength regarding the variable.

It can be argued that the absence of a real public transport alternative together with the serious problems associated with walking and cycling are helping fuel exponential growth of personal cars (Poboon et. al. 1994). Scarce, crowded, slow and mostly dirty buses or matatus are unable to provide an acceptable transport alternative for the growing middle class, who are fuelling the demand for car travel. It is therefore, expected that there is a positive correlation between this variable and WTP bids of motorists for the decongestion program. If the conditions in public transportation system are to be surely improved then individual motorists will be willing to pay high amounts of money for the program and vice versa.

RC – Monthly costs of running a car in terms of fuel and car maintenance costs, and parking fees. Motorists were asked to state their monthly car maintenance costs and parking fees they were charged per day. The average price of fuel was Ksh 80 and an average of number of days used to compute the monthly costs was 24 working days. The rest of the days were considered non-working days and therefore motorists would not be driving to town.

It is hypothesized that unless the price of oil rises suddenly enough to slow economic growth, the automobile populations will not stop growing. This is consistent with Johansson and Schipper's (1997) finding of a small negative fuel price elasticity of car ownership. Generally, when cars become inexpensive to use, imposing new rules that either restrict car use or suddenly raise costs is difficult. Parking spaces also attract cars, so they generate traffic. The availability of parking, much more than price, tends to determine the attractiveness of car commuting to the CBD. We therefore, expect a positive correlation between the Costs of Running a Car and the WTP of motorists for the decongestion program. That is, if fuel is cheap, parking is available and is relatively cheap and maintenance costs are generally low, then motorists will be willing to pay less for the program and vice versa.

PM – This was one of the quantitative variables and was about the price, in Kenya shillings, of the respondent's car. Respondents were asked to give an estimate or actual price of their cars.

It was expected that the motorists who exhibit high prices of their cars would have lower WTP bids than those with low prices of cars. Traditionally, cars are a

demonstration of affluence, that is, the status that one has a lot of money, possessions and wealth. Automobiles are also desired by individuals since they are convenient and guarantee flexibility and safety concerns to motorists unlike public transportation means. The motorists exhibiting high prices of cars were expected to have such a strong attitude about automobiles and would not be willing to forgo driving into the CBD. The converse was also expected to be true. It was therefore, hypothesized that the price of automobiles has a negative relationship with WTP bids of motorists to finance an alternative mode of transport.

GF (Dummy) – A dummy variable that sought for motorists' perceptions whether the government was responsible for funding such a program where 1 = strong and 0 = not-strong. Information to this variable was deduced through the WTP question and those with a strong perception that the government ought to fund the program were those that gave a zero WTP response. Other respondents were very categorical that they already pay high taxes and therefore the government should finance the program.

It was hypothesized that motorists' perceptions about the role of government in financing infrastructural projects would influence their WTP bids. Those with strong perceptions that the government ought to finance such programs would exhibit low WTP bids; and, vice-versa.

Gender (Dummy) – Gender category of respondents, where 1 = Male and 0 = Female. The scales (1, 0) were necessary because this was a dummy variable. The

question in the questionnaire simply asked the respondent to state their gender category whether male or female.

It is hypothesized that male motorists will be willing to pay more for the proposed traffic decongestion program than female motorists. The relatively high requirements for unrestricted mobility for men emanating from the nature of the activities they undertake is definitely not provided by Nairobi's traffic congested roads. There is therefore a positive relationship between gender category and the willingness to pay for the program.

Education – A quantitative variable that was eliciting information about the level of education of the motorists. Motorists were asked to indicate their level of education ranging from lack of formal education to university graduates.

It was hypothesized that motorists' WTP for the proposed traffic decongestion program would be influenced by their levels of education. Generally, the well educated motorists in Nairobi are persons with the best paying jobs both in the private and public sectors of the economy. In that regard, these are mainly the upper class persons in the city who can afford the price of cars including the costs of running them. Therefore, though they might understand the problems associated with traffic congestion and its causes; and, given their relatively high levels of understanding about government responsibilities and operations, due to their exposure; it is expected that these persons will not be willing to leave their cars at home because of their positions and status in society and their understanding of government responsibilities; and, in that case, they will not be willing to pay for the

proposed traffic decongestion program. It is therefore, expected that there is a negative relationship between the level of education of respondents and their WTP bids for an alternative mode of public transport.

3.8.5 Empirical Regression Model

The study used regression analysis to investigate the relationships between the identified study variables. The model was specified in the general linear form as follows:

$$WTP = \propto + \beta x + e_t$$

Where,

WTP = Maximum Willingness to Pay for the proposed traffic decongestion program by the individual motorist. x = A vector of variables representing the respondent's socio-economic characteristics and perceptions about the public transport sector in general. $\propto$, β = Are the parameters to be estimated and e_t is the error term.

According to Teh-Wei Hu (1982), no definite rule cites which functional form is the appropriate one for a given problem. Researchers have to decide this for themselves in each empirical study. However, out of these experiences in deciding on the functional form there are some general criteria for choosing a functional form. For example, one tends to choose a simple form rather than a complicated form if the two can explain the problem equally well. Simplicity is the virtue of a theory. The virtue of simplicity has perhaps induced many researchers to rely upon the linear functions. Other criteria include relying on economic theory as much as possible and considering the predictive power of the model. Specifically, we ascertained the

quantitative causal effect of motorists' WTP bids against the respective identified explanatory variables for these WTP bids.

The actual linear equation estimated was specified as follows:

$$WTP = \beta_o + \beta_1 CP + \beta_2 I + \beta_3 E + \beta_4 PT + \beta_5 G + \beta_6 RC + \beta_7 PM + \beta_8 GF + e_t$$

This linear specification was arrived at after several trials with other forms of specifications. The Linear Specification performed better than other specifications, for instance, we expected WTP to increase steadily with increases in income levels of respondents. The coefficients give marginal value of change of the WTP bids from a unit change of the explanatory variable or the condition of the dummy.

Estimation of the regression equation was done using Ordinary Least Squares (OLS) technique because the WTP questions were open-ended thereby producing continuous variables. The statistical package used was SPSS version 8.0. The package was chosen because of its simplicity.

3.8.6 Aggregation of the CVM Results

Aggregation and generalization of willingness to pay bids was done on the basis of (i) individuals that responded and, (ii) for the entire population of the motor vehicle owners within the study site. Sampled respondents' bids were generalized for the whole population in order to arrive at the total willingness to pay for proposed traffic decongestion program in the city. In the absence of outliers, this value is usually taken to be the true value of the commodity being valued, in this case, the less-congested city from motor traffic.

The formula used in aggregation is:

$$TWTP = \sum_{i=1}^{n} AWTP_i \left[\frac{ni}{N}\right] P$$

Where,

TWTP = Total Willingness to Pay.

$AWTP_i$ = Average Willingness to Pay.

n_i = Number of respondents willingness to pay.

N = Total number of people interviewed

P = Population of the motor vehicle owners in Nairobi.

I = 1,2,…,N = Various willingness to pay bids e.g. 1,000 per year; 1,500 year etc.

3.8.7 Appraisal of the CVM Study

There is always need to examine and evaluate the extent that the CVM study was successfully. There are a host of issues here:

(i) Technical Acceptability – This deals with methodological aspects.

(ii) Institutional Acceptability – Whether the decision makers can incorporate the method into their framework of analysis.

(iii) User Acceptability – Whether the analyst comprehends the method sufficiently to put it into practice.

(iv) Financial Acceptability – Whether the cost of undertaking the CVM is acceptable.

Technical acceptability was the aspect of the CVM study that was covered in detail. The very first thing here is to check the theoretical basis of CVM and see to it that the methodology we employed was consistent with the theoretical premise (e.g. were we to use WTP or WTA?).

There was also need to find out whether the methodology proposed produced reliable, valid and unbiased results. Reliability here deals with the consistency or repeatability of the CVM estimates. Validity refers to the degree to which the CVM correctly depicts the true value of the asset under investigation. Biases can be classified into general, procedural and instrumental types, Bateman and Turner (1993, pp 147). The appraisal report on the CVM study is detailed below.

3.9 Assessing the Effectiveness of Decongestion Measures

One of the study's objective was to assess the decongestion programs implemented by the City's authorities, in particular, the policy to phase out 14-seater PSVs from the CBD; constriction of bypass roads; expansion of Thika Road into a super highway; and, commissioning of the Syokimau commuter rail service. The purpose was to establish their impact on reducing traffic congestion in the city.

Impact program evaluation technique, Theodoulou and Kofinis (2004) was the basis for assessing the success of these programs. Program evaluation is a systematic method for collecting, analyzing and using information to answer questions about

whether projects, policies and programs achieved intended effects. This involves counterfactual analysis, that is, "a comparison between what actually happened or was implemented against the expected outcomes by the policy project actors or what standards prescribe.

3.9.1 Data Collection and Analysis

Data on the actual status of these programs was collected through observations, for instance, the levels of congestion in the city after completion of bypass roads; interviewing key resource persons such as *matatu* drivers, traffic policemen to solicit for expert information on particular issues; and, review and analysis of appropriate secondary sources. Both qualitative and quantitative processes were used during counterfactual analysis. For example, to quantitatively measure the impacts of the bypass roads in reducing traffic congestion in the city, the study developed a measuring scale of 0-10 where the two extremes 0 and 10 measured extremely un-noticeable and significant noticeable changes in traffic congestion in the city, respectively. The scoring was purely a product of the observations and judgments on the identified impacts.

Where:

0 (0%) = Nil Impact

1 – 4 (10-40%) = Low Impact

5 (50%) = Medium/Average Impact

6 – 9 (60-90%) = High Impact

10 (100%) = No Traffic Congestion

A summary of the type of data collected to assess the performance of the various programs is as indicated in Table 3.2:

Table 3.2: Programs Assessment Data

No.	Program/Policy	Type of Data
1.	Phasing out of 14-seater PSVs from the city's CBD.	• Status of the policy, that is, whether implemented or not. • Theoretical justification of the policy. • Views and comments from various stakeholders. • Consider theories and principles about traffic congestion to facilitate counterfactual analysis.
2.	Construction of bypass roads.	• Status of the bypass roads, that is, whether the roads are in use. • Observe usage of the bypass roads. • Re-evaluate traffic congestion in the CBD to determine any effect(s) specifically related to the bypass. • Examine any impact analysis carried out by the policy actors before and after construction of the roads.
3.	Expansion of Thika Road into a super highway.	• Determine the status of the highway in terms of completion and usage.

		• Measure time taken to enter CBD from areas where traffic congestion used to build and compare current and past results. • Consider statements about the road raised by users. • Use the data collected under Objective No. 3 to compute potential savings in terms of time and fuel consumed as a result of this new highway.
4.	Commissioning of Syokimau commuter rail service.	• Get a statement about the rail service – its rationale and purposes. • Measure the time taken to enter the CBD from the point of departure. • Get the cost of fare charged for the journey into the CDB. • Determine the number of parking slots allowed for motorists using the rail service. • Using the data in Objective No. 3 compute the potential savings by motorists in terms of time and fuel from using the rail service.

(Source: Author, 2012)

3.10 Managing the Study's Data

A common oversight among students in economics, particularly econometrics is that they are so eager to submit the data to estimate regression equations and to examine the significance or magnitude of regression coefficients that they fail to examine sufficiently the nature and quality of the data. A proper procedure for data management, especially with large survey data, is to first obtain the frequency, mean, median, range, and variance of each independent and dependent variable and check these for the possible existence of missing observations, inconsistent responses, extremely high and low values of certain variables, and then to use economics knowledge to see whether these values are sensible.

A second step is to prepare tabulations between dependent and independent variables or cross-tabulations based on subgroups, to provide a basic understanding of the characteristics of these variables within the entire sample or within various sub-samples. This will be helpful in interpreting the results of regression equation at a later stage. In certain cases, plotting individual independent variables against the dependent variable will also be helpful in determining the shape of a particular functional relationship and the potential usefulness of a particular independent variable in explaining the variations of the dependent variable.

A third step is to estimate the pair-wise correlation coefficients among independent variables and dependent variables. This step can help to determine which independent variable is a more likely candidate for providing good explanatory power for the dependent variable. It can also help to determine the likelihood of multicollinearity among independent variables. After following all these procedures,

and with the help of economic theory and the formulation and testing of certain hypotheses, we then estimate the specified regression model. This data management procedure minimized computation errors caused by data sources and improved the efficiency of the cost of model estimation. In simple terms, these procedures enabled the researcher to know what he had in his data.

Fourth, since this study developed a single-equation regression model, it was important that the problems associated with this model were tested i.e. multicollinearity, heteroscedasticity, endogeneity and errors in variables. Autocorrelation is a problem mainly in time series data and as such the Durbin-Watson statistic, a traditional test for the presence of the first order autocorrelation was not computed. Autocorrelation is a problem in time-series data where the error terms are correlated which violates the ordinary least squares (OLS) assumptions that error terms in regression analysis are uncorrelated.

Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly correlated where there is perfect multicollinearity if the correlation between two independent variables is equal to 1 or -1. In the presence of multicollinearity, the estimate of one variable's impact on y while controlling for the others tends to be less precise than if predictors were uncorrelated with one another. To test for the presence of this problem, we used the following formal detection-tolerance or the variance inflation factor (VIF) for multicollinearity suggested by O'Brien (2007):

$$\text{tolerance} = 1 - R^2, \qquad \text{VIF} = 1/\text{tolerance}$$

A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a multicollinearity problem.

Heteroscedasticity often arises in the analysis of cross-sectional data, Green (1993). If heteroscedasticity is present, the parameter estimates are still consistent but they are no longer efficient – the variance of the estimated regression coefficient. In regression analysis, heteroscedasticity mean a situation in which the variance of the dependent variable varies across the data which complicates analysis because many methods in regression analysis are based on an assumption of equal variance. To test the heteroscedasticity of the variance we plot the residuals (e_i) against the dependent variable and examined the patterns of residuals. If the shape was similar to that as shown in the Figure below, then there was a possibility of heteroscedasticity in the error terms, Hu (1982). The residuals (e_i) are defined as the differences between the observed dependent variables (Y_i) and their corresponding estimated dependent variables $\hat{Y}_i$:

$$e_i = Y_i - \hat{Y}_i$$

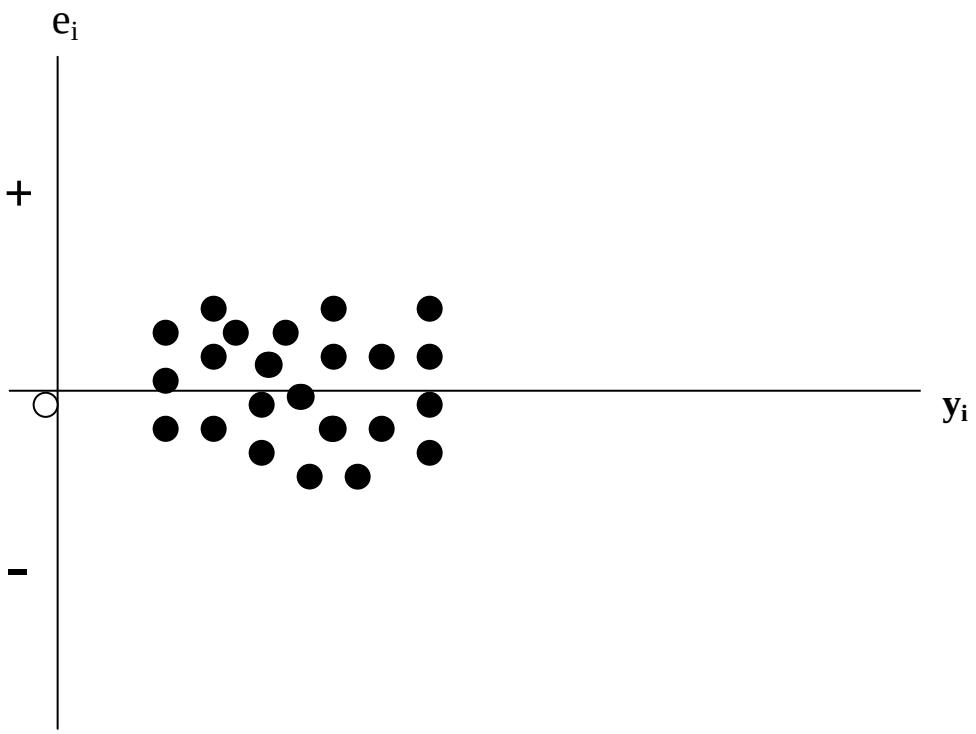

Figure 3.3: Heteroscedasticity in Error Terms
(Source: Hu, 1982)

This is a manual exercise, but is one of the simplest ways of testing for the presence of the problem.

Errors in variables is another problem in regression analysis. In the classical least-squares model it is assumed that sample observations are exactly measured. In other words, it is assumed that there are no errors of measurement in the variable. However, this assumption may not be realistic, since most published data or survey information like in our case contains errors of summarizing or reporting. When there are errors in the variables, the classical least-squares estimate of the regression coefficient will be an underestimate in comparison to the true regression coefficient and therefore any inferences from them may be misleading. There is no formal test

to detect the presence of errors in variables. Only economic theory and knowledge of how the data were gathered can sometimes give some indication of the seriousness of the problem Dominick and Derrick (1998). However, there are a number of ways that have been suggested to overcome the problem. Errors in variables was considered a problem and a method of correction that made use of maximum-likelihood estimation was employed.

Lastly, since endogeneity problem is particularly relevant in the context of time series analysis it was not tested in this study. The problem of endogeneity occurs when the independent variable is correlated with the error term in a regression model. This implies that the regression coefficient in an OLS regression is biased. There are many methods of overcoming this, including instrumental variable regression and Heckman selection correction, Peter Kennedy (2008).

3.11 Hypotheses Testing

The testing of hypothesis is designed to determine whether a given sample would reasonably come from a specified population. A statistical hypothesis is a statement about one or more parameters of a population or a group of populations. In testing a hypothesis, a number of steps should be taken. First, we must make an assumption about the nature of the underlying distribution of the population. Second, the hypothesis to be tested should be stated in terms of a specific parameter or parameters of the population. For example,

$$H_o: \mu = 5$$

$$H_a: \mu \neq 5$$

H_o is the **Null hypothesis,** the hypothesis that sample observations result purely from chance. H_a: is the **Alternative hypothesis,** the hypothesis that sample observations are influenced by some non-random cause. The third step is to specify the level of significance in advance used to decide whether to accept or reject the hypothesis. The concept of "statistically significant" refers to a significant difference between the hypothetical and estimated sample value. When H_o: is rejected, the results are statically significant. The most commonly used values for the level of significance range from 0.10 to 0.01. The choice of the level of significance is arbitrarily.

Once we have decided on the level of significance, the critical value is specified. For example, at 0.05 level of significance, the critical value for the Z variable is 1.96. The critical Z value is then compared with the calculated Z value. When the calculated Z value is larger than the critical Z value, we reject the null hypothesis H_o. When the population variance is unknown and the sample is small, we have to rely on the t-distribution. The Z and t variables are given as follows:

$$Z = \frac{\overline{X}-\mu}{\sigma/\sqrt{n}}$$

$$t = \frac{\overline{X}-\mu}{s/\sqrt{n}}$$

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the study's objectives including proposed recommendations on mechanisms to manage traffic congestion in the city. The study developed the following five objectives: to investigate the factors contributing to traffic congestion in the Nairobi city's roads; describe the behavior and characteristics of personal motorists; estimate the costs of excess fuel consumed and time lost due to traffic congestion; use CVM to estimate the monetary benefits of reducing traffic congestion; and, assess the effectiveness of decongestion measures implemented in the city, that is, construction of bypass roads and expansion of road networks. The results are presented for each respective objective in the sequence as they are listed above. The recommendations are provided for each respective finding as was noted or observed in the discussions.

4.2 Responses on Data Collection Processes

Data collection on the first and fifth objectives mainly involved researcher's own observations, interviews with key resource persons and study of secondary literature. The processes went smoothly as planned despite little delays that were experienced in meeting certain key resource persons. The CVM survey questionnaire that was used to collect data for the second objective also provided data on this objective as well. The researcher collected all the 150 survey questionnaires that were targeted for collecting data on the second and fourth objectives of the study. This indicated a 100% response. The third objective did not involve interviewing respondents but required physical observations and measurements carried out by the researcher and

the research assistants from/to designated points. For the two weeks of the exercise every step went as had been expected and planned and the researchers were able to collect necessary data.

4.3 Contributory Factors to Traffic Congestion in Nairobi City

This section provides findings and discussions on factors considered to contribute to traffic congestion in Nairobi.

4.3.1 Land use Planning vis-à-vis Congestion Management Strategies.

The researcher was not able to access Nairobi's Development Plan. However, secondary literature provided the following highlights about the city:

- Nairobi was founded by the British in 1899 as a simple rail depot on the railway linking Mombasa to Uganda and quickly grew to become the capital of British East Africa in 1907 and eventually the capital of a free Kenyan Republic in 1963.
- During Kenya's colonial period, the city became a centre for the colony's coffee, tea and sisal industry.
- Nairobi is the most populous city in East Africa with a population of 3.1 million inhabitants and the 12^{th} largest in Africa.
- Nairobi is one of the most prominent cities in Africa both politically and financially. The CBD is a square area surrounded by the Uhuru Highway, Haile Selassie Avenue, Moi Avenue and University Way measuring less than 30 KM^2.
- It is home to thousands of Kenyan businesses and over 100 major international companies and organizations, all government agencies

including the United Nations Environmental Programme (UNEP) and the main coordinating and headquarters for the UN in Africa and Middle East.

- It is an established hub for culture and business.
- The city is surrounded by several expanding villa suburbs.
- The Globalization and World Cities study Group and Network (GaWC) defines Nairobi as a prominent social centre, UNEP Reports, Wikipedia (2011).

Based on the above information, it is evident that Nairobi developed into a city that ought to provide virtually all government and private sector services, business and employment opportunities without comparison to any other major town in the country but all squeezed into a very small geographic area. The reality now is that virtually all workers and residents in the city and its surrounding areas as far as Kiambu, Machakos, Thika, Kajiado, Ngong and Limuru every morning travel in private cars and public means to the CBD to work or seek for various services. The high levels of migrations from virtually all rural parts of the country to Nairobi is equally an indication of the potential opportunities for business and employment or available services in the city which are non-existent in other part of Kenya. This phenomenon has direct relation to the travelling-trips exhibited in the city as argued under this variable in Section 2.3 above.

The consolidation of virtually all opportunities and services in one area without corresponding congestion mitigating measures related to land use planning strategies such as provision of adequate land for future roads, decentralizing services and opportunities to other parts of the country has been the main reason for the choked

city's roads. As indicated above, the city has expanded from all its surrounding areas. Real estate development is one of the most active sectors of the city's economy as a result of a rapidly expanding population and rural-urban migrations in search of jobs in the city. The construction works have used potential road expansion spaces to deal with traffic congestion in future due to lack of coordination between authorities dealing with land use planning in the city and those managing traffic congestion. The rising city's population should also be a pointer to a potential explosion in number of vehicles in future and consequently traffic congestion and ought to be planned for as well.

As mentioned earlier, there isn't a specific government agency to deal with traffic congestion though operations of various government agencies have direct and in-direct impacts to the problem. Approvals for land use are issued by the NCC mainly regarding the plans on the proposed construction structures and not on the impacts of the structures on traffic congestion. Title deeds for land ownership are indeed issued by a different government agency, the Ministry of Lands. Lack of coordination between these agencies has previously led to demolition of completed structures after realizing the structures stand on land earmarked for roads or other public utilities.

Corrupt practices have been reported against Nairobi City Council's planning department and the Ministry of Lands regarding their approvals on structural development plans and issuance of title deeds, respectively. However, the new political dispensation of devolving the country into forty seven County Governments may provide reprieve to population pressures in the city with consequent reduction

in the city's travel demand but the counties ought to learn from the experiences of Nairobi in managing land use plans in relation to traffic congestion.

4.3.2 Developments in New Roads Infrastructure.

The five main roads linking the city's surrounding to the CBD, Mombasa Road, Langata Road, Thika Highway, Waiyaki Way, Ngong Road and Jogoo Road were constructed in the early 1960s and 1970s. There hasn't been a new road linking the CBD with the city's environs to be constructed since then. The study though was specifically interested in new road construction from the year 2001 to date. One of the reason for this is lack of space as the areas surrounding the CBD have now become residential places, Westlands, Nairobi West, Pangani, Ngara, Kariokor, Kaloleni, Mbotela, State House, Adams Arcade, Kibera, Hurlingham, Milimani, etc. The scenario exhibits lack of vision or envisaged expansion of the CBD and the city in general in relation to growth in vehicle numbers.

It was however noted that most of the above listed roads linking the CBD are dual carriages with the capacity to accommodate large volumes of vehicles apart from Ngong Road, some sections of Jogoo Road and Mombasa Road that is why traffic was mainly realized to build a few kilometers, 8 km in average to the CBD as all vehicles struggle to either find space into CBD or pass-by to other destinations like Westlands and Industrial Area. The several round-abouts within these roads were noted to be the major build-up points of traffic jams as vehicles criss-crossed towards their respective destinations.

Plate 4.1: Part of Modern Thika Highway
(Source: Author, 2012)

New missing-link roads are now being constructed to link these residential areas with the four major roads to ease congestion by diverting traffic or spreading traffic towards the CBD or points of destinations.

4.3.3 Modification of Existing Infrastructure

The expansion of Thika Highway into an eight lane network has eased congestion tremendously with distances that took hours to CBD now taking a few minutes. There are various road modification projects currently underway as indicated in Table 4.10. As evidenced by the expansion of Thika Highway, such projects will of course significantly ease congestion.

There are many round-about and junctions in the city's roads causing unnecessary traffic congestion. For example from Barracks, a designated measurement point in the study which is a distance of 8 km into the CBD, there are four major round-about sections. These sections are mainly manned by traffic police meaning a driver will have to wait for direction to proceed leading to delay in travel times. It is usually worse when traffic police are not present in these points as drivers block each other from all the four sides of the round-about due to hurry or frustrations.

It was noted that the Ministry of Roads is planning a major project of constructing a fly-over above Mombasa Road, Uhuru Highway and Waiyaki which shall pour traffic from Westalands round-about to Bellevue or the converse. This shall tremendously reduce traffic congestion in these roads which are among the most trafficked in the city as the project shall eliminate seven heavily trafficked round-abouts into the CBD – removing round-abouts along the link roads to the CBD is the most urgent strategy to mitigate traffic congestion in the city.

Plate 4.2: Traffic Policeman Manning a Junction in Nairobi

(Source: Author, 2012)

4.3.4 Encouraging use of Public Transport

The perceptions that motorists fronted regarding inadequacy of the public transportation system in the city were as shown in the Figure below:

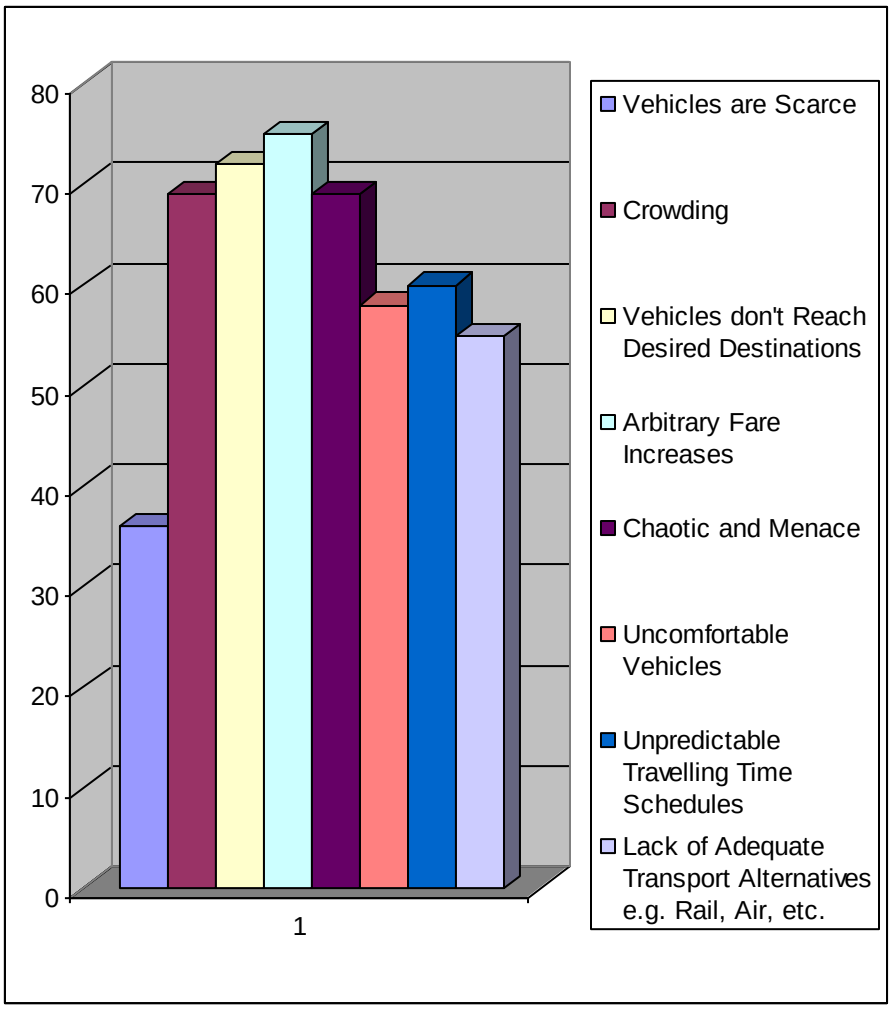

Figure 4.1: Perceptions on Problems with Public Transport (%)
(Source: Author, 2011)

With the exception of 36% of the motorists who said scarcity of vehicles is not a problem as regards public transportation, majority of them cited crowding (69%); vehicles not reaching desired destinations (72%); arbitrary fare increases (75%); chaos and menace (69%); lack of comfort (58%); unpredictability of traveling time schedules (60%); and, lack of adequate transportation alternatives such rail and air (55%), as key problems related to the public transportation system in the city.

The city's motorists understand the benefits of using personal cars including their demand for motor travel within the city and were therefore able to explicitly express the deficiencies of the public transport system in the city. These sentiments are not encouraging in managing traffic congestion in the city and will have to be taken into consideration seriously when designing proposed traffic decongestion programmes. This will require further studies to gather more information as regards these proposed attributes; for example, information will be required on the exact traveling hours by people in Nairobi, desired destinations within town or what they consider as fair fares to/from various points in the city.

4.3.5 Improving Traffic Operations

Though some Frequency Modulation (FM) radio stations and television channels in the morning and evening are doing a good job of broadcast information on the city's road situations, the frequency and coverage is not adequate enough to enable travelers reschedule trips to enhance easy flow of vehicles. Broadcasting traffic information would work very effectively in managing flow of traffic if it was compulsory to all radio stations as most cars do not have mobile television equipments. Besides, the broadcasting frequency of this information shall need to be regulated as well to enhance covering to as many travelers as possible. There are various radio stations airing different programs where without making it mandatory that stations broadcast traffic information, travelers will certainly choose stations of their choice. Most travelers have unknowingly or unexpectedly found themselves locked-up in traffic jams with little options to maneuver.

Incident management mechanisms are also very ineffective and sometimes very expensive. Minor accidents and downpours have caused very heavy traffic jams in

the city's roads at some point. It is common to find very old towing-vessels stationed just along the city's roads or towing broken down vehicles.

Plate 4.3: A Vehicle being Towed-away in Nairobi
(Source: Author, 2012)

Instead of relying on traffic lights within the roads, Traffic Police will often be seen in the city's roads trying to guide vehicles on their progression. Traffic operations to direct flow of vehicles and handle accidents need to rely on modern mechanisms and equipments to avoid unnecessary delays.

Plate 4.4: Traffic Policeman Trying to Control Heavy Traffic in Nairobi
(Source: Author, 2012)

4.3.6 Parking Management

Parking charges are seen more as sources of revenue by the NCC and other providers than a mechanism to managing traffic congestion through discouraging entry into areas where it is encompassed. It is therefore desirable that all parking slots are filled at all times. Parking attendants are very aggressive to ensure that users have paid otherwise the vehicle is clamped and towed away where one pays a hefty penalty than the parking fee.

An article appearing in the Business Daily of June 7, 2013 regarding parking charges in Nairobi:

"The City Council of Nairobi has more than doubled parking fees for cars entering the Central Business District…….starting November 1……..which will see private motorists pay Sh 300 per day to park in the CBD from Sh 140…….City Hall said the decision to increase rates and service charges aims at raising the money it needs to check its growing debt and offer residents better services".

Parking control is limited to designated and reserved parking areas only or during special events but is not practiced frequently as a technique to manage congestion. NCC parking attendants always move around the parking areas, not to deny vehicles entry into the CBD but to see if the vehicles exhibit payment receipts as evidence for having paid. Traffic Police officers and NCC staff man key entry points into the CBD, not to restrict entry but to harness flow of traffic into the CBD including at times within their knowledge that parking slots are no longer available within the CBD – it was observed that it was difficult to get a parking slot within the CBD by 7.00 am. The researcher at one instance tested a parking attendant by asking for parking slot within an already filled parking area and was honestly advised to move around until he finds one – a clear indication that parking policy is not intended to restrict entry into the CBD at any time. There is no parking control program designed to manage traffic congestion in the city.

4.3.7 Institutional Arrangements Managing Congestion

There isn't a single agency mandated with the sole responsibility of managing traffic congestion in the city which has led to ineffectiveness and inconsistencies in congestion management strategies. Though traffic congestion cuts across jurisdictional boundaries and requires collaboration of various actors, there should be one authorized office to spear-head and coordinate the various efforts.

Several government and non-governmental agencies undertake various programs and operations within their mandates (Table 1.1 above) to address the problem. But the programs and operations are neither harmonized nor coordinated and have often caused conflicts and blame. For instance, the NCC intended to raise parking charges by more than 200% but the Consumer Association in the city protested and the government advised the Council to stop the program. Commercial structures have been demolished for having been constructed on road reserves signifying lack of coordination and inconsistencies between city planners and the agency issuing title deeds. Traffic Police officers have often been blamed by both travelers and government authorities for causing traffic congestion at round-abouts and junctions or not doing enough signifying a lack of communication or understanding between the parties.

4.3.8 Congestion Pricing Schemes

The city did not apply congestion pricing schemes and therefore demand for entry into the CBD is not limited causing traffic jams in its roads during peak periods. The city should cordon areas around the CBD and charge vehicles for passing the cordon line; establish area wide congestion pricing schemes for identified sections of the CBD; institute a city center toll ring and collect toll surrounding the ring; and/or identify corridors or single lane facilities where access to the corridor or lane shall be priced.

4.3.9 Modeling Performance of Congestion Contributory Factors

On a scale of 0 - 10 the study scored the performance of how the above strategies were implemented by authorities in the city and the results are as indicated in the table below. The scores are based on the discussions of each respective variable as highlighted above.

Table 4.1: Performance of Strategies for Managing Congestion

No.	**Factor under Study**	**Maximum Score (Scale: 0 – 10)**	**Actual Score of Factor as Investigated**
1.	Coordinating land use planning with congestion management planning.	10	1
2.	Developments in New Road Infrastructure.	10	1
3.	Modification of Existing Infrastructure.	10	6
4.	Encouraging Use of Public Transport.	10	2
5.	Improving Traffic Operations.	10	5
6.	Parking Management in relation to congestion management.	10	2
7.	Institutional Arrangements Managing Congestion.	10	4
8.	Congestion Pricing Schemes	10	1
	TOTAL	**80**	**22**
	Percentage Score of Performance of all the Factors	**22/80 x 100 = 27.5%**	

(Source: Author, 2011)

At a score of 27.5%, an average of 2.75 points per factor, the performance of the city's Authorities was low on these traffic decongestion strategies discussed above. This explains the high levels of congestions exhibited in the city's roads on a daily basis.

4.4 Behaviors and Characteristics of Personal Motorists.

The city's motorists were interviewed through a questionnaire adequately designed to solicit for their views on the problem. About 59% and 41% of the respondents were male and female, respectively. The study results therefore reflect adequately the views of both gender categories. Gender (male or female) was also considered as one of the study variables influencing the motorists' WTP bids in the CVM survey below.

Motorists were asked about the roads they use in their way to the CBD. These were the roads that are considered to be the most congested in Nairobi. The responses are as follows:

Table 4.2: Mainly used Roads by Motorists in Nairobi

	Percentage (%) Yes
Thika Road	20
Mombasa Road	20
Jogoo Road	17
Lang'ata Road	33
Ngong Road	14
State House Road	6
Uhuru Highway/Waiyaki Way	17
Other Roads	18
TOTAL	**145%**
MEAN	**145/8 = 18%**

(Source: Author, 2011)

Seven roads linking the CBD with Nairobi's residential were identified as the mainly congested roads and from a total of 150 motorists that were interviewed, an average of 18% (No. 27) respondents were allocated to each road, as shown above. The total of 145% is explained by the fact that some motorists use about two or three roads before entering the CBD. For example, a motorist from Ongatta Rongai will use Lan'gatta Road then Uhuru Highway before he enters the CBD. It is therefore imperative to note that all the roads that are considered traffic congested were equally represented in the study.

92% of respondents said traffic congestion was a problem to them while 8% said it was not. Though the question is rather psychological, it was necessary in indicating expected responses to the WTP question or the desire for the proposed traffic decongestion program in the CVM survey.

4.4.1 Motorists' preferences on Personal Cars

About 47% of the respondents consider cars as a demonstration of one's social status while the rest (53%) did not. Traditionally, cars are a demonstration of affluence, that is, the status that one has a lot of money, possessions and wealth (Liza 2007). This minority category of motorists who consider cars as status symbol constrain the objective of promoting public transport as an alternate mode of transport in the city. However, the group may be convinced to substitute their preference for personal cars with public transport through appropriate awareness programs on the benefits of using public transport.

Results in Figure below show that the main reasons for using private vehicles were convenience and flexibility. Irungu (2007) observed that 54% of motorists in Nairobi would not switch to public transport system even if it was introduced with faster speed where resistance to change was exhibited by hate of walking and waiting, having baggage, uncomfortable public transport and security fears.

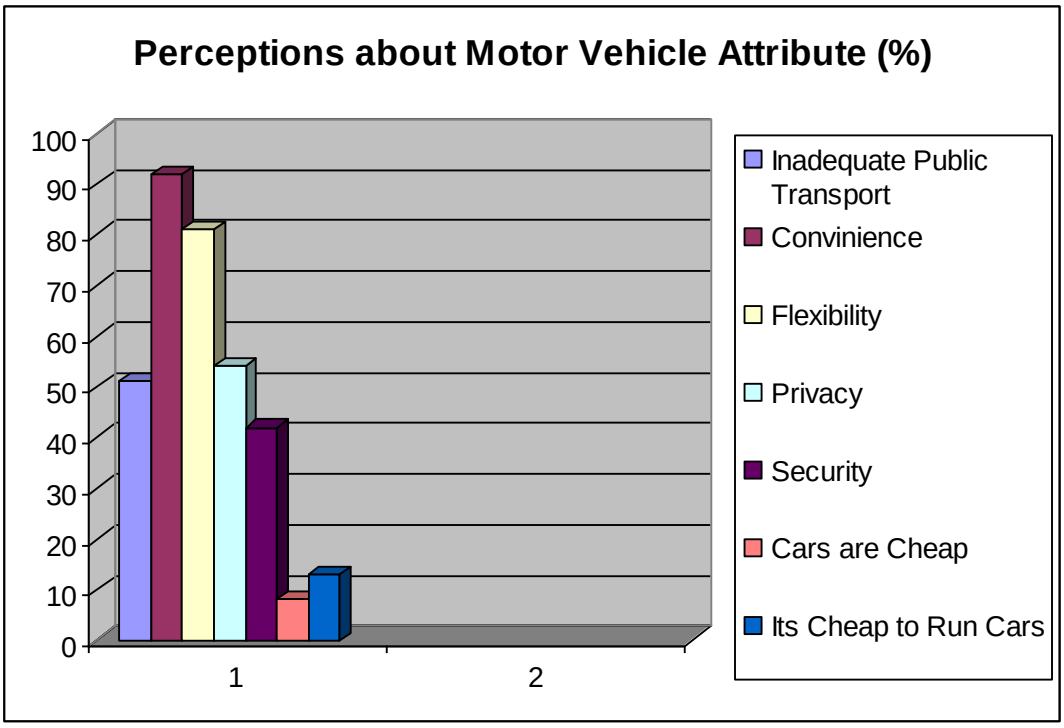

Figure 4.2: Perceptions about Car Attributes (%)

(Source: Author, 2011)

The proposed traffic decongestion program will have to consider seriously adequacy of public transport, privacy of motorists, security concerns, cost of running cars, relative prices of cars but mainly convenience and flexibility as its key attributes. Automobiles are usually desired by individuals since they are convenient and guarantee flexibility of movement unlike public transportation means. Flexibility and convenience of movement enhances individual's business opportunities and competitiveness. Majority (58%) of respondents did not associate their security with the car. Prices of cars and costs of running cars in terms of fuel, maintenance and parking charges were not considered as reasons enough by respondents as to their preferences of using personal cars. This implies that motorists in the city are much more concerned about time to carry out their various activities than anything else.

Despite the aforementioned benefits associated with the personal car, majority of motorists (62%) were willing to forgo the benefits of using personal cars if public transport was improved, that is, if public transportation would include the attributes associated with the individual's car against 46% observed by Irungu (2007). This also explains why majority of motorists were WTP for the proposed decongestion program. This is a very positive statement to the Ministry because it indicates that motorists in the city are willing to support its objective of promoting public transport as a preferred mode of travel as long as the system includes attributes mentioned above.

4.4.2 Problems Associated with Traffic Congestion

In investigating respondents' understanding on the exact problems associated with traffic congestion, the respondents were asked how they thought traffic congestion was a problem, and their responses are as follows:

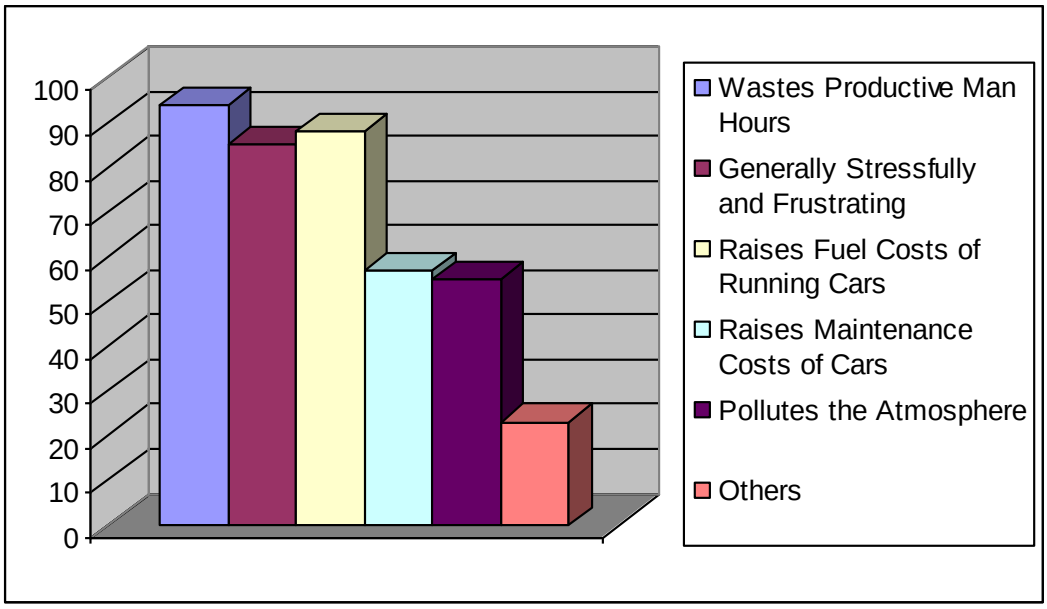

Figure 4.3: Perceptions on Problems Associated with Traffic Congestion (%)
(Source: Author, 2011)

This was one of the key questions in CVM study which was directly related to the WTP question and the expected attributes of the desired traffic congestion program. As shown in Figure 4.3 motorists understood the problems associated with traffic congestion in the roads and therefore when asked to state their WTP for the decongestion program they were aware of what benefits they expected or were valuing. They did not think there were any problems related to traffic congestion since only 23% said there could be other problems. Specifically, the benefits of reduced traffic congestion the motorists were valuing in their WTP statements were expected to reduce or alleviate the congestion problems of wastage of man hours in the roads; stress and frustrations; increased fuel costs of running cars; increased maintenance costs; and, atmospheric pollution problems.

The foregoing step was very important in that empirical CVM studies have suggested that in order to minimize the potential of part-whole bias in CVM; the questionnaire needs to clearly describe the good/service under analysis. This bias occurs when individual respondents fail to distinguish between the specific good/service being analyzed from the wider collection of goods/services into which the good/service under investigation belongs.

Motorists were asked if they considered themselves cause of the traffic congestion problem in the city's roads and the responses were that 65% agreed they are a cause of the problem while 35% did not agree.

It was expected that respondents would be WTP for the proposed traffic decongestion with regard to responses of this question since they would equally be taxed or charged fees to control this problem. The questionnaire did not ask a follow-up question to understand the reasons of those who said they are not cause of the problem. However, this was among the group of respondents who believed that they already pay adequate taxes to the government and were therefore not WTP for the proposed decongestion program, and instead expected the government to finance it or believed that the authorities in Nairobi have not done enough to deal with the problem.

4.5 Costs of Traffic Congestion in Nairobi.

This section provides results on the study's third objective.

4.5.1 Travel Delay Costs (Extra Time Spent in Congestion)

The following Table 4.3 presents a summary of the data that was used to estimate the cost of extra time spent due to congestion in Nairobi during peak hour (Appendix D):

Table 4.3: Estimates of Motorists' Travel Data in Nairobi

No.	Item Description	Data
1.	Daily Average Time Spent to enter CBD during peak time.	49 minutes.
2.	Average Distance from Designated Measurement Point to CBD.	8 Kilometers.
3.	Allowed Posted Speed	80 km/hr
4.	Value of Time in Nairobi (Average Earnings per Hour in 2011 as per Government Statistics).	Ksh 1,618.74
5.	Estimated Number of Vehicles entering the CBD Everyday.	500,000
6.	Number of Working Days in 2011.	252 Days

(Source: Author, 2011)

From the above data, the cost of travel delay is computed as follows:

- The average distance of 8 km from the designated points of measurement to the CBD would take 0.1 hours (6 minutes) if a vehicle travels at free flow while traveling at the city's allowed speed of 80 km/hr;

- The extra time spent in congestion every day is therefore the difference between the daily average time spent to enter the CBD from the designated points (49 minutes) and the time it would take while traveling at free flow from those points (6 minutes), that is, 43 minutes;
- In the year 2011, the number of minutes wasted due to congestion for the 252 working days was 10,836 minutes (252 x 43), equivalent to 181 hours annually;
- A single traveler therefore losses earnings worth Ksh 292,991.94 annually (181 x 1618.74) in Nairobi due to traffic congestion;
- The total social cost in terms of the number of vehicles that are estimated to enter the CBD everyday is Ksh 146,495,970,000 equivalent to $1,635,912,562.80 (in 2011 dollars – 1$ = Ksh 89).

The results are conservative because the cost would be higher if the total figures for workers in the city, value of time in private sector was used to compute it and if it is translated to the whole country's economy. However, the results indicate that delay costs are the largest component of total congestion costs at about 89.9%. A study in Canada estimated that the total delay cost of congestion (in 2002 dollars) for eight cities in the country (Vancouver, Edmonton, Calgary, Winnipeg, Hamilton, Toronto, Ottawa, Montreal and Quebec) was $2.7 billion which was 90% of total congestion cost including cost of excess fuel. The figure of $1,635,912,562.80 for one city (Nairobi) is very large compared to a total $2.7 billion for eight cities in Canada. The inflationary pressures of about a decade between the periods within which the two studies were done most likely explain this difference.

4.5.2 Cost of Wasted Fuel (for speeds of less than 20km/hr)

Table 4.4 presents a summary of the data that was used to estimate the cost of extra fuel consumed due to congestion in Nairobi during peak hour (Appendix D):

Table 4.4: Extra Fuel Consumed by Motorists

No.	Item Description	Data
1.	Fuel consumption (ml/veh-km) for Arterial LOS road driving at 20km/hr (Virginia Tech Energy and Emission Model).	141.59 ml.
2.	Average Distance from Designated Measurement Point to CBD.	8 Kilometers.
3.	Fuel consumption (ml/veh-km) at Freeway High-Speed driving at 105 km/hr (Virginia Tech Energy and Emission Model).	65.22 ml.
4.	Estimated Number of Vehicles entering the CBD Everyday.	500,000 Cars
5.	Number of Working Days in 2011.	252 Days
6.	Average Price of Fuel (combined, Petrol and Diesel) in 2011.	Ksh 108.28

(Source: Author, 2011)

From the above data, the cost of excess fuel due to congestion is computed as follows:

- A vehicle moving from the designated point of measurement to the CBD, a distance of 8 km and moving at a speed of 20 km/hr during traffic congestion would consume 1,132.72 ml of fuel;
- At freeway high speed the vehicle would consume 521.76 ml of fuel from the designated point of measurement to the CBD;
- The excess fuel used by the vehicle as a result of traffic jam is therefore 1,132.72 ml less 521.76 ml which is equivalent to 610.96 ml, the wasted fuel by one vehicle per day (one way);
- For 252 working days in 2011, one vehicle wasted 153,961.92 ml due to traffic congestion, equivalent 153.96 liters annually;
- At an average price of Ksh 108.28 for a liter of fuel, one vehicle wasted fuel worth Ksh 16,670.79 annually;
- The social cost of wasted fuel for an estimated 500,000 vehicles entering the CBD, is Ksh 8,335,395,000 which doubles to Ksh 16,670,790,000 return equivalent to $186,161,809 (in 2011 dollars).

The cost of wasted fuel is about 10% of the total (delay and wasted fuel) cost of traffic congestion in Nairobi. The results are consistent with the Canadian study which observed that cost of wasted fuel made up 7% of the total cost of traffic congestion for eight cities in the country (Vancouver, Edmonton, Calgary, Winnipeg, Hamilton, Toronto, Ottawa, Montreal and Quebec) estimated at about $200 million (in 2002 dollars). Inflationary causes explain why the Nairobi figure ($186,161,809) is substantially large against a total of the eight Canadian cities.

4.6 CVM Results

Using CVM to estimate the benefits of reducing traffic congestion in the city through the WTP construct was the study's fourth objective. The results are as discussed here below.

4.6.1 Results of Quantitative Variables

Table 4.5 gives a summary of the Quantitative Variables in the CVM survey:

Table 4.5: Quantitative Variables of CVM Survey

No.	Variable	Minimum	Maximum	Mean
1.	WTP (Ksh)	0	20,000	1,387
2.	Monthly Income (Ksh)	40,000	160,000	78,133
3.	Education (Years)	0	16	14.6
4.	Cost of Car (Ksh)	100,000	5,000,000	743,100
5.	Monthly Costs of Running Cars (Ksh)	0	147,600	26,263

(Source: Author, 2011)

Most of the motorists with zero WTP bids said they already pay taxes which according to them were relatively high and therefore thought the central authorities ought to fund such decongestion programs without requesting further payments from them. Zero bids jeopardize the quality of regression results when OLS method of estimation is employed due to the assumption of normal distribution entailed in this technique. However, the central limit theorem justifies estimation of populations that

are not normally distributed and therefore the zero bids did not further estimation processes.

It was also thought theoretically strong to leave the WTP question open ended to reflect the respondent's preferences out of own choice and his/her consequent valuation of the commodity under consideration. Proposing WTP bids to respondents, though empirically applicable in CVM studies, raises questions on theoretical justification of the researcher's proposed initial bids.

The mean WTP of Ksh 1,387 by respondents indicates significant impact as regards the willingness of the motorists in Nairobi to contribute towards finding a solution to the traffic congestion problem. The minimum WTP bid was zero and maximum of Ksh 20,000 which matched with the mean monthly income of respondents. WTP bids that were considered abnormal were ignored. It was observed above that even those with zero bids were still willing to leave their cars at home once the public transport system is improved. A zero bid therefore, did not necessarily mean lack of willingness-to-pay for the decongestion program. As mentioned above, zero bids were mainly explained by the scenario feature of level of taxation in the country. The regression analysis of the WTP bids is shown below.

Monthly income of the respondents was also considered as a significant variable in explaining their WTP bids. The monthly mean income of Ksh 78,133 for respondents reveals their potential to finance the program, *ceteris paribus.* The mean years for the level education of the motorists was 15 years which implies that motorists in Nairobi are relatively educated to the level of university and were

therefore expected to understand the various issues related with the traffic congestion problem in Nairobi including the benefits and costs of using personal cars.

The average price of cars in Nairobi was Ksh 743,100 equivalent to US $9,527. It was observed that most employers and financial institutions in the city offer car loans to both public and private sector employees. Therefore, in relation to the average levels of incomes of motorists in the city, most of them have the ability to finance motor vehicle purchases through loans. Cars are therefore affordable which will imply the desire to use personal cars since cars are easy to buy. Car running costs in terms of maintenance, fuel and parking averaged Ksh 26,263 per month which is within the ability of motorists in relation to the their average monthly incomes. This variable was considered important in explaining the potential to use/or not to use personal cars and would consequently explain the motorists' WTP bids. The regression results of these variables in relation to WTP bids are shown below.

4.6.2 Results of Qualitative Variables

It is quite common in econometrics research for many variables to be classified as categories or in a qualitative sense such as race and sex. Most commonly these variables are included in the regression analysis by creation of a categorical variable or dummy variable (also known as a binary variable), mainly denoted by (1, 0), to dichotomize these variables that are not directly quantifiable, Hu (1982). Using dummy variables in regression is useful to capture fixed/random effects. However, this technique must be used with caution. For example, one might be caught in the

"dummy variable trap," perfect multicollinearity. As you include many dummies, the likelihood of being in trouble will increase sharply, Park (2002).

This study was interested in examining the qualitative influences of gender of respondents and their perceptions on severity of the congestion problem; perceptions on the public transport system in Nairobi; motorists' perceptions generally about the car in explaining their WTP bids; and, perceptions on whether funding for the decongestion program should come from central authorities in Nairobi. The regression results of these variables vis-à-vis the WTP bids are shown below. However, a summary of these qualitative variables for the 150 motorists is shown below:

Table 4.6: Qualitative Variables of CVM Survey

No.	Variable	Percentage of Ones (1)	Percentage of Zeros (0)
1.	Gender	59	41
2.	CP	98	2
3.	PT	73	27
4.	GF	37	63

(Source: Author, 2011)

CP – Perceptions on Severity of the Congestion Problem

Prior to asking the respondents to state their maximum WTP for the proposed decongestion program, we sought to know their perceptions towards the severity of

congestion problem and whether they agreed or not-agree that they contributed to the problem. Responses would determine whether perceptions were strong or not-strong. The consistency of this question was checked through another question about the specific road that the respondent uses every day. The roads were those considered to be the most congested in Nairobi.

98% of respondents admitted that traffic congestion was a problem affecting them while 2% thought traffic congestion was not a problem. The study did not ask a follow up question to those that said traffic congestion was not a problem to understand their reasons. However, since these were only 2% of the respondents it was concluded that majority of respondents were within the theme of the study and therefore, these minority would not affect the study results.

This question would reveal the inconsistency in responses from the respondents. We expected that negative perceptions about the traffic congestion in the city should be followed by a low or zero WTP bid, and the converse to be true too. From our results this presupposition was not uniform to all respondents because in some cases severe perceptions about the congestion problem including the willingness to leave cars at home if public transport was improved was followed by zero bids in the WTP question. The reasons given for this inconsistency were that motorists already pay taxes and therefore the Ministry of Nairobi Metropolitan Development should finance that project. It is worth noting that the respondents that offered zero bids still admitted that traffic congestion was a problem and they equally contributed to that problem. It was therefore, concluded that the zero bids were not spoilt responses at all. The regression results of this variable are shown below.

PT – Perceptions by Respondents that adequate Public Transport will be an Alternative means of Travel

The study sought to understand perceptions of respondents whether an adequate public transport would be a preferred alternative mode of transport. Perceptions were concluded whether strong or not from the responses. 73% and 27% of respondents revealed a strong perception that an adequate public transport system would be an alternative mode of transport, and the converse, respectively.

It was thought that such perceptions would influence motorists' WTP bids. Those with strong perceptions that an adequate public transport like the one envisaged would be an alternative mode of transport would have high WTP bids and vice-versa. The regression results about this variable are shown below. These results are also consistent with other findings, for example, majority of respondents were WTP for the traffic decongestion program.

GF – Perceptions by Respondents that Central Authorities ought to Finance the Proposed Decongestion Program

The study lastly sought to understand perceptions of respondents as regards funding for the proposed decongestion program, that is, whether the government ought or ought-not-to finance the program. This variable was considered useful based on the responses from the respondents that offered zero WTP bids where they sighted their reasons for the zero bids as that they already pay taxes. And so they thought

government or the city council of Nairobi needed to be solely responsible for financing the decongestion program. The perceptions as regards the levels of taxation in the country, as has been earlier mentioned was one of the strongest scenario features that was revealed from this WTP study.

The observations were that 37% of respondents wanted the government to finance the decongestion program whereas 63% thought otherwise. These results were consistent with the number of respondents that had suggested zero WTP bids in terms of numbers. The regression results of this variable as indicated below.

4.6.3 Correlation Analysis

The study, before undertaking regression analysis, investigated the correlation between the variables, that is, the strength and direction of relationship between pair of variables using the best known Pearson product-moment correlation coefficient. The closer the Pearson coefficient is to either 1 or -1, the stronger the linear correlation between the variables. This step helped to determine which independent variable was a more likely candidate for providing good explanatory power for the dependent variable. It also helped to determine the likelihood of multicollinearity among independent variables. However, a correlation between two variables is diluted in the presence of measurement error around estimates of one or both variables, in which case disattenuation provides a more accurate coefficient. The correlation coefficients from the study variables are as shown in the following table below:

Table 4.7: Pearson Correlation Coefficients on Study Variables

	WTP	**CP**	**I**	**E**	**PT**	**G**	**RC**	**PM**	**GF**
WTP	1.0	0.0	0.1	-0.2	0.1	-0.0	0.1	-0.1	-0.3
CP		1.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1
I			1.0	0.1	-0.1	-0.0	0.0	0.4	0.1
E				1.0	-0.1	-0.1	-0.1	-0.1	0.20
PT					1.0	-0.0	-0.1	-0.0	-0.1
G						1.0	-0.1	0.1	0.2
RC							1.0	0.2	0.1
PM								1.0	0.1
GF									1.0

(Source: Author, 2011)

Several authors (Green, Koutsoyiannis, etc) have offered guidelines for the interpretation of a correlation coefficient. Cohen (1988), has observed, that all criteria on interpretation of the correlation coefficient are in some ways arbitrary and should not be observed too strictly. This is because the interpretation of a correlation coefficient depends on the context and purposes. The following is one of proposed criteria for interpreting correlation coefficients.

Table 4.8: Criteria for Interpreting Correlation Coefficients

Correlation	**Negative**	**Positive**
Small	-0.3 to -0.1	0.1 to 0.3
Medium	-0.5 to -0.3	0.3 to 0.5
Large	-1.0 to -0.5	0.5 to 1.0

(Source: Author, 2011)

However, from the above argument, it is important to note that “large” and “small” should not be taken as synonymous for “good” and “bad” in terms of determining that a correlation is of a certain size, Cohen (1988). For example, a strong correlation of 1.0 or -1.0 between government role and responsibility on infrastructural projects (GF) and operational costs of running cars (RC) would scientifically indicate a trivial result than a profound one since the relationship between the two variables is not clear.

Nevertheless, as mentioned above the correlation coefficients inform a lot about the regression results between variables. For example, from the correlation coefficients above, it would be expected that GF would reveal a stronger explanatory power on WTP than the other variables in the regression results. This was true from the regression results in that GF was the highest statistically significant variable than the other explanatory variables. Further, the direction of relationships between all the variables against WTP as indicated in the correlation results is similar to those in the regression results. The low values of the correlation coefficients indicated that multicollinearity between the variables was not a problem. Possibly, the low correlation coefficients, as mentioned above, were as a result of measurement error around estimates of variables. More detailed regression results for all the independent variables against the endogenous variable are shown below.

4.6.4 Regression Results

The results of the linear version of regression estimation are given below as follows.

Table 4.9: Regression Results of Determinants of WTP

Variable	**Coefficient**	**t-Statistic**
	- 360.9	
Income	613.8	3.07
PT	728.2	1.37
Education	- 367.2	- 1.56
RC	0.04	2.77
GF	- 1682.9	- 3.30
PM	- 0	- 2.34
CP	1139	0.67
Gender	485	0.98
R^2	0.182	
Adjusted R^2	0.136	
N = 150		

(Source: Author, 2011)

All explanatory variables have the expected signs. Five variables, that is, monthly net income of respondents, monthly cost of running cars, gender, perceptions on the severity of the congestion problem and perceptions on alternative mode of transport were positively correlated to WTP bids. While, perceptions on government responsibility, level of education of respondents and price of cars were negatively correlated with WTP bids. The coefficient of determination (**$R^{2)}$** was low at 0.182 implying that there was a weak linear relationship between the dependent and

independent variables which is consistent with the correlation coefficients shown above and cross-sectional data as well.

However, due to the drawbacks involved in the use of $\mathbf{R^2}$ as a result of its computation, Draper and Smith (1998), the interpretation of the regression results was mainly based on the t-statistic which revealed, as shown above, that four of the explanatory variables, that is, GF, income, PM and RC were statistically significant at 5% level of significance. A detailed explanation on the results for the respective individual variables is as follows:

CP (Dummy) – The variable was not statistically significant but exhibited the expected positive sign. Therefore, the motorists' perceptions about the severity of traffic congestion in the city and the envisaged success of the decongestion program did not, statistically, explain their WTP bids.

Income – Income was observed to influence WTP bids of the respondents. The variable exhibited the expected positive sign and was statistically significant in explaining the variations in WTP bids. It was hypothesized that despite the severity and understanding of traffic congestion as perceived by the motorists, plus the expected success of the decongestion program, their WTP bids would mainly be determined by their levels of income.

The variable's beta coefficient was 613.80 meaning that if the monthly incomes of the motorists in the city were increased by one unit, one Kenya shilling, motorists

would be willing to pay an extra Ksh 613.80 for the proposed traffic decongestion program.

PT (Dummy) – The variable was statistically not significant though it exhibited the expected positive sign. It was initially conceived that if the conditions in public transportation system were to be surely improved then individual motorists would be willing to pay high amounts of money for the program and vice versa. However, the results indicated that perceptions on an alternative mode of transport did not influence the WTP bids.

RC – The variable exhibited the expected positive sign and was statistically significant with a t-statistic of 2.77. It was hypothesized that if operational costs of running the car in terms of fuel prices, parking fees and monthly maintenance costs were generally low, then motorists would be willing to pay less for the proposed traffic decongestion program and vice versa. This turned out to be true. The beta coefficient for the variable was 0.04 which implied a low predictive power of the variable. That is, a unit increase in the cost of car operational expenses would induce motorists to pay a paltry Ksh 0.04 more for the proposed traffic decongestion program. Nevertheless, the results indicated that car operational expenses influenced the motorists' WTP bids.

PM – The variable was statistically significant with a t-statistic of (-2.34) and exhibited the expected negative sign. As was expected, it was revealed that the motorists who exhibit high prices of their cars would have lower WTP bids than those with low prices of cars. It was thought that cars are a demonstration of

affluence, that is, the status that one has a lot of money, possessions and wealth including the fact that individuals prefer automobiles since they are convenient and guarantee flexibility and safety. The motorists exhibiting high prices of cars were expected to have such a strong attitude about automobiles and would not be willing to forgo driving into the CBD. The converse was also expected to be true.

The beta coefficient for the variable was 0.0 which like, RC, indicated a very low predictive power despite the fact that price of cars influenced motorists' WTP bids. This result meant that if the prices of cars were reduced by a unit that would not change the amount the motorists were WTP for the traffic decongestion program. Nevertheless, the revelation that there is a correlation between the motorists' WTP bids and the price of cars is worth noting by policy makers designing the decongestion program.

GF (Dummy) – This was the most statistically significant variable and exhibited the expected negative sign as well. It had a t-statistic of (-3.30). It was hypothesized that motorists' perceptions about the role of government in financing infrastructural projects would influence their WTP bids negatively. Those with strong perceptions that the government ought to finance such programs would exhibit low WTP bids; and, vice-versa.

The variable had a beta coefficient of -1682.9 implying that if government does not build the confidence of motorists in it in the city, then the motorists would lower their payment for the proposed traffic decongestion program by Ksh 1682.90, and vice versa.

Gender – Though it was hypothesized that male motorists will be willing to pay more for the proposed traffic decongestion program than female motorists, the regression results revealed that gender did not have any influence on WTP bids given that the variable was statistically insignificant. However, it exhibited the expected positive relationship between it and WTP. Therefore, gender should not be a major concern to the Ministry of Nairobi Metropolitan Development in designing the traffic decongestion program.

Education – Lastly, it was hypothesized that motorists' WTP for the proposed traffic decongestion program would be influenced by their levels of education. This was not true given that the variable was statistically insignificant, but exhibited the expected negative sign. The level of education of motorists did not influence their WTP bids such that the ministry does not need to concern itself with the education levels of motorists in designing the proposed traffic decongestion program, from a statistical perceptive.

4.6.5 Dropping the Insignificant Variables

The insignificant variables were all dropped to see their effect on the overall fit of the model. It was noted that dropping the insignificant variables just slightly enhanced the significance of GF, RC, PM and income, that is, the variables that were already statistically significant. The coefficient of determination, $\mathbf{R^2}$ was in fact reduced meaning that the dropped variables were explaining the variations in the dependent variable to some extent. The expected signs for the variables stood.

4.6.6 Testing for Multicollinearity

Multicollinearity refers to a situation in which two or more explanatory variables in a multiple regression model are highly correlated where there is perfect multicollinearity if the correlation between two independent variables is equal to 1 or -1. To test for the presence of this problem, we used the following formal detection-tolerance or the variance inflation factor (VIF) for multicollinearity suggested by O'Brien (2007):

$$\text{tolerance} = 1 - R^2, \qquad \text{VIF} = 1/\text{tolerance}$$

A tolerance of less than 0.20 or 0.10 and/or a VIF of 5 or 10 and above indicates a multicollinearity problem.

The results were as follows:

$$\text{tolerance} = 1 - 0.182 = 0.82, \qquad \text{VIF} = 1/0.82 = 1.22$$

Multicollinearity therefore, was not a problem in the variables. In the absence of multicollinearity, the estimate of one variable's impact on y while controlling for the others was precise.

4.6.7 Testing for Heteroscedasticity

Heteroscedasticity often arises in the analysis of cross-sectional data, Green (1993). To test the heteroscedasticity of the variance we plotted the residuals (e_i) against the dependent variable and examined the patterns of residuals. If the shape was similar to that as shown in the Figure 3.3 above, then there was a possibility of heteroscedasticity in the error terms, Hu (1982). The graphical results of this exercise are as follows:

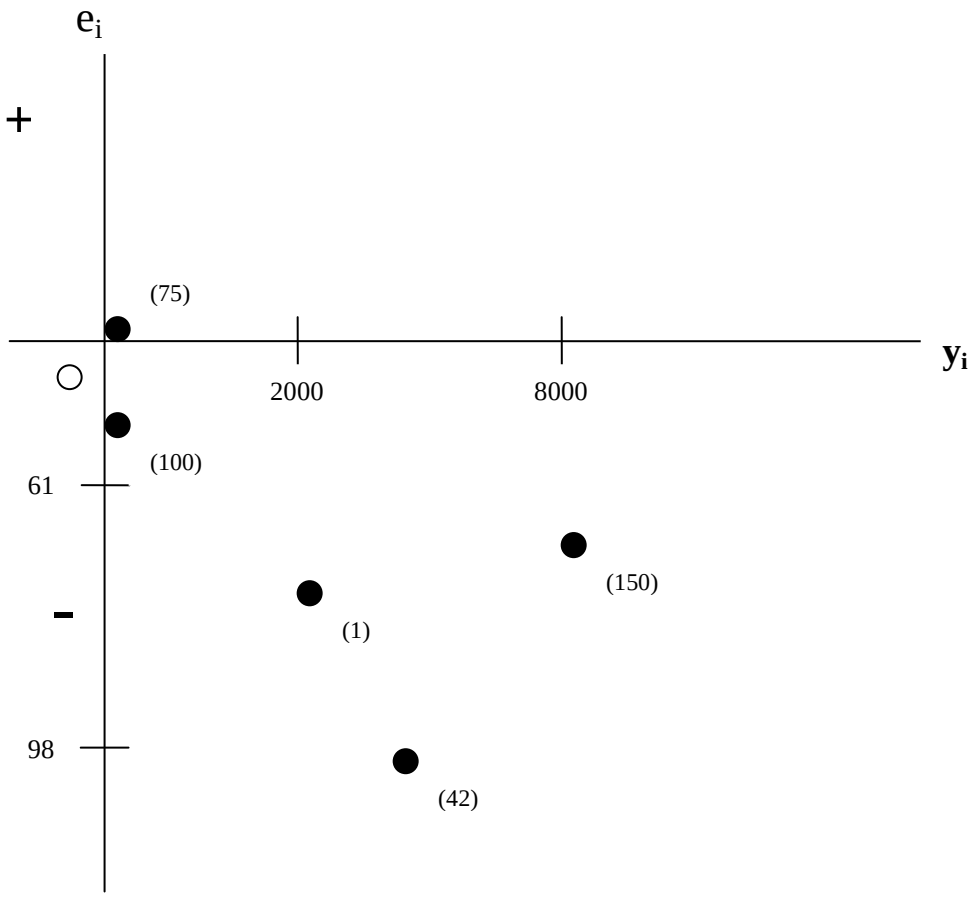

Figure 4.4: Evidence of Existence of Heteroscedasticity in Error Terms
(Source: Author, 2011)

Heteroscedasticity was therefore found to be a problem and this is evident from the high values of standard errors in some coefficients. The existence of heteroscedasticity may often occur in the cross-section data like the one used in this study. For example, the variance of cost of running personal cars among high-income families may be larger than the variance among low-income families. Since the main effect of heteroscedasticity is not on the biasness of the estimated regression coefficients but on efficiency – the variance of the estimated regression coefficients, Breusch and Pagan (1979), action on the problem was thought

unnecessary. Changing the functional form of the regression equation, for example using a double-log functional form to treat the problem, would have complicated the interpretation of the regression results.

4.6.8. Summary of Regression Results

Despite the existence of heteroscedasticity, these regression results are acceptable. The monthly net income; price of cars; operational costs of cars; and, perceptions about government role and responsibility on infrastructural projects, the four being the most important variables in this research were statistically significant at 5% level.

We can, therefore, accept the alternative hypothesis that the WTP for the proposed traffic decongestion program by the Ministry of Nairobi Metropolitan Development is determined by monthly net income; price of cars; operational costs of cars; perceptions about government role and responsibility on infrastructural projects; gender; level of education; perceptions that an adequate public transport system could be an alternative mode of transport; and, perceptions on the severity of the traffic congestion problem. However, it is only monthly net income; price of cars; operational costs of cars; and, perceptions about government role and responsibility on infrastructural projects that are significant determinants of the WTP. The other variables are statistically insignificant determinants at 5% level.

The variables that were considered to explain the WTP bids were: monthly net income; price of cars; operational costs of cars; perceptions about government role and responsibility on infrastructural projects; gender; level of education; perceptions that an adequate public transport system could be an alternative mode of transport;

and, perceptions on the severity of the traffic congestion problem. The variables exhibited low Pearson correlation coefficients ruling out the problem of multicollinearity amongst them. All the explanatory variables exhibited the a priori expected signs in the regression results. Monthly net income, price of cars, operational costs of running the car and perceptions about role and responsibility in funding infrastructural projects were statistically significant in determining the motorists' WTP bids while the others were not at 5% level. Further tests for multicollinearity between the explanatory variables showed that this was not a problem but the error terms were found to be heteroscedastic.

Despite the criticisms of the CVM technique which are about its empirical application, the method is superior than any other technique in estimating benefits of provision of non-market environmental services because of its strong economic theoretical ability and the potential to engage true stakeholders. The motorists in the city revealed the worth of the benefits that should be expected every month by decongesting the city from motor traffic or rather the opportunity costs they incur as a result of traffic jams in the city through their open-ended WTP bids. Other techniques would have underestimated these benefits.

The motorists revealed adequate understanding of the impacts of traffic congestion in the city and what they would expect from the proposed public transport system. This minimized part-whole biases associated with the CVM technique. The potential for strategic biases was also minimal, first because of adoption of the WTP construct, strategic biases are a major problem with WTA CVM constructs. Second, the presence and nature of protest bids in this survey with clear policy statements on

those bids was an indication of minimal strategic behavior. The views that open-ended formats are strategically biased than referendum formats are thus relative and based on specific circumstances which the researcher may minimize through appropriate survey design.

Though the coefficient of determination, R^2, was low indicating non-linear relationship between the motorists' WTP bids against their socio-economic factors thought to influence the bids and which is consistent with cross-sectional surveys, the statistical significance of various variables through the t-statistics signified the importance of regression analysis and the relevance of the results of this CVM study. The assessment of correlation between the study variables and the various tests of problems associated with regression analysis also enhanced the efficiency of these CVM results.

Therefore, despite the existence of heteroscedasticity which does not bias the estimated regression coefficients but simply affects their efficiency the results were acceptable. The alternative hypothesis was thus accepted, that the WTP for the traffic decongestion program proposed by the Ministry of Nairobi Metropolitan Development was determined by monthly net income, price of cars, operational costs of cars, perceptions about government role and responsibility on financing infrastructural projects, gender, level of education, perceptions that an adequate public transport system could be an alternative mode of transport and perceptions on the severity of the congestion problem.

4.6.9 Aggregation and Generalization of WTP Bids

Aggregation and generalization of willingness to pay bids was done on the basis of (i) individuals that responded and, (ii) for the entire population of the motor vehicle owners within the study site. Sampled respondents' bids were generalized for the whole population in order to arrive at the total willingness to pay for proposed traffic decongestion program in the city. In the absence of outliers, this value is usually taken to be the true value of the commodity being valued, in this case, the less-congested city from motor traffic.

The formula used in aggregation is that shown in section 3.8.6 above.

The results are as follows:

- With an average WTP of Ksh 1,387 per month.
- Total motorists population of 500,000.
- And, 150 motorists interviewed.

Total Willingness-to-Pay (TWTP) = Ksh 693,500,000 ($8,891,026) per month, translating to Ksh 8.3 billion annually. This is therefore, the total value, including both use and non-use values, of some benefits of reducing traffic congestion in the city's CBD.

4.6.10 Treatment of Protest Zero Bids

The study considered zero bids as legitimate zero valuation and added them in computing the mean WTP and in computing the aggregate value of benefits. Though they may have had a down-ward effect on these statistics, the purpose was not to ignore the policy effects exhibited by the respondents with these bids.

McGuirk, Stephenson, and Taylor (1989), have argued that protest bids "should be considered legitimate WTP bids as respondents are essentially valuing a proposed policy, not just a commodity". Randall (1986), notes that WTP estimates are based not only on the value of the commodity being offered, but also on the means by which the public good will be provided and the method of payment for the good, so that the strict valuation of the good cannot be separated from the public policy issues associated with its provision. Motorists that gave zero bids were very categorical that they pay large amounts of taxes and the government should therefore finance the decongestion program.

4.7 Effectiveness of Decongestion Measures

Generally, interventions to deal with traffic congestion by transportation authorities in the city have emphasized investments towards dramatic expansion and rebuilding of road networks; and, institution of traffic regulations to control and manage the flow of motor vehicles into the city center. The following are some of the proposed programs to help ease traffic congestion in the city between 2010 and 2012:

Table 4.10: Proposed Infrastructural Decongestion Projects

No.	Project	Scope	Status
1.	Nairobi Eastern Bypass.	31.5 km from Mombasa Road (A 104) and ends at connection with Ruiru-Kiambu Road near Kamiti Prisons.	Completed (2013).
2.	Nairobi Northern Bypass.	20.2 km from Ruaka Trade Centre on Limuru Road (C 62) and ends at EK30+193 of the Eastern Bypass.	Completed (2013).
3.	Nairobi Southern Bypass.	29 km from Mombasa Road to Waiyaki Way.	Ongoing.
4.	Construction of Missing Link Roads within the city's Metropolitan Region.	Nairobi Western Ring Roads, Parklands, Eastlands, Industrial Area, etc).	Ongoing.
5.	Rehabilitation and upgrading of Ngong-Karen-Bomas-Langata Roads.	Dualling of the section from All Saints Cathedral to Adams Arcade, Karen, Bomass, Langata Road.	Ongoing
6.	Rehabilitation and upgrading of Thika Highway.	Expansion of the highway into a several lane road.	Completed (2012).
7.	Phasing out of 14 seater matatus from the city (2015).	Announced on Tuesday October 19, 2010 by the Transport Minister to replace the 14 seaters with bigger buses with a carrying capacity of 25 persons or more. Banned registration of 14 seater Public Service Vehicles as from January, 2011.	Suspended.
8.	Raising of parking fees within the CBD.	The Nairobi City Council doubled parking fees from Ksh 70 per day to Ksh 140 per day and from Ksh 140 to Ksh 300.	Effective and planned for (2013).

(Source: Author, 2011)

The expected benefits of these programs are to reduce the various road transport costs within the city that shall be manifested through:

1. Shorter travel time at off peak hours;
2. Decongestion by increased road capacity, easing of traffic pressure and facilitation of traffic diversion from the CBD;
3. Decongestion of surrounding roads following the construction of the missing links;
4. Security, safety and convenience of pedestrians and bicycle/motorbike users due to construction of footpaths and bicycle lanes;
5. Encourage the use of high capacity public service vehicles; and,
6. Discourage entry of personal cars into the CBD.

Equally, road construction works are very expensive which may pose a serious challenge to the transportation authorities in the city despite the necessity of such programs in easing the problem.

4.7.1 Impact of Thika Road Expansion on Traffic Congestion

Thika road (A2) is part of the major Road network in Kenya classified as A. This road links Nairobi to Ethiopia through the border town of Moyale. A section of this road, Nairobi to Thika town, about 50 km, received a major fund for improvement with most sections scheduled for completion in mid 2012. The total cost of the expansion was estimated at Ksh 27 billion but could be higher due to increasing fuel costs.

The expansion project kicked off in April 2009 and will involve changing the road from a four to eight-lane super highway. The project will also include construction of interchanges, flyovers, box culverts, and standard pipe culverts. The highway has

been split into three sections for construction works. These sections are Muthaiga Roundabout to Uhuru Highway, Muthaiga Roundabout to Kenyatta University (KU) and KU to Thika.

The Kenya Alliance of Resident Associations (Kara) and the Center for Sustainable Urban Development (CSUD) at the Earth Institute at Columbia University together with the University of Nairobi (UoN) Department of Geography and Environmental Studies and the Jomo Kenyatta University of Agriculture and Technology (JKUAT) examined emerging issues around the expansion of the road by holding focus group discussions (FGD), stakeholders' meetings and public forums.

The following positive impacts of the expansion project were identified during the discussions:

- Reduced travel time from Thika town to Nairobi as a result of reduced traffic jams along the highway as the road is amongst the congested roads in the city;
- Increased property values along the highway caused by increased demand for property;
- Enhanced access to facilities such as banks, supermarkets, social clubs, amongst others which are expected to set up branches; and,
- Improved efficiency in doing business, especially for those businesses that rely on traveling or moving goods between Nairobi and Thika.

The following were the concerns raised by the participants during the discussions:

- Road safety such as frequent accidents particularly on the densely populated parts of the highway;
- Health, workers hired by the contractors do not have clinically approved devices to protect them from inhaling chemicals and dust, a lot of noise pollution from the construction works, etc;
- Water Drainage, Road and Property Damage was also raised as a concern;
- Information and Public Involvement - the feeling is that minimal information was relayed to the local residents and users of the highway regarding the project; and,
- Socio-economic impacts – given rent increases some tenants have been forced to move as they are unable to pay; there has been loss of business due to demolition.

The report proposed the following recommendations amongst others:

- A series of awareness-creation initiatives and public events to educate citizens on highway and transportation plans and policy more generally;
- More careful research on transportation infrastructure policy, projects and processes by universities in support of improving how the GoK and citizens develop and use such infrastructure in future, etc.

The report made very useful observations and recommendations but did not provide estimates of the observed benefits and costs of the expansion of the road. Unless we provide monetary estimates of the benefits and costs of such projects then they remain explicitly zero and may not enhance significant policy direction.

This study estimated some of the observed benefits of decongesting the city from traffic through the CVM and estimated the costs of excess fuel consumption and time delay due to traffic congestion in the aforementioned major roads in the city. Thika road was excluded from these estimates due to its reconstruction. However, using sentiments by users of the highway this study estimated the value of expected benefits from this road. *"It is a whole new experience,"* Ms Wacera says. *"These days it takes 20 minutes to get to town. I wake up at half past six and leave the house at half past seven, drop my son at a day care centre in the neighborhood and still get to work on time,"* she adds.

Plate 4.5: A Section of New Thika Highway
(Source: Author, 2011)

Based on the above sentiments and computations of costs in Sections 4.5.1 and 4.5.2, it is estimated that road expansion projects such as the Thika Super Highway have the potential of saving the city's motorists Ksh 80 billion annually in terms travel time and fuel consumption. The CVM survey above indicated that motorists in Nairobi are WTP Ksh 8.3 billion annually to decongest the city from traffic.

4.7.2 Effectiveness of Bypass Roads in containing Traffic Congestion

The Ministry of Roads through the Kenya Urban Roads Authority has undertaken the construction of three bypass roads to decongest the city from traffic. These new roads are the Eastern Bypass, the Northern Bypass and Southern Bypass. They are three major trunk road links in the Nairobi Road Network Master Plan. The Eastern Bypass and Northern Bypass Roads are now complete but the Southern Bypass had just been started by the time this thesis was being finalized. The study therefore discusses the impacts of the completed two Bypasses.

The Eastern Bypass links Mombasa Road (A 104) to Ruiru – Kiambu Road near Kamiti Prison. It starts from the junction with Mombasa Road with an interchange, the road extends to northeast with overpass over the existing Kangundo road at EK13 + 075. The road first turns to north to cross Nairobi, Gatharaini and Kamiti rivers, then turns to northwest at EK21 + 760 with a proposed interception, underpasses the Nairobi-Thika Road (A2) at EK27 + 000, and overpasses a railway at EK27 + 825. The road ends at approximately EK32 + 000, to connect with Ruiru-Kiambu Road near Kamiti Prisons. The first 5 km from Mombasa Road Junction shall be a dual carriageway in addition to a maximum 5 km service road. There shall

be a loop road within Ruai neighborhood of approximately 7.2 Km. Total length of the road is approximately 40 Km.

The Northern Bypass links Limuru Road to Thika Road. It starts from Ruaka Trade Centre on Limuru Road (C 62), the road overpasses Banana Road (C 63) and reaches the Closeburn Farm. Then it runs through Runda area and Githogoro Village to cross the Kiambu Road on Ridgeways. Afterwards the road underpasses Windsor, Marurui, Thome and United States International University (USIU) and, 2 Km thereafter, intersect the Kamiti Road at Githurai. Then it crosses the Riara river at NK13 + 171, passes through the Kamuthi Farm, before crossing the Kiu River at NK15 + 043 to the west of Kahawa, after passing through Kamae Slums, Kiwanja and crossing the Kamiti River. The road ends at EK30 + 103 of the Eastern Bypass. Total length of the road is approximately 21 Km.

The Southern Bypass (about 30 Km) runs from Kikuyu to Mombasa Road via Ngong Road and Langata Road. The road joins the Nairobi-Nakuru Highway at Rironi. It is expected to ease traffic congestion along the Mombasa Road by providing route to transit vehicles that use the Kenya Coast-Western Kenya and Uganda which relies on the Mombasa port for heavy commercial imports, being a landlocked country.

The overall goal of construction of the bypasses is to achieve a sustainable socio-economic development in Nairobi. This will be manifested through the following anticipated outcomes:

- Facilitate traffic diversion;

- Enhance service level;
- Alleviate traffic pressure;
- Employment creation during construction;
- Mitigate vehicles emission; and,
- Improving urban environment.

The expected challenges or costs to the program were as follows:

- Land acquisition issues;
- Traffic management during construction;
- Road safety particularly for NMT users;
- Acclimatization of foreign contractors may cause delays;
- Language barriers;
- Coordination of involved parties;
- Relocation of PAPs; and,
- Destruction of vegetation and environment.

The Ministry did not measure the expected impacts of this program. On a scale of 0-10 described above, this study measured the magnitude of four types of impacts of the bypass roads in Nairobi. The results are as follows:

Table 4.11: Impacts of Bypass Roads

No.	Type of Impact	Actual Score on Impact (Scale: 0 – 10)	Maximum Score of Impact
1.	The bypass roads have reduced traffic in the CBD.	0	10
2.	The bypass roads have significantly diverted traffic from the CBD.	1	10
3.	Social impact on excess fuel consumption by vehicles in the CBD.	1	10
4.	Social impact on time delay by vehicles in the CBD.	1	10
	Total Score/Magnitude of Impact	**3**	**40**
	Percentage Impact of Bypass Roads in Nairobi	**3/40x100 = 7.5%**	

(Source: Author, 2011)

Though a few motorists that were interviewed said they often use the bypass roads and have avoided the eight roads mentioned above that were studied, the overall congestion levels in the eight roads and the CBD was observed not to have changed as indicated in the table above. Consequently, the impacts associated with traffic congestion scored in the table above remained. The overall impact of the bypass roads in Nairobi is low at 7.5%, that is, bypass roads are less effective in reducing traffic congestion in the city's CBD and mitigation of its effects, fuel and delay

costs. This result is inconsistent with the program's expectations which was to facilitate traffic diversion and alleviate traffic pressure from the city's CBD.

Similar to these results, a study by Margaret and Glen (2000) on economic impacts of freeway bypass routes in four cities in USA (Danville, Richmond, Fort Wayne and Appleton) observed that bypasses do not necessarily result in a reduction in total traffic volume in the downtown area. Often, the removal of most truck movements and other pass-through highway traffic encourages more local traffic, which had previously avoided the downtown area due to heavy traffic. They conclude that the result is often little or no change in total traffic levels, which is often associated with improved travel opportunities for local residents and access for downtown businesses.

4.7.3 Phasing-out of 14-Seater PSVs to Curb Congestion

The Government through the Ministry of Transport intends to phase out 14-seater PSVs commonly known as *matatus* when the new urban transport system is introduced such that by January, 2012 no new PSV licenses shall be issued to these vehicles. The privately owned 14-seaters are considered to be a major contributor to the city's traffic congestion as they invade the capital city on all major roads and arteries from suburbs and rural areas. The city routes are considered the most lucrative because they are short, most of the roads are good and the morning and evening rush hours guarantee good returns. The current route operators would be encouraged to form societies through which they can buy and run mini-buses, which carry upward of 25 passengers.

The evolution of the matatu, from a quick and easy response to unmet travel demand, to the dominant mode of transport in Kenya began in the late 1950s. The industry has played a central role in mobility, politics and economics, solidifying its role and importance in Kenya's cultural fabric. As Nairobi became independent upon matatus to transport people to and from various destinations located in the metropolitan area, their numbers increased from 400 in 1973 (Lee-Smith) to an estimated 15,000 matatus in the Nairobi Metropolitan Area (Jennifer, 2009). The matatu industry could be described as organized chaos. However, by understanding its stakeholders and networks, it becomes easier to understand how the industry organizes itself. From this perspective, the industry begins to look less chaotic (Jennifer, 2009).

Plate 4.6: 4-Seater Matatus Parked at Railway Station Bus Park
(Source: Author, 2011)

The policy was later suspended but had raised a lot of mixed reactions from the industry's stakeholders. Both the Matatu Owners Association (MOA) and the Matatu Welfare Association (MWA) welcomed the decision as being in the right direction but needed the right kind of support from the Government. The Chairman of MWA was more cautious in his support of the move saying that the programme is good but there has to be time to transform. He added that the move will need to be complemented by "soft credit facilities" (low interest loans) driven by the Government to enable both the societies and individuals to access cheap loans to purchase the bigger vehicles.

Matatu crew while voicing their concerns on the programme to the Kenyan media (Transport World Journal, 2010 Volume 1 No. 02) said they would suffer the most as they would lose jobs once the small matatus were eventually removed from the CBD. They added that they would eventually lose their jobs since the busses would need less manpower and carry more passengers than the *matatus*.

Though the introduction of a Bus Rapid Transit (BRT) would get the support of the city's majority residents as the *matatu* industry could be described as organized chaos (Jennifer Graeff, 2009), the effectiveness of phasing out the *matatus* to decongest the city is discussed here below as follows:

- I was not able to access the policy document that recommended the phasing out of *matatus* to decongest the CBD to understand the theoretical justification of the arguments. However, that not withstanding, these sentiments cannot be ignored because traffic congestion as discussed above

was defined as a perception phenomenon as well. Such that, if the people of Nairobi want the *matatus* phased out from the CBD to decongest the city, then that shall have to be implemented.

- However, in the course of the study, there was no evidence that the people of Nairobi demanded phasing out of *matatus* from the CBD. The series of meetings between the city's authorities and *matatu* industry players discussed above was evidence that these perceptions were not reflective of the city's people.

- Technically, *Matatus* make only 3% of the total number of vehicles entering the CBD everyday (Irungu 2007) which is inaccurate to blame them for the daily recurrent congestion witnessed in the city's roads. The surface area to be occupied by the BRT vehicles on the roads after removal of *matatus* shall virtually remain the same (assuming constant number of commuters and absence of change in preferences by personal motorists) which will have insignificant effect on reducing traffic congestion in the city;

- The BRT vehicles may create heavy traffic within the CBD's centre if they are allowed to reach such points because the city's roads are mostly narrow where the BRT vehicles may cause obstructions for sticking to the road unlike the smaller *matatus* which are able to maneuver through pavements or footpaths to keep moving thereby causing more traffic jams and delays.

- The behavior of *matatus* to maneuver through path-ways and footpath has made them popular with passengers, especially the youth and those that are in a hurry. It was observed that a category of *matatus* were called *"wire",* those that shall not stop or delay in anyway even at peak time. They would find a way to move however unethical. They charged an average of Ksh 50 more than the others within the city's residential areas. Surprisingly, regardless of such behavior by *matatus,* it was difficult to find an accident caused by *matatus.* My opinion out of my observation was that *matatu* drivers are very effective and efficient users of road space. It is the law which did not want such behavior but not because they abused road spaces.

- Due to lack of adequate justification on the policy to phase out *matatus* out of the CBD, I got a perception that the reasons could potentially be business rivalries between the *matatu* players and bus players. *Matatus* seemed to earn more than the busses in the public transport business in the city.

- Lastly, *Matatus* are the informal paratransit industry in Kenya that provide service to millions of people a day and are essentially the backbone of the transportation system in Nairobi and therefore phasing them out abruptly may cripple the whole public transportation system in Nairobi and thereby creating a bigger problem than traffic congestion;

4.7.4 Impacts of the Syokimau Commuter Rail Service

According to a report by Kenya Railways Corporation (2012), the Syokimau commuter rail service was the first phase implementation under the Nairobi

Commuter Railway (NCR) Project. The commuter train was commissioned in November, 2012 by the President. The station came with modern amenities, ample and secure parking (2,500 slots), Wi-Fi, restaurants and a scheduled train service designed to ensure that passengers get to their destination in time. It was estimated that it would take 30 minutes to get to the city from Syokimau using the commuter train as opposed to spending 90 minutes commuting using Mombasa Road.

Train fare were based on peak and off peak times plus special charges for NCR card holders. Seasonal tickets would be available as well. They would have specified validity period and users would enjoy discounts. Combo tickets were equally available for commuters who would take up parking, train journey and other services, all in one ticket. A summary of chargeable fares is as indicated in Table 4.12:

Table 4.12: Fares for Syokimau-Nairobi Commuter Train

Type of Fare	**Tariff Peak (Ksh)**	**Tariff Off Peak (Ksh)**	**Average (Ksh)**
Normal Fare	340	310	325
Combo – Park and Ride	300	-	300
NCR Prepaid Card	200	-	200
Grand Average (Ksh)			**275**

(Source: Author, 2012)

Based on the above data and other information discussed above, the study estimated the potential savings to city's motorist from such a facility as follows:

- Motorists using the Syokimau commuter train would not suffer traffic jams as they would no longer use the roads.

- They would not therefore incur the costs they previously suffered in terms of delays and excess fuel.

- We observed above that one motorist losses Ksh 309,662.73 annually in terms of delays and excess fuel due to traffic congestion.

- A motorist using the Syokimau train paying combo fare to be able to park at the station would require Ksh 75,600 annually (Ksh 300 x 225 working days).

- The net outcome to a single motorist for using the commuter rail is a saving of Ksh 309,662.73 – Ksh 75,600 = Ksh 234,062.73.

- The net social benefit if the estimated motorists in the city were able to use such a facility would be Ksh 117.03 billion annually for estimated number of motorists in the city.

Figures from other places were not available for comparison purposes, however, a report by Pennsylvania Department of Transport cites commuter rail as not only

benefiting the people who use it but the community as a whole. That cities with rail systems tend to have significantly higher public transit ridership, lower vehicle ownership, less traffic congestion, lower traffic death rates, and on average, people spend less on transportation overall.

4.8 Testing Study's Hypotheses

This section provides the results of the tests on the study's hypotheses using the formual provided in Section 3.11. One, it was expected that the performance of congestion management strategies in the city was at 40%. That is:

$$H_o: \mu = 40\%$$

$$H_a: \mu \neq 40\%$$

The null hypothesis was rejected with a critical t-statistic of 1.645 against the calculated t-statistic of 52.4 at 0.05 level of significance. The study did not therefore fail in trying to investigate effectiveness of intervention measures to deal with traffic congestion in the city. Many researchers and reviewers see accepting the null hypothesis as a failure of the experiment.

Second, it was expected that 80% of the motorists in Nairobi agree that traffic congestion is a problem affecting their quality of life. That is:

$$H_o: \mu = 80\%$$

$$H_a: \mu \neq 80\%$$

The null hypothesis was rejected with a critical t-statistic of 1.645 against the calculated t-statistic of 540.54 at 0.05 level of significance.

Third, the study hypothesized that the annual total cost of excess fuel and time delay from traffic congestion shall be about Ksh 100 billion. That is:

$$H_o: \mu = 100$$

$$H_a: \mu \neq 100$$

The null hypothesis was rejected with a critical t-statistic of 1.645 against the calculated t-statistic of 29.97 at 0.05 level of significance. Once again this result confirms the success of the experiment.

The fourth hypothesis expected that motorists in the city would be WTP Ksh 2,000 per month for the proposed traffic decongestion program by the Ministry of Nairobi Metropolitan Development, that is:

$$H_o: \mu = 2{,}000$$

$$H_a: \mu \neq 2{,}000$$

At 0.05 level of significance, the alternative hypothesis was accepted with a calculated t-statistic of 2.579 against a critical t-statistic of 1.645.

The last hypothesis tested was that the bypass roads program in the city and policy of phasing out 14-seater mini buses from the city's CBD would reduce traffic congestion by about 5%. That is:

$$H_o: \mu = 5$$

$$H_a: \mu \neq 5$$

The null hypothesis was rejected with a calculated t-statistic of 10 against a critical t-statistic of 2.353.

The sample statistics were sufficiently different from our assumed values of the population that it was unlikely to explain them by chance. Rejecting the null hypothesis is a strong decision which leads to acceptance of the alternative hypothesis and signifies the success of the experiment.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study conducted an economic analysis of traffic congestion in Nairobi and assessed the effectiveness of decongestion measures that the city has implemented. The problem's costs associated with travel delay and excess fuel consumption by motorists were estimated, CVM was used to measure money-benefits of reducing the problem and motorists' perceptions on the problem generally in the city were also elicited to facilitate determination of effective decongestion strategies.

Conceptual frameworks relied on strategic principles about congestion management, OECD/ECMT (2007); theories on stakeholder participation, Glicken, et.al (2000); theories on CVM; and, theories and principles on policy evaluation. Data was collected through interviewing key informants, administration of questionnaires, researcher's own observations and secondary sources. Data analysis was conducted both qualitatively and quantitatively using counterfactual analysis, mathematical computations and regression analysis. Research questions were developed to facilitate implementation of the study objectives and hypotheses were tested to examine success of the study's results.

The genesis of traffic congestion in Nairobi was observed to be historical due to poor land use planning that did not provide for congestion management strategies way back in the 1900s when Nairobi was established as the country's capital city intended to provide all citizens' services and jobs. As a result, the main link roads to

the CBD, that is, Mombasa Road, Thika Road, Uhuru Highway, Langata Road, Waiyaki Way are always chocked as everyone tries to reach the CBD for services and to work. Further, with the exception of the recently reconstructed Thika Road, there has been little infrastructural development particularly on the main link roads leading to the CBD to accommodate the growing numbers of personal cars and instead they have remained the narrow two-vehicles roads that were constructed in the 1960s and 1970s. Though transport authorities are also currently undertaking infrastructural modification projects around the city to ease traffic jams, the main roads leading to the CBD are still marked with many round-abouts and junctions which have turned out to be a major cause of delays and congestion.

The city's information and communication networks are not holistic as regular broadcasts on traffic information to motorists and general public particularly on road situations to help them behave appropriately are inadequate and mechanisms to deal with non-recurrent congestion incidences such as accidents, road-works, etc are equally very slow and sometimes unaffordable. The city's parking policy is misguided where authorities see it more as an avenue for raising revenue other than a mechanism to control the flow and demand for traffic within the CBD.

The absence of a single agency mandated with the sole responsibility of managing traffic congestion has been a hindrance as it has led to confusion and ineffectiveness in decision making to mitigate the problem. Other decongestion policies and techniques aimed at mitigating the problem have been generally shallow and inadequate, for instance, Nairobi has never adopted any form of congestion pricing schemes to control demand for traffic into the CBD.

The city's motorists raised various issues regarding traffic congestion in the city. Traffic congestion affected their quality of life where motorists cited wastage in productive man hours; general stress and frustrations; increased fuel costs; increased maintenance costs of the car; pollution of the environment, amongst others as the problems they suffer from traffic congestion. The solution to decongesting the city must closely involve the city's personal motorists as 65% admitted that they are the cause of the problem. However, many of them (53%) did not see the personal car as a status symbol but preferred it majorly due to its convenience and flexibility – this indicates an opportunity towards the efforts aimed at mitigating the problem.

They cited public transport system in the city as inefficient and inadequate characterized by scarcity of vehicles, crowding, not reaching the desired destinations, arbitrary fare increases, chaos and menace, uncomfortable vehicles, unpredictable traveling schedules and lack of adequate alternatives (rail, air, etc.) as its problems. However, as an opportunity for decongestion, 62% of the city's motorists said they were willing to leave their cars at home if public transport was improved to their taste.

Traffic congestion was observed as a wasteful phenomenon where on average each motorist in the city wastes 49 minutes (one-way) everyday due to traffic jam costing them Ksh 146.5 billion annually of worth of useful time. Motorists also consume an extra 154 liters annually of fuel as a result of traffic congestion costing them Ksh 16.7 billion each year of wasted fuel.

CVM results hinted support by the city's motorists towards decongestion efforts as they are WTP a monthly average of Ksh 1387 for the expected benefits of the proposed traffic decongestion program by the Ministry of Nairobi Metropolitan Development totaling to Ksh 8.3 billion annually. Regression results posted a small R^2 of 0.18, expected in cross-sectional data. All the explanatory variables exhibited the a priori expected signs in the regression results. Monthly net income, price of cars, operational costs of running the car and perceptions about role and responsibility in funding infrastructural projects were statistically significant in determining the motorists' WTP bids while the others were not at 5% level. Further tests for multicollinearity showed that this was not a problem but the error terms were found to be heteroscedastic.

Assessment of decongestion measures revealed that rebuilding of the city's roads network will ease congestion and save costs incurred due to congestion – the expansion of Thika Road into a super highway has saved the city's motorists Ksh 80 billion annually in terms of wasted travel time and excess fuel consumption. Bypass roads shall not have much impact on reducing traffic congestion in the city – it was observed that though some of the bypass roads have not been completed, the impact of the completed few is minimal at 7.5%. The policy to phase out 14seater public service vehicles is technically weak with the potential of crippling public transport in the city if haphazardly implemented. Commissioning of the Syokimau commuter rail service has the potential of saving city's motorists Ksh 117.03 billion annually in terms of time and excess fuel which would otherwise be wasted due to traffic congestion.

All the research questions were answered and rejection of all the study's null hypotheses shown above indicated success of the experiment. However, research on the problem has been complicated by lack of consensus on a common definition of the problem and a uniform technique to estimate the costs associated with it; including lack of adequate data on the subject.

5.2 Conclusion

Nairobi's roads like any other public good suffer from the problem of "tragedy of the commons", the situation where a common property resource is used by everyone until it is of no use to everyone, Hardin (1974). Personal motorists are the main cause of traffic jams as they must drive through the city's roads into the CBD to work or get services.

The causes of traffic congestion vary between areas and there is no single miracle solution to it because traffic congestion is both a physical phenomenon about road characteristics and a relative event based on road users' perceptions. However, there is strong correlation between traffic congestion and a city's economic growth; land use planning; mechanisms of identifying decongestion measures; adequacy of public transport system and road networks; institutional arrangements related to managing traffic congestion; and, research on the subject. Generally, implementation of congestion management strategies in the city has been inadequate at 27.5% and the attitudes of motorists towards the personal cars and public transport are slightly exaggerated.

Lack of consensus in defining traffic congestion and agreement on its impacts including techniques to measure costs and benefits associated with it has complicated efforts towards identifying effective mitigating strategies – without estimating these values, though it will be difficult to formulate and implement effective policies on the problem.

This study despite the theoretical and methodological challenges surrounding the subject of traffic congestion devised a working definition of traffic congestion for Nairobi and developed methodology to estimate the costs and benefits associated with it. These frameworks shall be a basis for studies on the subject in the city in future. In other words, the study's findings have added to the body of knowledge on the subject in Nairobi.

Lastly, due to historical poor planning of Nairobi during its establishment as the capital city which failed to provide for congestion management strategies, decongestion programs in the city are now limited to very expensive infrastructural modifications of the existing road networks as there is no land to construct new roads or relocate some of the services outside the CDB given that all its surrounding has been built into mainly residential areas. In this time of devolved system of government, all counties need to learn from the experiences of Nairobi in the matters of traffic congestion to prevent similar occurrences in their potential urban centers and cities.

Plate 5.1: An Example of Expensive Road Infrastructure in Nairobi
(Source: Author, 2012)

5.3 Recommendations and Policy Implications

The study proposes the following recommendations and policy suggestions to effectively address the escalating problem of traffic congestion in Nairobi:

a) The information generated from this study should inform and complement other proposals that intend to find a sustainable solution to the increasing and wasteful problem of traffic congestion in the city's roads and prevent other parts of the country from experiencing this kind of problem in this time of the devolved system of government where there is potential of many places becoming into urban centres or cities. However, the objective should not be

to eliminate traffic congestion in totality from the city but how to avoid excessive congestion and manage it to acceptable levels. One way of determining excessive congestion is when people say it is.

b) Traffic congestion in Nairobi should now be designated as a matter of national priority to enhance attention on it in terms of budgetary allocation as it is a wasteful phenomenon and affects the quality of life of the city's residents. In this regard, there is need to assign a government agency with the sole responsibility of managing and coordinating other agencies on the problem.

c) Appropriate financing strategies that will not generate controversies with the public for the expensive infrastructural and traffic control decongestion programs should be identified. This will require addressing the perceptions of the city's motorists regarding their desire to use personal cars and inadequacy concerns about the existing public transport system. Specifically, through acceptable payment vehicles, authorities in the city should find ways of exploring the potential exhibited by the city motorists' WTP to raise funds for these expensive decongestion projects.

d) The road infrastructure within the city must be refurbished and rebuild to modern standards to accommodate the increasing number of vehicles with particular urgent attention to removal or reduction of the number of round-abouts on the main link roads into the CBD. The remaining bypass roads should be completed to release traffic within the CBD.

e) The city should introduce a BRT system that takes into account perceptions of the city's residents to enhance efficiency of the public transport system. However, the phasing-out of the current 14-seater PSVs should be done gradually and in consultation with all relevant stakeholders to avoid crippling public transport in the city.

f) Parking policy and management in the city should be redesigned to be a tool for controlling traffic demand in the CBD and not seen only as a source of finance.

g) The city should urgently introduce appropriate congestion pricing schemes in liaison with stakeholders particularly the motorists to control flow of vehicles into the CBD.

h) There is need to enhance traffic broadcasts to disseminate information regularly to road users to influence appropriate behavior on their travel demands. Mechanisms to deal with non-recurrent congestion incidences such accidents, road works, etc should be enhanced. For example, authorities should invest in towing services other than leaving this solely to private individuals alone to reduce costs. Traffic Police should also be seen to facilitate than hinder traffic flow.

i) Based on the regression results, authorities in the city will have to devise measures to address issues related with motorists' levels of income; prices of

cars; operating costs of cars in terms fuel, maintenance and parking charges; and, the effectiveness of government in undertaking its roles and responsibilities to the expectation of the people. These concerns were statistically significant determinants of the motorists' willingness to pay for the proposed traffic decongestion program.

j) The emphasis is that the city's authorities and the motorists should consider using an integrated approach to managing this problem. It should be realized that the success of the proposed decongestion program very much depend on how much input the motorists will be willing to put, in terms of their willingness to pay for it by choice or through congestion taxes or charges, including their willingness to cooperate for it to succeed. Undertaking such projects without the support of the motorists to a large extent will be constrained.

k) There is need for statutory recognition of CVM as an expert technique and that its results should necessarily inform policy makers. Though the CVM survey is applied in hypothetical markets and faces various challenges in its empirical application, the fact that it engages stakeholders in its survey who offer objective responses and its strong theoretical (economic) foundations, these reasons make its results politically feasible and theoretically sound. It is also consistent with various democratic techniques.

l) Lastly, it is the desire of the researcher with the support of the University to disseminate these results to the survey respondents in acknowledgement of

their willingness to participate in the survey and in supporting the researcher to accomplish his academic endeavors. This study's results are their product as well.

5.4 Recommended areas for Further Research

The following can be areas for further research in Nairobi and Kenya generally on the subject of traffic congestion:

- This study should be cascaded to all major cities in the country to compute national results on the costs of traffic congestion and the expected benefits of reducing it.

- Research in estimation techniques that shall be able to compute acceptable results for social phenomenon such as traffic congestion.

REFERENCE

Abala (1987) "A Theoretical and Empirical Investigation of Willingness to pay for Recreational Services: A Case Study of Nairobi National Park" Eastern Africa Economic Review 3.No 2 Nairobi.

Alcala, A. (1998) "Effects of Marine Reserves on Coral Fish Abundances and Yields of Philippine Coral Reefs", Ambio, Vol 17, No. 3, 1988

Aligula et al (2005) "Urban Public Transport Patterns in Kenya: A Case Study of Nairobi City" KIPPRA Special Report No. 5.

Anderson, J. (1985) "Marine Resource use and the Establishment of Marine Park: Ngazi, Z., Mafia Island, Tanzania" Ambio, Vol.24 No.7-8, 1985.

Arrive Alive South Africa (2010) "Bus Rapid Transit System (BRT) and Road Safety" Report.

Autralian Government, Department of Transport and Regional Services (2007) "Estimating Urban Traffic and Congestion Cost Trends for Autralian Cities- Working Paper No. 71", Bureau of Transport and Regional Economics, Canberra, Australia.

Baltagi, Badi H. (2001) Econometric Analysis of Panel Data. Wiley, John & Sons. Fox, John. 1997. Applied Regression Analysis, Linear Models, and Related Methods. Newbury Park, CA: Sage.

Bateman I. J. (1993) The impacts of changing WTP question format in Contingent Valuation Studies (1993), GEC working paper 93-95. CSERGE London.

Bateman I. J. and Turner K.R. (1993) Valuation of the Environment, Methods and Techniques: The CVM in : Sustainable Environmental Economics and Management. London P.120-191.

Barnes J. (1992) Wildlife Tourism. In Economics for the wilds. London: Earthsean.

Breusch, T. and Pagan, A. (1979) "A Simple Test for Heteroscedasticity and Random Coefficient Variation," *Econometrica*, 47, 1287-1294.

Button, Kenneth J. (1993) *Transport Economics 2nd Edition,* Edward Elgar Publishing Ltd. England, pp. 153.

Clawson, M.(1959) Methods of Measuring the demand for and value of outdoor Recreation RFF: Reprint 10, Washington DC: Resources for Future pp.1-36.

Chatterjee, N. (1992) "Economic Aspects of Forestry Development". Kenya Forestry Masters Plan, Consultancy Report, Part 4 Report, Nairobi.

Cummings, H. (1986) Valuing Environmental Goods: A State of the Arts Assessment of the Contingent Method (Totowa; N.J., Rowman and Allanheld).

Dasmann, Raymond F. (1984b) The Relationship between Protected Areas and Indigenous Peoples In: National Parks conservation and Development. Smithsonian Institute Press.

Debreu, G. (1959) Theory of Value. New York: Wiley.

Delcan Consultants et al (2006) The Cost of Urban Congestion in Canada, Transport Canada Environmental Affairs, Canada.

Dixon et al (1995). Economic Analysis of Environmental Impacts, Earthscan Publications Ltd, 120 Penton Ville Road, London.

Dyson John (1989), From Poachers to Protectors.

Government of Kenya, Economic Survey, 2011.

Finance and Development (1993) Making Development Sustainable

Faucheux, S. & Noel, J. F. (1995), *Economie des resources naturelles et de l'environment.* Armand Colin, Paris.

Freund, Rudolf J. and Ramon C. Little. (2000) SAS System for Regression, 3rd ed. Cary, NC: SAS Institute.

Glicken, J. (2000) Getting Stakeholder Participation Right, a Decision of the Participatory Processes and Possible Pitfalls, Environmental Science and Policy.

Greene, W. H. (1993) *Econometric Analysis, Second Edition*, New York: Macmillan Publishing Company.

Greene, W. H. (1993) *Econometric Analysis, Fourth Edition*, New York: Prentice Hall.

Hanemann W, M. (1991) "Willingness to pay and willingness to accept: How much Can they differ?" American Economic Review pp.635-47.

Irungu, Z. K. (2007) Decongesting Nairobi – Urban Transportation Challenges. Ministry of Roads and Public Works, Roads Department, Nairobi, Kenya.

IUCN (1985) United Nations list of National Parks and Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK.

Jennifer, G. (2009) The Organization and Future of the Matatu Industry in Nairobi, Kenya, Columbia University, New York, USA.

Kenya Institute for Public Policy Research and Analysis (KIPPRA), "Nairobi Metro 2030 – Vision for a World Class Metropolis – The First and Foremost in Africa and the World," KIPPRA, Nairobi, Kenya.

Kenya Urban Roads Authority (2009) "Brief on Vision 2030 Flagship and Other Development Projects" Nairobi.

Kenya Urban Roads Authority (2011) "Nairobi Eastern & Northern Bypass Road Project" Progress Report No. 30, Nairobi.

Knetsch, J.L.and Davis, R.K. (1966). Comparisons of Methods of Recreation. Evaluation in Allen V. Knees and Stephen C. Smith (eds.) Water Research, Baltimore: The Johns Hopkins Press for Resources for the future pp. 125-42.

Kothari, C.R. (1985) Research Methodology: Methods and Techniques Wishwa Prakashan, New Delhi.

Kreg, L., Rebecca, L. J. and Robert, P. B. (1997) "Contingent Valuation of Rural Tourism Development with Tests of Scope and Mode Stability," *Journal of Agriculture and Resource Economics* 22(1): 44-60.

Lescuyer, G. (1998) Globalization of Environmental Monetary Valuation and Sustainable Development. An Experience in the Tropical Forest of Cameroon. *International Journal of Sustainable Development*, 1(1), 115-33.

Lindsey, Robin (May 2006) "Do Economists Reach a Conclusion on Road Pricing? The Intellectual History of an Idea" (PDF). Economic Journal Watch 3 (2): 292-379.

Madibana, K. (2009) Standay Standard. The Road Traffic (Amendment) Act, Botswana, 2008.

Margaret et al (2000) Economic Impact of Freeway Bypass Routes in Medium Size Cities, USA.

McClanahan, T.R (1997) The effects of traditional fisheries management on fisheries yields and the coral-reef ecosystem of Southern Kenya.

McClanahan, T.R, (1997) Effects of fishing and reef structure on East African Coral Reefs.

McClanahan, T.R et al (1994) Status of Kenyan Coral Reefs, the Wildlife Conservation Society, Mombasa, Kenya.

Mc Clanahan, T.R. et al (1997) The effect use on the hard coral communities of the Kisite Marine Park, Kenya, the wildlife Conservation Society, Mombasa, Kenya.

McGuirk, A. M., K. Stephenson, and D. B. Taylor (19890) The Use of Tobit Analysis in the Valuation of Nonmarket Resources, Department of Agriculture Economics. Virginia Polytechnic Institute and State University, Blacksburg, V. A.

Mitchell, R.C. and Carson, R.T, (1989) Using Surveys to Value Public Goods: The Contingent Valuation Method, The Johns Hopkins Press Washington DC.

Morteza, R. (2005) "Contingent Valuation Method," California State University. Fullerton, USA.

Munasinghe, Hohan (1993). "Environmental Economics and Sustainable Development". World Bank Environmental Paper, No.3. World Bank, Washington DC.

Nation Newspaper, Sunday, August 15, 2012.

Nyangena, W (1997) "Contingent Valuation in Environmental Policy; A case Study of Lake Bogoria National Reserve, University of Nairobi, Nairobi".

O'Brien, Robert M. (2007) "A Caution Regarding Rules of Thumb for Variance Inflation Factors", Quality and Quantity. 41 (5) 673-690.

OECD, (2002) Handbook of Biodiversity Valuation: A Guide for Policy Makers. Organization for Economic Co-operation and Development, Paris.

OECD, (2004) Summary Document: Managing Urban Traffic Congestion. Organization for Economic Co-operation and Development, Transport Research Centre, Paris.

Omondi, P. ((1994) Wildlife-human conflict in Kenya: Intergrating wildlife conservation_with human needs in the Masai Mara region._Phd. Thesis, Megill University Montreal, Canada.

Peter Kennedy. "A Guide to Econometrics". Sixth Edition. (c) (2008) Page 139.

Pearce, D., Pearce, C. and Palmer, C. (2004) *Valuing the Environment in Developing Countries. Case Studies*. Edward Elgar, Cheltenham.

Rachel Thompson, Stakeholder Analysis. Mind Tools.

Randall, A. (1986) The Possibility of Satisfactory Benefit Estimation with Contingent Markets. *In Valuing Environmental Goods: As Assessment of the Contingent Valuation Method.* Rowman and Allanheld, NJ.

"Road Pricing: Congestion Pricing, Value Pricing, Toll Roads and HOT Lanes". TDM Encyclopedia. Victoria Transport Policy Institute. 2007-09-04.

SAS Institute Inc. (1993) SAS/*ETS User's Guide, Version 6, Second Edition*, Cary, NC: SAS Institute Inc.

SAS Institute Inc. (2004) SAS/*ETS User's Guide.* Cary, NC: SAS Institute Inc.

Scura et al (1993) 'Economic Valuation of Surface Water Quality Improvements in the Metropolitan Region of Rio de Janeiro Using Objection and Subjective Valuation Approaches'. Consultancy report submitted to the World Bank Environment Department. Washington, DC.

Scura et al (1993) The Ecology and Economics of Bonaire Marine Park. Environment Department Divisional Paper No.1933-44. Washington D.C: The World Bank.

Sheldon, G. Strickland and Wayne Ber (Winter 1995) "Congestion Control and Demand Management". Public Roads Magazine (U.S. Federal Highway Administration) 58 (3).

Small, Kenneth A., Verhoef, Erik T. (2007) The Economics of Urban Transportation, Routledge, New York, pp. 120.

Smith, Petricia L. (1979) "Splines as a Useful and Convenient Statistical Tool." American Statistician 33(2) (May): 57-62.

STATA Press. (2003) STATA Base Reference Manual, Release 8. College Station, TX: STATA Press.

STATA Press. (2003) STATA Cross-Sectional Time-Series Reference Manual, Release 8. College Station, TX: STATA Press.

Steve, K. (2001) Debunking Economics, New York, Zed Books.

The Kenya Alliance of Resident Association (2012) "The Social/Community Component of the Analysis of the Thika Highway Improvement Project" Abridged Version, Nairobi.

Transport World Journal (2010) "14-Seater Matatus to be banned in Nairobi", Vol. No. 01.

Turner, R. K. (1995) Sustainable Environmental Economics and Management: Principles and Practice, Johnwiley and Sons Ltd, Baffins Lane, Chichester.

UNEP (1998) Eastern Africa Atlas of Coastal Resources, BADC, Nairobi.

UNEP (1988) People, Parks and Wildlife: guidelines for Public Participation in wildlife conservation: Case studies in Kenya. Nairobi, Kenya.

Van den Poel Dirk, Lariviere Bart (2004) Attrition Analysis for Financial Services Using Proportional Hazard Models, European Journal of Operational Research, 157 (1), 196-217.

WCED (1987), Our common Future.

White, H. (1980), "A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity, " Econometrica, 48, 817-838.

Whittington, D. et al (1990) "Estimating Willingness to pay for Services in Developing Countries. A case Study of the use of Contingent Valuation Surveys in Southern Haiti". Economic Development and Cultural Change Vol.38 No.2.

Whittington Dale et. Al (1992) Giving Respondents Time to Think in Contingent Valuation Studies: A Developing Country Application, Journal of Environmental Economics and Management pp.205-225.

APPENDIX I: SURVEY QUESTIONNAIRE

Hello, I am a doctorate student in Environmental Economics at Moi University undertaking research work for my thesis writing. This study is a survey that uses the Contingent Valuation Method (CVM) to elicit your perceptions on the escalating problem of traffic congestion in Nairobi. Specifically, the survey intends to elicit your perceptions on the proposed traffic decongestion program in the city by the Ministry of Nairobi Metropolitan Development. Through her recently launched Nairobi Metro 2030 Strategy, the Ministry intends to put in place an elaborate road infrastructure; modern commuter train system; introduction of mass rapid transport (sleek buses); and, manage traffic so that schedules of public transport vehicles are predictable. All this is generally aimed at improving the Public Transport System in the city so that you feel encouraged to leave your car at home and consequently relieve you from the stresses of traffic congestion.

The key question in this CVM study therefore will be to find out from you the amount of money you would be Willing-to-Pay (WTP) every month towards this traffic decongestion program. This is a hypothetical scenario and we shall not therefore, collect the payment you suggest but by participating in this survey: - One, your views will assist the Ministry of Nairobi Metropolitan Development to adequately plan for that traffic decongestion program; and, two, you qualify as a member of an Anti-Traffic Congestion Lobby in Nairobi that would possibly push for the implementation of the study results once they get the necessary approvals. If we are to go ahead and collect your proposed payment, the money would be managed as a private fund where you will be actively involved in the budgeting

processes. We therefore, expect your objective answer to this WTP question, the last in the questionnaire.

You have been selected randomly and your willingness to spare a few minutes to fill in this questionnaire will be highly appreciated. The information you provide will be used purely for this academic purpose and shall be accorded the utmost confidentiality necessary. **Thanking You in Advance.**

1. Name……

2. Sex

( ) Male

( ) Female

3.

Email/Telephone/Box……...

4. Please indicate your level of education.

Do Not Have Formal Education	**Primary Education**	**O – Level**	**A – Level**	**University**

5. Please indicate the range of your monthly net-income (Kshs).

Below 40,000/=	**40,001/= to 80,000/=**	**80,001/= to 120,000/=**	**120,001/= to 160,000/=**	**Above 160,000/=**

6. Cost of your Car (Approximate) Kshs)……

7. Do you drive into the Central Business District every day?

( ) Yes

( ) No

8. Is traffic congestion a problem to you?

( ) Yes

( ) No

9. Which road do you often use when driving into the CBD?

( ) Thika Road

( ) Mombasa Road

( ) Jogoo Road

( ) Langata Road

( ) Ngong Road

( ) State House Road

( ) Uhuru Highway

( ) Others

10. How is traffic congestion a problem to you? (Tick as many reasons as are applicable to you)

( ) Wastes productive man hours

( ) Generally stressful and frustrating

( ) Raises fuel costs of running cars

( ) Raises maintenance costs of car

( ) Pollutes the atmosphere

( ) Others

11. Do you agree that you are also a cause to traffic congestion?

( ) Yes

( ) No

12. How many liters of fuel do you use daily?……..

13. Are you offered parking by company/organization?

( ) Yes

( ) No

14. If No, how much do you pay everyday for parking (Kshs)?.....

15. Estimate your monthly car maintenance costs (Kshs)…….

16. Do you agree that cars are a demonstration of one's social status?

( ) Yes

( ) No

17. What else makes you use your personal car (Tick as many reasons as are applicable to you)

( ) Inadequate Public Transport

( ) Convenience

( ) Flexibility

( ) Privacy

( ) Security

( ) Cars are generally cheap to buy

( ) It is generally cheap to run a car in Nairobi

18. Are you willing to forgo all these benefits of using your personal car if Public Transport System was improved in the city?

( ) Yes

( ) No

19. How is the Public Transport System inadequate in the city? (Tick as many reasons as are applicable to you)

( ) Vehicles are scarce

( ) Crowding

( ) Vehicles don't reach desired destinations

( ) Arbitrary fare increases

( ) Chaotic & Menace

( ) Uncomfortable Vehicles

( ) Unpredictable traveling time schedules

( ) Lack of adequate alternatives e.g. road, rail or air

20. How much money are you Willing-to-Pay **every month** towards the traffic decongestion program proposed by the Ministry of Nairobi Metropolitan Developme nt (Kshs)?.....

APPENDIX II: SURVEY RESULTS

	sex	educat	netincom	carcost	drive	traffic	thikard
1	1	16	100000	1000000	yes	yes	no
2	1	16	100000	600000	yes	yes	no
3	0	16	60000	500000	yes	yes	yes
4	0	12	60000	600000	yes	yes	no
5	1	16	100000	350000	yes	yes	no
6	0	16	60000	650000	yes	yes	no
7	1	12	60000	500000	yes	yes	no
8	1	16	100000	1200000	yes	yes	no
9	1	16	60000	500000	yes	no	no
10	1	16	60000	1400000	yes	yes	no
11	1	16	100000	1000000	yes	yes	no
12	1	12	60000	500000	no	yes	no
13	1	12	60000	550000	no	yes	no
14	1	14	40000	250000	no	yes	no
15	0	12	40000	600000	yes	yes	no
16	1	16	60000	400000	yes	yes	no
17	1	16	100000	850000	yes	no	no
18	1	16	100000	800000	yes	yes	no
19	1	12	60000	1500000	yes	yes	no
20	1	16	60000	850000	yes	yes	no
21	1	12	40000	150000	no	yes	no
22	1	16	60000	450000	yes	yes	no
23	1	16	100000	1000000	no	yes	no
24	1	16	60000	450000	yes	yes	no
25	1	16	60000	800000	yes	yes	no
26	0	16	60000	400000	no	yes	no
27	1	16	100000	600000	yes	yes	yes
28	1	16	100000	750000	yes	yes	no
29	1	12	100000	1000000	yes	yes	no
30	1	16	140000	1850000	yes	yes	no
31	1	12	60000	250000	no	yes	no
32	1	16	100000	800000	yes	yes	no
33	1	14	100000	650000	yes	yes	yes
34	1	16	140000	1200000	yes	yes	no
35	1	16	100000	300000	yes	yes	no
36	1	16	60000	700000	no	yes	no
37	1	16	60000	500000	yes	yes	no
38	1	16	60000	400000	yes	yes	no
39	1	16	40000	400000	no	yes	no

	mmbsrd	jogoo	langata	ngong	statehs	uhuru	otherrds
1	no	yes	yes	no	no	no	no
2	no	no	yes	no	no	yes	no
3	yes	yes	yes	yes	yes	yes	no
4	no	no	no	no	no	yes	no
5	no	no	yes	no	no	no	no
6	no	yes	yes	no	no	no	no
7	no	no	yes	no	no	no	no
8	no	no	yes	no	no	no	no
9	no	yes	no	no	no	no	no
10	no	no	yes	no	no	no	no
11	no	no	yes	no	no	yes	no
12	no	no	yes	no	no	no	no
13	no	no	yes	no	no	no	no
14	no	no	yes	no	no	no	no
15	no	no	yes	no	no	no	no
16	no	no	yes	no	no	yes	no
17	no	no	yes	no	no	no	no
18	no	no	yes	no	no	yes	no
19	no	no	yes	no	no	no	no
20	no	no	yes	no	no	no	no
21	no	no	yes	no	no	no	no
22	no	no	yes	no	no	no	no
23	no	no	no	no	no	yes	no
24	no	no	yes	no	no	yes	no
25	no	no	yes	yes	no	no	no
26	no	no	no	yes	no	no	yes
27	no	no	no	no	no	no	no
28	no	no	yes	yes	yes	yes	no
29	no	no	yes	no	no	yes	no
30	no	no	yes	no	no	no	no
31	no	no	yes	no	no	no	no
32	no	no	yes	no	no	no	no
33	no	no	no	yes	no	no	no
34	no	no	yes	no	no	no	no
35	no	no	yes	no	no	no	no
36	no	no	yes	no	no	no	no
37	no	no	yes	no	no	no	no
38	no	no	yes	no	no	no	no
39	no	no	no	no	no	no	yes

	manhours	stress	fuelcost	maintene	polute	otherp	agree
1	yes	yes	yes	no	no	no	yes
2	yes	yes	yes	yes	yes	no	yes
3	yes	yes	yes	yes	yes	no	yes
4	yes	yes	yes	yes	yes	no	yes
5	yes	yes	yes	yes	yes	yes	yes
6	yes	no	yes	no	yes	no	yes
7	yes	yes	yes	no	yes	no	yes
8	yes	no	yes	yes	no	no	yes
9	yes	yes	yes	yes	yes	no	yes
10	no	yes	no	no	no	no	yes
11	yes	yes	yes	yes	yes	no	no
12	yes	yes	yes	yes	yes	yes	no
13	yes	yes	yes	yes	yes	yes	yes
14	yes	yes	yes	yes	yes	no	yes
15	yes	yes	no	no	yes	no	yes
16	yes	yes	yes	no	no	yes	no
17	yes	yes	yes	yes	yes	yes	yes
18	yes	yes	yes	yes	yes	no	yes
19	yes	no	yes	no	no	no	yes
20	yes	yes	yes	no	no	no	no
21	yes	yes	yes	yes	yes	no	no
22	yes	yes	yes	yes	yes	no	yes
23	no	no	yes	no	no	no	yes
24	yes	yes	yes	yes	yes	yes	yes
25	no	yes	yes	no	no	no	no
26	yes	no	no	no	no	no	yes
27	yes	yes	yes	no	yes	no	yes
28	yes	yes	yes	no	yes	no	no
29	yes	no	yes	no	no	no	yes
30	yes	yes	yes	yes	yes	yes	no
31	yes	yes	yes	no	no	no	no
32	yes	yes	yes	yes	yes	no	yes
33	yes	yes	yes	no	yes	no	yes
34	yes	yes	yes	yes	yes	yes	no
35	yes	yes	yes	yes	yes	no	no
36	yes	yes	yes	no	yes	no	no
37	yes	yes	yes	yes	no	no	yes
38	yes	no	no	no	no	no	yes
39	yes	yes	yes	yes	no	yes	yes

	litres	parking	socialst	publictr	convenie	flexibil	privacy
1	5	no	no	yes	yes	yes	no
2	5	no	no	no	yes	yes	yes
3	5	no	no	no	yes	yes	yes
4	6	yes	no	no	yes	yes	yes
5	4	no	yes	yes	yes	yes	yes
6	12	no	yes	yes	yes	yes	no
7	4	yes	yes	yes	yes	yes	yes
8	12	yes	yes	no	yes	yes	no
9	6	no	no	yes	yes	yes	yes
10	5	no	yes	no	yes	no	no
11	20	yes	no	no	yes	yes	yes
12	10	no	no	no	yes	yes	no
13	5	no	no	no	yes	yes	yes
14	10	no	no	no	yes	yes	no
15	5	no	yes	yes	no	no	yes
16	10	no	yes	yes	yes	yes	yes
17	7	no	yes	no	yes	yes	yes
18	7	no	yes	no	yes	no	no
19	4	no	no	no	yes	yes	no
20	10	yes	yes	no	yes	yes	yes
21	4	no	no	no	yes	no	no
22	20	no	no	yes	yes	yes	no
23	5	no	yes	yes	yes	yes	yes
24	8	no	no	no	yes	yes	no
25	10	yes	yes	no	yes	yes	yes
26	4	yes	yes	no	yes	yes	no
27	13	yes	yes	yes	yes	yes	yes
28	5	no	no	yes	yes	yes	no
29	5	no	no	no	yes	yes	yes
30	20	no	no	no	yes	yes	yes
31	10	yes	no	no	yes	yes	no
32	5	yes	yes	yes	yes	yes	yes
33	4	no	no	yes	yes	yes	no
34	10	no	no	yes	yes	yes	no
35	6	yes	yes	yes	yes	yes	no
36	5	yes	no	yes	yes	yes	yes
37	5	yes	no	no	yes	yes	no
38	5	yes	no	yes	yes	yes	yes
39	5	yes	no	yes	yes	yes	yes

	security	cheapcos	runcost	forgo	scarce	crowding	destinat
1	no	no	no	yes	yes	no	yes
2	yes	no	yes	yes	no	yes	yes
3	no	no	no	yes	no	no	yes
4	yes	yes	no	no	yes	yes	yes
5	yes	yes	no	no	yes	yes	yes
6	no	no	no	yes	no	yes	yes
7	yes	no	no	yes	no	yes	yes
8	no	no	no	no	no	no	no
9	no	no	no	yes	no	yes	yes
10	no	no	no	yes	no	yes	yes
11	yes	no	no	no	no	yes	yes
12	no	no	no	yes	no	yes	yes
13	yes	no	no	yes	no	yes	no
14	yes	no	no	yes	no	no	yes
15	no	no	no	yes	yes	no	no
16	yes	no	no	yes	yes	yes	yes
17	yes	no	yes	no	no	yes	yes
18	yes	no	no	no	no	no	yes
19	no	no	no	no	no	yes	yes
20	yes	no	no	yes	no	yes	yes
21	no	no	no	yes	no	no	yes
22	no	no	no	yes	yes	yes	yes
23	no	no	no	no	no	yes	no
24	no	no	yes	no	yes	yes	no
25	no	no	no	yes	no	yes	no
26	no	no	no	no	no	no	no
27	yes	no	no	yes	yes	yes	yes
28	yes	no	no	no	yes	yes	yes
29	no	no	no	no	no	yes	yes
30	yes	yes	yes	yes	no	no	yes
31	no	no	no	no	no	yes	no
32	no	no	no	yes	yes	no	yes
33	yes	no	no	yes	no	no	no
34	no	no	no	yes	yes	yes	yes
35	no	no	no	yes	no	no	no
36	yes	no	no	yes	no	yes	yes
37	no	no	no	yes	no	yes	no
38	yes	no	yes	yes	yes	yes	yes
39	yes	no	no	yes	no	yes	yes

	fare	chaose	uncomf	timeshed	alternat	wtp	cp
1	yes	no	yes	no	no	2000	1
2	no	yes	yes	no	yes	2120	1
3	yes	yes	yes	yes	no	3000	1
4	yes	yes	yes	yes	yes	0	1
5	yes	yes	yes	yes	yes	0	1
6	yes	no		yes	no	5000	1
7	yes	yes	yes	yes	no	1000	1
8	no	yes	no	yes	no	0	1
9	yes	yes	no	yes	yes	0	1
10	yes	no	yes	no	yes	200	1
11	yes	yes	yes	yes	no	0	1
12	yes	yes	yes	yes	yes	0	0
13	yes	yes	yes	no	yes	0	1
14	yes	yes	no	no	no	200	1
15	no	no	no	yes	no	2000	1
16	yes	yes	yes	yes	yes	0	1
17	yes	yes	yes	yes	yes	0	1
18	no	yes	no	no	no	0	1
19	yes	no	no	no	yes	0	1
20	yes	yes	no	no	no	1000	1
21	yes	yes	no	yes	yes	0	1
22	yes	yes	yes	yes	yes	2000	1
23	no	yes	no	yes	no	0	1
24	yes	no	no	no	no	1000	1
25	yes	yes	no	no	no	1000	1
26	yes	yes	yes	yes	no	0	1
27	yes	yes	yes	no	yes	5000	1
28	yes	yes	yes	yes	yes	0	1
29	yes	no	no	yes	no	0	1
30	yes	yes	yes	no	no	0	1
31	yes	yes	no	no	no	0	1
32	yes	yes	no	yes	no	5000	1
33	yes	yes	no	yes	yes	1000	1
34	yes	yes	yes	yes	yes	0	1
35	yes	yes	no	yes	no	1000	1
36	yes	no	yes	yes	no	1000	1
37	yes	yes		no	no	200	1
38	yes	yes	yes	yes	yes	0	1
39	yes	yes	yes	yes	yes	0	1

	pt	gf	rc
1	0	0	30650
2	1	0	15420
3	1	0	16420
4	1	1	21260
5	0	1	16740
6	1	1	46530
7	1	0	47360
8	0	0	82080
9	1	1	24260
10	1	0	17420
11	0	1	56800
12	1	1	69620
13	1	1	22420
14	1	1	26620
15	1	0	17120
16	1	0	31620
17	0	0	18588
18	0	1	30180
19	0	0	14080
20	1	0	23400
21	1	0	11360
22	1	0	65020
23	0	0	15420
24	1	0	22940
25	1	1	23400
26	0	0	6000
27	1	0	43000
28	1	1	43000
29	0	1	16220
30	1	1	16420
31	0	1	115020
32	1	0	33400
33	1	0	19200
34	1	1	17580
35	1	0	29000
36	1	0	33040
37	1	0	9200
38	1	0	24200
39	1	0	9600

	sex	educat	netincom	carcost	drive	traffic	thikard
40	1	16	60000	600000	yes	yes	no
41	0	16	100000	850000	no	yes	no
42	1	16	160000	1000000	no	no	no
43	1	16	100000	600000	yes	yes	no
44	1	16	160000	2000000	yes	yes	no
45	1	16	100000	250000	yes	yes	no
46	1	16	100000	600000	no	yes	no
47	0	12	140000	900000	no	yes	no
48	0	16	40000	350000	no	yes	no
49	0	16	160000	1800000	yes	yes	yes
50	1	16	60000	1200000	yes	yes	yes
51	1	12	40000	350000	yes	yes	no
52	1	16	60000	400000	yes	yes	no
53	0	16	60000	550000	yes	yes	no
54	1	14	60000	500000	yes	yes	no
55	1	16	60000	250000	yes	no	no
56	0	12	60000	750000	yes	yes	yes
57	1	12	40000	500000	yes	yes	no
58	1	16	60000	600000	yes	yes	yes
59	1	16	60000	760000	yes	yes	no
60	1	16	40000	250000	no	yes	no
61	1	16	40000	120000	yes	yes	no
62	1	16	100000	500000	yes	yes	yes
63	0	14	60000	250000	yes	yes	yes
64	1	16	120000	400000	yes	yes	no
65	1	16	160000	1500000	no	yes	no
66	0	16	60000	500000	yes	yes	no
67	0	16	40000	750000	yes	yes	no
68	0	16	140000	900000	yes	yes	no
69	0	14	40000	600000	yes	yes	no
70	0	12	100000	1300000	yes	yes	yes
71	0	12	40000	450000	yes	yes	yes
72	0	16	160000	1500000	yes	yes	yes
73	0	12	40000	450000	yes	yes	no
74	1	16	40000	250000	yes	yes	yes
75	0	16	60000	400000	yes	yes	yes
76	0	16	100000	250000	yes	yes	yes
77	0	16	40000	250000	yes	yes	yes
78	0	12	100000	300000	yes	yes	yes

	mmbsrd	jogoo	langata	ngong	statehs	uhuru	otherrds
40	no	no	yes	no	no	no	yes
41	no	no	yes	no	no	no	no
42	no	no	yes	no	no	no	no
43	no	no	yes	no	no	no	no
44	no	no	yes	no	no	yes	no
45	no	no	yes	no	no	yes	yes
46	no	no	no	yes	no	no	no
47	no	no	no	yes	yes	no	yes
48	no	no	no	yes	yes	no	no
49	no	no	no	no	no	no	no
50	no	no	no	no	no	no	no
51	no	yes	no	no	no	no	no
52	no	yes	no	no	no	no	no
53	no	yes	no	no	no	no	no
54	no	yes	no	no	no	no	no
55	yes	no	no	no	no	no	no
56	no	no	no	no	no	no	no
57	no	no	no	no	no	no	yes
58	no	no	no	no	no	no	no
59	no	no	yes	no	no	no	no
60	no	no	no	no	no	no	yes
61	no	no	no	no	no	no	yes
62	no	no	no	no	no	no	no
63	no	no	no	no	no	no	no
64	no	no	yes	no	no	yes	no
65	no	yes	no	no	no	no	no
66	no	no	no	no	no	yes	no
67	no	no	no	yes	no	no	no
68	no	no	no	no	no	yes	no
69	no	yes	no	no	no	no	no
70	no	no	no	no	no	no	yes
71	no	no	no	no	no	no	no
72	no	yes	no	no	no	yes	no
73	no	no	no	no	no	yes	no
74	no	no	no	no	no	no	no
75	no	no	no	no	no	no	no
76	no	no	no	no	no	no	no
77	no	no	no	no	no	no	no
78	yes	yes	no	no	no	no	no

	manhours	stress	fuelcost	maintene	polute	otherp	agree
40	yes	yes	no	no	no	no	yes
41	yes	yes	yes	no	no	yes	no
42	yes	yes	yes	yes	yes	no	yes
43	yes	yes	yes	yes	yes	no	yes
44	yes	yes	yes	yes	no	no	yes
45	yes	yes	no	no	no	no	no
46	yes	yes	yes	yes	yes	no	no
47	yes	no	no	no	no	no	yes
48	yes	yes	yes	no	yes	no	no
49	yes	yes	yes	yes	yes	no	yes
50	yes	yes	yes	yes	no	no	no
51	yes	yes	yes	yes	no	yes	no
52	yes	yes	yes	yes	no	no	no
53	yes	no	no	no	no	no	no
54	yes	yes	yes	no	yes	no	yes
55	yes	yes	yes	no	no	no	yes
56	yes	yes	yes	no	no	no	no
57	yes	yes	yes	no	yes	no	yes
58	yes	yes	yes	no	yes	no	no
59	yes	yes	yes	no	no	no	no
60	yes	yes	yes	yes	yes	yes	yes
61	yes	no	yes	yes	no	no	yes
62	yes	yes	yes	yes	yes	yes	no
63	yes	yes	yes	yes	no	yes	yes
64	yes	yes	yes	yes	yes	yes	yes
65	yes	no	yes	yes	yes	no	yes
66	yes	yes	yes	no	no	no	no
67	no	yes	yes	yes	yes	yes	yes
68	yes	yes	yes	yes	yes	no	yes
69	yes	yes	yes	yes	yes	no	yes
70	yes	yes	yes	no	yes	yes	yes
71	yes	yes	yes	yes	no	no	yes
72	yes	yes	yes	no	no	no	no
73	yes	yes	yes	no	no	no	no
74	yes	yes	yes	yes	yes	yes	yes
75	yes	yes	yes	yes	no	no	no
76	yes	yes	yes	yes	no	no	yes
77	yes	yes	yes	yes	yes	no	no
78	no	no	no	no	no	yes	yes

	litres	parking	socialst	publictr	convenie	flexibil	privacy
40	4	yes	yes	yes	yes	yes	no
41	6	yes	yes	yes	yes	yes	no
42	10	yes	yes	yes	yes	yes	yes
43	5	yes	no	yes	yes	yes	no
44	10	no	no	yes	yes	yes	yes
45	10	yes	no	yes	yes	yes	yes
46	6	yes	yes	yes	yes	yes	yes
47		no	yes	no	yes	no	no
48	2	no	no	yes	yes	yes	yes
49	10	no	yes	no	yes	yes	yes
50	4	no		no	yes	yes	yes
51	2	yes	no	yes	yes	yes	no
52	2	no	no	yes	yes	yes	no
53	4	no	no	no	yes	yes	yes
54	7	yes	no	no	yes	no	no
55	5	no	yes	no	yes	yes	no
56	5	no	yes	yes	yes	yes	yes
57	10	no	no	no	yes	yes	yes
58	13	no	yes	no	yes	yes	yes
59	5	yes	yes	no	yes	yes	no
60	8	no	no	yes	yes	yes	yes
61	5	no	yes	yes	no	yes	yes
62	4	no	yes	no	yes	no	no
63	4	no	no	yes	yes	yes	yes
64	5	no	yes	yes	yes	yes	yes
65	4	no	yes	no	yes	no	yes
66	3	no	yes	yes	yes	yes	yes
67	5	no	no	yes	yes	yes	no
68	2	no	yes	yes	yes	yes	yes
69	6	no	no	yes	yes	yes	no
70	8	no	yes	no	yes	yes	yes
71	10	no	yes	yes	yes	yes	yes
72	3	no	no	no	yes	yes	no
73	14	no	no	yes	yes	yes	no
74	3	no	no	no	yes	yes	no
75	3	no	no	yes	yes	yes	no
76	20	no	yes	yes	yes	yes	no
77	5	no	no	yes	yes	yes	yes
78	3	yes	no	no	yes	yes	yes

	security	cheapcos	runcost	forgo	scarce	crowding	destinat
40	no	no	no	yes	yes	no	no
41	no	no	no	yes	no	yes	yes
42	yes	no	no	yes	yes	yes	yes
43	no	no	no	yes	no	no	yes
44	no	no	no	no	yes	yes	yes
45	no	no	no	no	no	yes	yes
46	no	no	no	no	no	no	no
47	yes	no	no	yes	no	yes	no
48	yes	no	no	yes	no	yes	yes
49	yes	no	no	no	no	yes	yes
50	yes	no	no	yes	no	yes	no
51	no	no	yes	yes	no	yes	yes
52	no	no	no	no	yes	no	no
53	yes	no	no	yes	yes	no	yes
54	no	no	no	no	no	no	no
55	no	no	no	no	no	no	yes
56	yes	no	no	no	yes	yes	yes
57	yes	no	no	yes	no	no	yes
58	no	no	21	no	yes	yes	yes
59	no	no	no	no	no	no	no
60	yes	no	no	yes	yes	no	yes
61	no	no	no	yes	no	no	no
62	no	no	no	yes	no	yes	yes
63	yes	yes	yes	no	yes	yes	yes
64	yes	no	no	yes	yes	yes	yes
65	no	no	no	yes	no	yes	no
66	yes	no	no	yes	no	yes	yes
67	no	no	no	no	no	yes	yes
68	yes	no	no	yes	yes	yes	yes
69	no	yes	yes	yes	yes	yes	yes
70	yes	no	no	no	no	yes	yes
71	yes	no	no	yes	no	yes	yes
72	no	yes	no	no	no	no	yes
73	no	no	no	no	no	no	yes
74	no	no	no	no	no	yes	yes
75	no	no	no	no	no	no	no
76	no	no	no	yes	yes	yes	yes
77	yes	no	no	yes	yes	yes	yes
78	yes	no	no	no	no	yes	yes

	fare	chaose	uncomf	timeshed	alternat	wtp	cp
40	yes	yes	yes	no	no	0	1
41	yes	yes	yes	no	yes	200	1
42	yes	yes	yes	yes	yes	3000	0
43	yes	yes	yes	yes	yes	2000	1
44	yes	yes	yes	no	no	0	1
45	no	yes	yes	yes	yes	0	1
46	no	yes	yes	yes	yes	500	1
47	no	yes	no	yes	no	10000	1
48	no	yes	yes	yes	yes	4000	1
49	yes	yes	yes	yes	yes	0	1
50	yes	yes	yes	no	yes	0	1
51	yes	yes	no	no	yes	150	1
52	no	no	no	no	yes	1000	1
53	no	yes	yes	no	yes	20	1
54	no	yes	no	no	no	500	1
55	yes	yes	no	yes	no	1000	1
56	yes	no	no	no	no	20000	1
57	yes	no	no	yes	no	15000	1
58	yes	yes	yes	no	yes	0	1
59	no	no	no	no	yes	2000	1
60	yes	no	no	yes	yes	0	1
61	yes	no	yes	no	yes	100	1
62	no	yes	no	no	no	0	1
63	yes	yes	yes	yes	yes	50	1
64	yes	yes	yes	yes	yes	10000	1
65	yes	yes	no	yes	yes	500	1
66	yes	yes	yes	yes	yes	200	1
67	yes	yes	yes	yes	yes	2000	1
68	yes	yes	yes	yes	yes	3000	1
69	yes	yes	yes	yes	yes	0	1
70	yes	yes	yes	yes	yes	0	1
71	yes	no	yes	no	no	0	1
72	yes	no	no	no	yes	20	1
73	yes	no	no	no	no	0	1
74	yes	no	no	yes	no	0	1
75	no	no	no	no	no	0	1
76	yes	yes	yes	yes	yes	0	1
77	yes	yes	no	yes	yes	0	1
78	yes	no	no	yes	no	0	1

	pt	gf	rc
40	1	0	15200
41	1	0	19360
42	1	0	16040
43	1	0	38400
44	0	1	14200
45	0	1	27620
46	0	0	33400
47	1	0	21040
48	1	0	16900
49	0	0	22680
50	1	0	53540
51	1	0	25580
52	0	0	34260
53	1	0	12900
54	0	0	2600
55	0	0	20650
56	0	0	22420
57	1	0	36620
58	1	1	52140
59	1	0	14200
60	1	1	26820
61	1	0	18800
62	1	1	19960
63	0	0	15580
64	1	0	32420
65	1	0	19960
66	1	0	15580
67	0	1	32420
68	1	1	15400
69	1	1	25640
70	0	1	17940
71	1	1	36620
72	0	0	10240
73	0	1	29980
74	0	1	8130
75	0	1	8740
76	1	1	47420
77	1	1	22420
78	0	0	7720

	sex	educat	netincom	carcost	drive	traffic	thikard
79	0	16	60000	200000	yes	yes	yes
80	1	16	60000	420000	yes	yes	yes
81	1	16	100000	220000	yes	yes	no
82	1	16	100000	520000	yes	yes	no
83	1	16	120000	600000	yes	no	yes
84	1	16	40000	400000	yes	yes	no
85	1	16	60000	350000	yes	yes	no
86	0	16	100000	500000	yes	yes	no
87	1	16	100000	400000	yes	yes	no
88	0	16	60000	400000	yes	yes	no
89	0	16	40000	700000	yes	yes	no
90	0	16	140000	500000	no	yes	yes
91	1	16	100000	550000	yes	yes	no
92	0	16	160000	2500000	yes	yes	no
93	0	16	40000	300000	no	yes	no
94	1	0	40000	1000000	yes	yes	no
95	1	0	100000	450000	yes	yes	no
96	1	16	40000	450000	yes	yes	no
97	1	0	100000	700000	no	yes	no
98	1	16	100000	500000	no	yes	no
99	0	16	40000	400000	yes	yes	yes
100	1	16	100000	370000	no	yes	no
101	1	16	60000	300000	yes	yes	no
102	1	16	140000	500000	yes	yes	no
103	0	16	100000	500000	no	yes	no
104	1	16	100000	400000	yes	no	no
105	0	0	160000	400000	yes	no	yes
106	1	16	160000	200000	no	yes	no
107	1	14	40000	400000	yes	yes	no
108	0	16	100000	600000	yes	yes	no
109	0	12	160000	5000000	no	yes	no
110	0	16	100000	670000	yes	no	no
111	1	16	60000	650000	yes	yes	no
112	0	16	60000	700000	yes	yes	no
113	0	16	60000	1000000	no	yes	no
114	0	16	140000	1100000	yes	yes	no
115	0	16	100000	2200000	yes	yes	no
116	0	16	60000	500000	yes	yes	no
117	0	16	40000	100000	no	yes	no

	mmbsrd	jogoo	langata	ngong	statehs	uhuru	otherrds
79	no	no	no	no	no	no	no
80	no	no	no	no	no	yes	no
81	no	no	yes	no	no	no	no
82	no	yes	no	no	no	no	no
83	no	no	no	no	no	no	no
84	no	yes	no	no	no	no	no
85	no	yes	no	no	no	no	no
86	no	no	no	yes	no	no	no
87	yes	no	no	no	no	no	no
88	no	no	no	yes	no	yes	yes
89	no	no	no	no	no	yes	no
90	no	no	no	no	no	yes	yes
91	no	no	yes	no	no	no	no
92	no	no	no	no	no	yes	yes
93	no	no	no	yes	yes	no	yes
94	no	no	no	yes	no	no	no
95	no	no	no	yes	no	no	no
96	no	no	no	no	no	no	yes
97	yes	no	yes	no	no	no	no
98	no	no	no	yes	no	no	no
99	no	no	no	no	no	no	no
100	no	no	yes	no	no	no	no
101	yes	no	no	no	no	no	no
102	no	no	no	no	no	no	yes
103	no	no	no	no	no	no	yes
104	yes	no	no	no	no	no	no
105	yes	no	no	no	yes	no	yes
106	yes	no	no	yes	no	yes	no
107	no	yes	no	no	no	no	no
108	no	yes	no	no	no	no	yes
109	no	no	no	no	no	no	yes
110	no	no	no	no	no	no	yes
111	no	no	no	no	no	no	yes
112	no	no	no	no	no	no	yes
113	no	no	no	no	no	yes	no
114	yes	no	no	no	no	no	no
115	yes	yes	no	no	no	no	yes
116	no	no	no	no	no	no	yes
117	yes	no	no	no	no	no	no

	manhours	stress	fuelcost	maintene	polute	otherp	agree
79	yes	yes	yes	yes	no	no	yes
80	yes	yes	yes	yes	no	no	yes
81	yes	yes	yes	no	no	no	yes
82	yes	yes	yes	no	no	no	yes
83	yes	no	no	no	no	no	yes
84	yes	no	yes	no	yes	yes	yes
85	yes	yes	yes	yes	no	no	yes
86	yes	yes	yes	yes	yes	no	no
87	yes	yes	yes	yes	yes	yes	yes
88	yes	yes	yes	yes	no	no	yes
89	yes	yes	yes	no	no	no	yes
90	yes	yes	yes	yes	yes	no	yes
91	yes	yes	yes	no	no	no	yes
92	yes	yes	yes	yes	yes	no	no
93	yes	yes	yes	yes	no	yes	yes
94	yes	yes	no	yes	no	yes	no
95	yes	no	yes	no	no	no	no
96	yes	yes	yes	no	no	no	yes
97	yes	yes	yes	no	yes	no	yes
98	yes	yes	yes	no	yes	no	no
99	yes	yes	yes	no	no	no	no
100	yes	yes	yes	no	no	no	yes
101	yes	yes	yes	no	yes	no	yes
102	yes	yes	yes	yes	yes	yes	no
103	yes	yes	yes	yes	no	no	no
104	no	yes	no	yes	yes	no	yes
105	yes	yes	yes	yes	yes	no	no
106	yes	yes	yes	yes	yes	yes	yes
107	yes	yes	yes	no	yes	no	yes
108	yes	yes	yes	yes	yes	no	no
109	yes	no	yes	yes	yes	no	no
110	yes	yes	yes	no	no	yes	no
111	yes	yes	yes	yes	yes	no	no
112	yes	yes	yes	yes	yes	yes	yes
113	yes	yes	yes	yes	yes	no	yes
114	yes	yes	yes	yes	yes	no	no
115	yes	yes	yes	yes	yes	yes	no
116	yes	yes	yes	yes	yes	yes	yes
117	yes	yes	yes	yes	yes	yes	no

	litres	parking	socialst	publictr	convenie	flexibil	privacy
79		no	yes	no	yes	yes	yes
80	7	no	no	yes	yes	yes	no
81	9	yes	yes	no	yes	yes	no
82	7	no	yes	yes	yes	yes	no
83	10	yes	yes	no	yes	no	no
84	7	no	yes	yes	yes	yes	no
85	10	no	yes	no	yes	yes	yes
86	4	no	no	yes	yes	yes	yes
87	3	no	yes	yes	yes	yes	yes
88	4	no	no	yes	no	yes	no
89		yes	no	no	yes	yes	no
90		yes	yes	yes	yes	yes	yes
91	8	yes	yes	yes	yes	yes	no
92	10	no	yes	yes	yes	yes	yes
93	5	no	yes	yes	yes	yes	no
94	12	no	yes	no	yes	no	yes
95	4	no	no	no	yes	yes	yes
96	13	no	yes	no	yes	no	yes
97	11	no	no	no	yes	no	yes
98	2	no	yes	no	yes	yes	yes
99		no	yes	no	no	no	yes
100	4	no	no	yes	yes	yes	no
101	3	no	no	no	yes	yes	no
102	5	no	yes	yes	yes	yes	yes
103	0	no	no	no	yes	yes	yes
104	2	no	no	no	yes	yes	no
105	4	no	no	yes	yes	yes	no
106	10	yes	yes	no	yes	yes	yes
107	17	yes	yes	no	yes	yes	yes
108	1	no	no	no	no	yes	yes
109	10	no	no	no	yes	yes	no
110	2	no	yes	no	yes	no	yes
111	2	no	no	no	yes	yes	no
112	6	no	no	no	yes	yes	no
113	5	no	no	yes	yes	yes	yes
114	5	yes	no	no	yes	yes	yes
115	15	yes	no	no	no	no	no
116		no	no	yes	no	no	no
117	5	yes	yes	no	yes	no	no

	security	cheapcos	runcost	forgo	scarce	crowding	destinat
79	no	no	no	yes	yes	yes	yes
80	yes	no	no	yes	yes	no	yes
81	no	no	no	no	no	yes	yes
82	no	no	no	yes	yes	yes	yes
83	no	no	no	no	no	no	yes
84	no	no	no	no	no	yes	no
85	yes	no	no	yes	no	yes	yes
86	yes	no	no	yes	yes	yes	no
87	yes	no	yes	yes	yes	yes	yes
88	no	no	no	yes	no	no	no
89	no	no	no	yes	no	no	yes
90	yes	no	no	yes	no	yes	no
91	no	no	no	yes	no	no	no
92	yes	no	yes	yes	no	yes	no
93	no	no	no	yes	yes	yes	yes
94	no	no	no	no	no	yes	yes
95	no	no	no	yes	no	yes	yes
96	yes	yes	no	no	no	no	no
97	no	no	yes	yes	no	yes	yes
98	no	no	yes	no	yes	yes	yes
99	no	no	no	no	no	yes	no
100	yes	no	no	yes	no	yes	no
101	no	no	no	no	yes	no	no
102	yes	no	no	yes	yes	yes	yes
103	yes	no	no	no	no	yes	no
104	no	no	yes	yes	no	yes	yes
105	no	no	no	yes	no	no	yes
106	yes	no	no	no	yes	yes	yes
107	no	no	no	yes	yes	yes	yes
108	yes	no	no	yes	no	no	yes
109	no	no	no	yes	no	yes	yes
110	yes	no	no	yes	no	yes	yes
111	no	no	no	no	no	yes	no
112	no	no	no	no	no	yes	yes
113	yes	no	no	yes	yes	yes	yes
114	yes	no	no	yes	no	yes	yes
115	no	no	no	no	no	no	no
116	no	no	no	no	no	no	yes
117	no	no	no	yes	no	yes	no

	fare	chaose	uncomf	timeshed	alternat	wtp	cp
79	no	no	no	yes	no	70	1
80	yes	no	yes	yes	yes	2000	1
81	yes	no	no	no	yes	800	1
82	yes	yes	no	no	no	900	1
83	no	no	no	no	no	3500	1
84	yes	no	yes	no	no	4000	1
85	no	yes	no	yes	no	1000	1
86	no	yes	no	yes	no	0	1
87	yes	yes	no	yes	yes	0	1
88	no	yes	no	yes	no	0	1
89	no	yes	yes	yes	no	0	1
90	yes	yes	yes	yes	yes	0	1
91	yes	no	yes	yes	no	1000	1
92	no	yes	yes	yes	yes	0	1
93	yes	yes	yes	yes	yes	100	1
94	yes	no	no	yes	no	70	1
95	no	yes	no	yes	yes	0	1
96	yes	yes	yes	no	no	1000	1
97	yes	yes	yes	yes	yes	5000	1
98	yes	yes	yes	yes	yes	500	1
99	no	no	yes	no	no	0	1
100	yes	yes	no	no	yes	500	1
101	no	yes	yes	yes	yes	0	1
102	yes	yes	yes	yes	yes	1000	1
103	yes	no	yes	no	yes	0	1
104	yes	yes	no	no	no	0	1
105	no	yes	no	yes	yes	2000	1
106	yes	yes	yes	yes	yes	15000	1
107	yes	yes	no	yes	no	2000	1
108	yes	yes	yes	yes	yes	0	1
109	yes	yes	yes	yes	yes	500	1
110	no	yes	yes	yes	no	0	0
111	yes	no	no	no	no	0	1
112	yes	no	no	yes	yes	0	1
113	yes	yes	yes	yes	yes	0	1
114	no	yes	no	yes	no	0	1
115	no	no	no	no	yes	0	1
116	yes	yes	no	no	no	200	1
117	yes	no	yes	no	no	4800	1

	pt	gf	rc
79	1	0	3220
80	1	0	25480
81	0	0	34140
82	1	0	25180
83	0	0	50400
84	1	0	26100
85	1	0	51620
86	1	1	31960
87	1	1	13740
88	1	1	21960
89	1	1	10000
90	1	1	13220
91	1	1	20720
92	1	1	27100
93	0	1	30180
94	1	0	29220
95	1	0	12580
96	1	0	32228
97	1	0	33460
98	1	0	4388
99	0	1	20580
100	0	0	14580
101	0	1	13820
102	0	1	17420
103	0	0	1610
104	1	0	8020
105	1	0	12580
106	1	0	28400
107	1	1	37280
108	1	0	2920
109	1	1	41620
110	1	1	18280
111	1	1	10280
112	1	1	25640
113	1	1	19270
114	1	1	25200
115	0	1	147600
116	0	0	15450
117	1	0	39200

	sex	educat	netincom	carcost	drive	traffic	thikard
118	0	16	40000	500000	yes	yes	yes
119	1	12	120000	1600000	yes	yes	yes
120	1	16	120000	2500000	yes	yes	no
121	1	16	100000	650000	yes	yes	no
122	1	16	100000	700000	yes	yes	no
123	0	16	60000	300000	yes	no	no
124	1	16	40000	1500000	yes	yes	no
125	0	16	60000	1600000	no	yes	no
126	0	12	60000	600000	yes	yes	no
127	1	16	40000	600000	no	no	no
128	0	16	100000	1200000	yes	yes	no
129	0	16	60000	900000	yes	yes	yes
130	0	16	60000	700000	yes	yes	no
131	0	12	40000	220000	yes	yes	no
132	0	12	40000	300000	yes	no	no
133	1	12	40000	150000	yes	yes	no
134	1	12	40000	350000	yes	yes	yes
135	1	12	40000	450000	yes	yes	no
136	1	12	100000	1500000	yes	yes	no
137	0	12	40000	1200000	yes	yes	no
138	0	12	60000	3000000	yes	yes	yes
139	0	12	100000	1250000	yes	yes	no
140	1	12	120000	160000	no	yes	yes
141	0	16	60000	355000	yes	yes	no
142	0	8	40000	800000	yes	yes	no
143	1	12	60000	1000000	yes	yes	no
144	0	12	40000	700000	yes	yes	no
145	1	16	60000	550000	yes	yes	no
146	1	16	40000	1500000	yes	yes	no
147	0	16	60000	1600000	no	yes	no
148	0	12	60000	600000	yes	yes	no
149	1	16	40000	600000	no	no	no
150	0	16	100000	1200000	yes	yes	no

	mmbsrd	jogoo	langata	ngong	statehs	uhuru	otherrds
118	no	no	no	no	no	no	no
119	no	no	no	no	no	no	no
120	no	no	no	yes	no	no	no
121	no	yes	no	no	no	no	no
122	no	no	yes	no	no	no	no
123	no	no	no	yes	no	no	no
124	no	no	yes	no	no	no	no
125	no	yes	no	no	no	no	no
126	no	yes	no	no	no	no	no
127	yes	no	no	no	no	no	no
128	no	no	no	no	yes	no	no
129	no	no	no	no	no	no	no
130	yes	no	no	no	no	no	no
131	no	no	no	no	no	no	yes
132	no	no	no	no	no	no	no
133	yes	no	no	no	no	no	no
134	yes	no	no	no	no	no	yes
135	no	no	no	yes	no	no	no
136	yes	yes	no	yes	no	no	no
137	yes	yes	no	no	no	no	no
138	no	no	no	no	no	no	yes
139	yes	no	yes	no	no	no	no
140	no	no	yes	no	no	no	no
141	no	no	no	no	yes	no	no
142	no	no	no	no	no	no	no
143	no	yes	no	no	no	no	no
144	no	no	no	no	no	yes	no
145	no	no	no	yes	no	no	no
146	no	no	yes	no	no	no	no
147	no	yes	no	no	no	no	no
148	no	yes	no	no	no	no	no
149	yes	no	no	no	no	no	no
150	no	no	no	no	yes	no	no

	manhours	stress	fuelcost	maintene	polute	otherp	agree
118	yes	no	yes	yes	no	no	yes
119	yes	yes	yes	no	no	no	yes
120	yes	yes	yes	yes	yes	no	no
121	yes	yes	yes	no	yes	no	yes
122	yes	yes	yes	yes	yes	no	yes
123	yes	no	no	no	no	no	yes
124	yes	yes	yes	yes	yes	yes	yes
125	yes	yes	yes	yes	no	no	no
126	yes	yes	yes	yes	yes	no	no
127	yes	yes	yes	no	no	no	yes
128	yes	yes	yes	no	no	no	yes
129	yes	yes	yes	yes	yes	no	yes
130	yes	yes	yes	yes	yes	no	yes
131	yes	yes	yes	yes	no	no	yes
132	yes	no	no	no	no	no	no
133	yes	yes	yes	yes	yes	no	yes
134	no	yes	yes	no	no	no	yes
135	yes	yes	yes	yes	yes	no	yes
136	yes	no	yes	no	yes	no	yes
137	yes	no	no	yes	no	no	yes
138	no	no	no	no	no	yes	no
139	no	yes	no	yes	no	no	yes
140	yes	yes	yes	yes	yes	no	yes
141	yes	yes	yes	no	yes	yes	yes
142	yes	yes	yes	yes	yes	yes	yes
143	yes	yes	yes	no	yes	no	yes
144	yes	yes	no	no	no	no	no
145	yes	yes	yes	yes	yes	no	yes
146	yes	yes	yes	yes	yes	yes	yes
147	yes	yes	yes	yes	no	no	no
148	yes	yes	yes	yes	yes	no	no
149	yes	yes	yes	no	no	no	yes
150	yes	yes	yes	no	no	no	yes

	security	cheapcos	runcost	forgo	scarce	crowding	destinat
118	no	no	no	no	no	no	yes
119	no	no	no	yes	yes	yes	yes
120	no	no	no	no	no	no	yes
121	no	no	yes	no	no	yes	yes
122	yes	no	yes	no	yes	yes	yes
123	no	no	no	yes	no	yes	no
124	no	no	no	yes	no	yes	yes
125	no	no	no	yes	yes	yes	yes
126	yes	yes	no	no	yes	yes	yes
127	no	no	no	yes	no	no	yes
128	no	no	no	yes	yes	yes	yes
129	no	yes	no	yes	no	yes	yes
130	no	no	yes	yes	yes	yes	yes
131	yes	no	no	yes	no	yes	no
132	no	no	yes	no	no	no	yes
133	yes	no	no	yes	no	yes	yes
134	yes	no	no	yes	yes	yes	no
135	yes		no	no	yes	no	no
136	yes	no	no	yes	no	no	yes
137	yes	no	no	yes	yes	yes	no
138	no	no	yes	no	yes	no	yes
139	no	no	no	no	no	no	no
140	yes	yes	no	no	yes	no	yes
141	yes	no	no	yes	no	yes	yes
142	yes	no	no	yes	no	yes	yes
143	yes	no	no	yes	yes	yes	yes
144	no	no	no	yes	yes	yes	yes
145	no	no	yes	no	no	yes	no
146	no	no	no	yes	no	yes	yes
147	no	no	no	yes	yes	yes	yes
148	yes	yes	no	no	yes	yes	yes
149	no	no	no	yes	no	no	yes
150	no	no	no	yes	yes	yes	yes

	fare	chaose	uncomf	timeshed	alternat	wtp	cp
118	yes	no	yes	no	no	500	1
119	no	yes	yes	yes	no	1000	1
120	no	yes	no	no	no	1500	1
121	yes	no	yes	no	no	0	1
122	yes	yes	yes	yes	yes	200	1
123	yes	no	yes	no	yes	50	1
124	yes	yes	no	yes	yes	0	1
125	yes	yes	yes	yes	yes	0	1
126	yes	12	no	yes	yes	0	1
127	yes	no	no	no	yes	3000	1
128	yes	yes	yes	yes	yes	0	1
129	yes	yes	yes	yes	yes	500	1
130	yes	yes	yes	yes	yes	0	1
131	yes	no	yes	no	no	200	1
132	no	no	no	no	no	500	1
133	yes	yes	yes	yes	no	0	1
134	no	no	yes	no	yes	5000	1
135	yes	yes	yes	no	yes	0	1
136	no	no	yes	no	no	0	1
137	no	no	yes	no	no	2000	1
138	no	no	no	no	no	3000	1
139	yes	no	no	no	no	5000	1
140	yes	yes	yes	no	yes	15000	1
141	yes	yes	yes	yes	yes	250	1
142	yes	yes	yes	yes	yes	180	1
143	yes	yes	yes	yes	no	50	1
144	no	yes	yes	yes	no	200	1
145	yes	no	yes	no	no	1000	1
146	yes	yes	no	yes	yes	2000	1
147	yes	yes	yes	yes	yes	1000	1
148	yes	yes	no	yes	yes	2000	1
149	yes	no	no	no	yes	1000	1
150	yes	yes	yes	yes	yes	8000	1

	pt	gf	rc
118	0	0	22360
119	1	0	23780
120	0	1	19560
121	1	0	18140
122	0	0	37080
123	1	1	18740
124	1	1	31620
125	1	1	20580
126	0	1	14740
127	1	0	8670
128	1	1	29200
129	1	0	21960
130	1	1	13820
131	1	0	15920
132	1	0	0
133	1	0	43320
134	1	0	31320
135	1	0	28400
136	1	0	37080
137	1	0	19880
138	1	0	83000
139	1	0	69320
140	1	0	65530
141	1	0	14380
142	1	0	12240
143	1	0	20120
144	1	0	9360
145	1	0	8100
146	1	0	41850
147	1	0	29200
148	1	0	13660
149	1	0	9180
150	1	0	17520

APPENDIX III: PRICES OF FUEL IN NAIROBI (YEAR 2011)

Date	Super Petrol (Ksh/Ltr)	Diesel (Ksh/Ltr)	Regular Petrol (Ksh/Ltr)	Average (Ksh/Ltr)
15/12/2010 – 14/01/2011	94.03	87.45	94.39	91.96
15/01/2011 – 14/02/2011	95.67	88.71	97.17	93.85
15/02/2011 – 14/03/2011	98.08	91.72	98.11	95.97
15/03/2011 – 14/04/2011	102.44	94.53	100.90	99.29
15/04/2011 – 14/05/2011	111.17	107.52	108.16	108.95
15/05/2011 – 14/06/2011	115.35	108.02	111.48	111.62
15/06/2011 – 14/07/2011	114.93	106.30	112.17	111.13
15/07/2011 – 14/08/2011	115.39	106.12	115.29	112.27
15/08/2011 – 14/09/2011	117.22	108.97	116.71	114.30
15/09/2011 – 14/10/2011	117.75	108.17	116.68	114.20
15/10/2011 – 14/11/2011	120.50	110.94	116.73	116.06
15/11/2011 – 14/12/2011	124.13	114.30	123.88	120.77
15/12/2011 – 14/01/2012	119.06	110.98	121.85	117.30
GRAND AVERAGE				**108.28**

(Source: Statistical Abstract, 2011/2012)