AN ANALYSIS OF THE SUPPLY OF URBAN PUBLIC TRANSPORT SERVICES IN KUMASI, GHANA

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ABSTRACT

The level of supply of public transport increases proportionately with population size. However, increased population growth and urbanization have led to several transport problems, including meeting the supply of transport services. The rationale behind the supply model as used in the study is generally found in economic theory, where vehicle operators/owners choose among alternative opportunities before investing in the urban transport service industry. The main objective of the study is to identify the factors affecting the supply of urban transport services in Kumasi, Ghana. Data for this paper was from two main surveys spanning a period of three weeks, which resulted in interviewing 150 transport operators in the Kumasi Metropolis. The study identified the cost of vehicles, the cost of providing urban transport services, the demand level, and the number of vehicles available in the study area as key factors, which affected the supply of urban transport services in Kumasi. These factors have served as the basis in modeling the supply situation in the study area. In addition, the study outlines some policy directions, which need to be considered in order to sustain the supply of urban transport services.

Keywords: Supply; Public Transport Service; Private Sector; Utility; Investment

INTRODUCTION

Many researchers, such as Vuchic (2005) and Sperling (1995; 1997), have studied the roles and adverse effects of transportation on cities. To this end, Blonk (1979) has stated that transport is a catalytic force, both as an agent vital for economic growth and as an agent for economic decline where economic resources and conditions, as well as human endeavor, are insufficient. In this vein, efficient transportation should be seen as a factor that unifies the entire economy, which facilitates development. Kwakye, Turner, and Grieco (1994) have also noted that a well functioning transport system helps to maximize the economic growth or progress of cities.

Urban mass transport continues to be a high priority social obligation of governments throughout the world and, in some jurisdictions, it is the prime responsibility of national governments, while in other localities, it is a state or local government responsibility (Hensher, 2002). Mass transport in developing countries is essential for the urban poor who have to rely on walking, cycling, and road-based public transport to meet most of their travel needs. Mainly buses provide urban mass transport and competition guarantees the efficient supply of mass transport services.

The supply of urban transport services, therefore, helps in realizing this potential presented by mass transit services to cities development. This study documents the factors that influence the supply of urban transport services in Ghana.

AN OVERVIEW OF THE SUPPLY OF URBAN TRANSPORT SERVICES IN KUMASI

The level of supply of public transport increases proportionately with population size (Maunder, Fouracre, and Jacobs, 1987). Increased population growth and increased urbanization have led to several transport problems, including meeting the supply of transport services. According to Pucher, Korattyswaropam, Mittal, and Ittyerah (2005), the supply of transport services has lagged far behind demand. This is because public finances, in general, are so limited that funding for transport improvement is woefully inadequate. It is usually thought that smaller cities rely more heavily on intermediate public transport, but this is not substantiated by field data (Maunder, Fouracre, and Jacobs, 1987). According to them, intermediate public transport accounts for at least 30 percent of supply in most cities and, in some, it may account for as much as 60 to 70 percent of public transport provision.

City form may influence the type of mode that can be employed. Dense compact cities with limited road networks may have high intermediate public transport content because it is physically impossible to operate buses efficiently. In the circumstances, public transport users may incur high public transport unit costs, although their absolute demand for public transport may be low. According to Vuchic (2005), the dynamic growth and changes in cities require that their transportation systems be further developed and modified in order to influence its growth.

Although most city bus operations are in the nationalized sector, there is no uniformity about the institutional arrangements for providing the service. Public transport services are provided, in most cities, either by the private sector, public sector, or both. However, Amos (2004) argued that transport services that are privately owned and operated are widespread throughout developed and developing countries, but the government's provision of the services to the public has been found to be disappointing in many countries. For example, in Ghana, as many as 195 out of over 600 buses of the Metro Mass Transit Limited (MMT) have been grounded and are not in operation due to mechanical and electrical faults, unavailability of spare parts, and engine problems.

In Ghana, Public Transport Services are provided predominantly by the private sector, which operates a mix of buses, minibuses ('trotro'), and taxis (Poku-Boansi, 2003). Trotro is defined as an efficient and inexpensive, minibus used for short distance travel. It evolved from the Ga language word "TRO" meaning three pence, that is, the penny coins that were in use in the colonial days of the Gold Coast, now Ghana. Those vehicles charged each passenger three pence per trip; hence, it was dubbed "tro - tro". Though the penny is no longer used, and the fare has been inflated in multiples, the old name still stands, probably as a reminder of the transport service that operated in those good old days when life was simple and easy - going (Ross, 2006).

Quite recently, the government has imported a number of new, large buses with capacities ranging between 62 and 120 for urban transit operations. One hundred and twenty-four (124) have been delivered and are operating in the major cities under management of Metro Mass Transit. Public transport is critical to the welfare of the urban poor and a crucial element in any poverty-oriented city development strategy. The Metro Mass Transit Company Limited is responsible for the provision of urban mass transit services in Ghana. The services being provided are usually unscheduled and often, on demand-responsive routes, filling gaps in informal transit provision.

Urban public transport service supply needs an improvement in Ghana. This is because old and poorly maintained buses and minibuses, overcrowding, undependable, and insufficient services (Adarkwa and Tamakloe, 2001) characterize the current system. With the exception of the buses of the Metro Mass Transport Company, an average of vehicles providing urban transport services in the two major cities in Ghana ranges between eighteen years in Accra and thirteen years in Kumasi (Poku-Boansi, 2008). The unreliable nature of public transport services has resulted in the gradual increase in cars, which further congest the roads in the cities and worsen air pollution, noise, and safety problems. Government control over the operation of the public transport is virtually non-existent; however, the private operations are strictly controlled by trade unions, of which the most powerful is the Ghana Private Road Transport Union (GPRTU).

Good quality transport services are seen by passengers to mean affordable fares, good frequency of transport services, short travel time, and improved safety (Poku-Boansi, 2008). This implies that vehicle operators need to provide services which meet these needs as well as in an economically, efficient manner. These call for the proper management of operating cost, revenue, and having the required vehicle fleet. According to Markus (2006), service quality considers the requirement of passengers who ask for a short travel time, short walking distances, frequent and reliable services, decent comfort, and appropriate fares.

STUDY APPROACH AND METHODOLOGY

The study was undertaken in the Kumasi Metropolitan Area in Ghana. The Kumasi Metropolis has 34 traffic zones (Figure 1) from which urban transport operators were interviewed. These traffic zones serve as generators and terminating points of trips generated in the Metropolis. The thirty-four (34) traffic zones in were delineated after a review of the Kumasi Traffic Zones demarcation by the Department of Urban Roads during the study, "Landuse Forecast and Traffic Volume Growth Trends in Accra, Tema, Kumasi, Sekondi – Takoradi and Tamale" in 1997 (Department of Urban Roads, 1997). These zones were delineated on the basis of homogeneous social and economic characteristics, such as income, housing quality, the general culture of the people, and the level of economic activities generated in the area. The study focused on population, traffic patterns, and socio-economic characteristics within each of the traffic zones. Vehicle operators in the selected communities in each of these zones were interviewed to obtain data on vehicle operations, such as travel time, fares charged, revenue, and number of trips made in a day, among others.

**Figure 1: Traffic Zones in the Kumasi Metropolis**
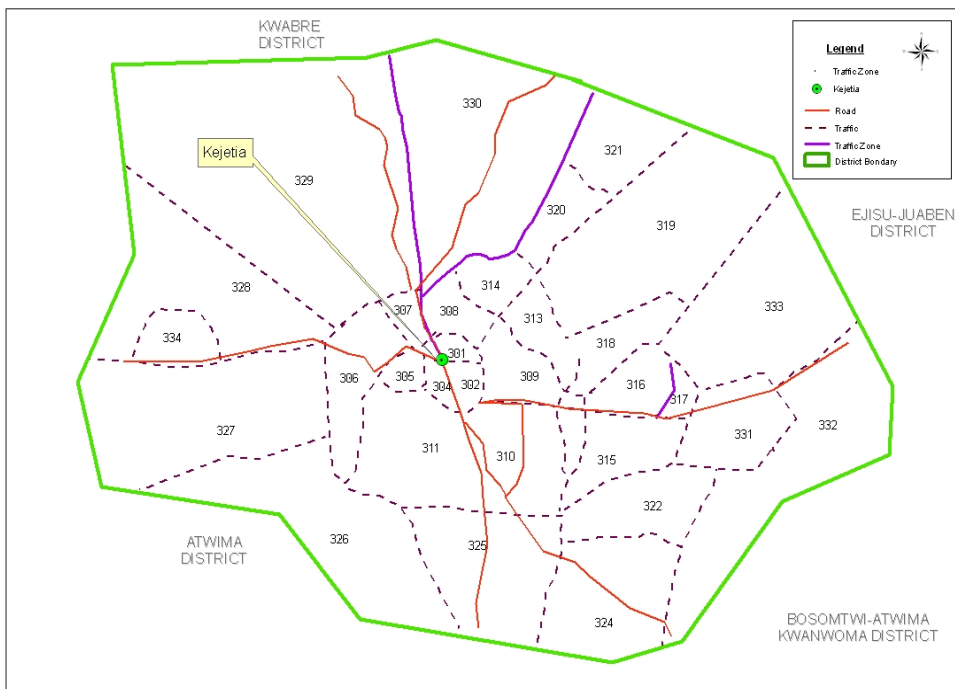
Source: Department of Urban Roads, 1997

Several methods were used in collecting data for this study. First, a reconnaissance survey was carried out to observe critical features about the operations of service providers, establish contacts with stakeholders, such as the Ministry of Road Transport (MRT), the Ghana National Road Transport Coordinating Council (GNRTCC), the Ghana Private Road Transport Union (GPRTU), the Progressive Transport Owners Association (PROTOA), and the Cooperative Union. Second. Interviews were conducted with the stakeholders listed above to obtain relevant data. This was done in a more discursive manner than the extractive type of interview, where respondents just provide answers to structured questionnaires. This approach provided an in-depth understanding of the relevant issues affecting the supply of urban transport services in Kumasi.

The stepwise regression method was used in the analysis of the factors affecting the supply of urban transport services in the study area. Data for this paper was gathered from 150 transport operators operating along the five major arterial routes (Figure 2) within the study area. These routes served as the main focal transport link between the northern and southern parts of the country. Together, they carry about 128,329 vehicles per day (Department of Urban Roads, 2005). The selection of the vehicles was done using the various bus terminals in the city along the routes and the main bus terminal at the central business district (CBD) as the link. Drivers stationed at these bus terminals were interviewed together with those who operate in any of these terminals, but ply the study routes.

Figure 2: Study Routes
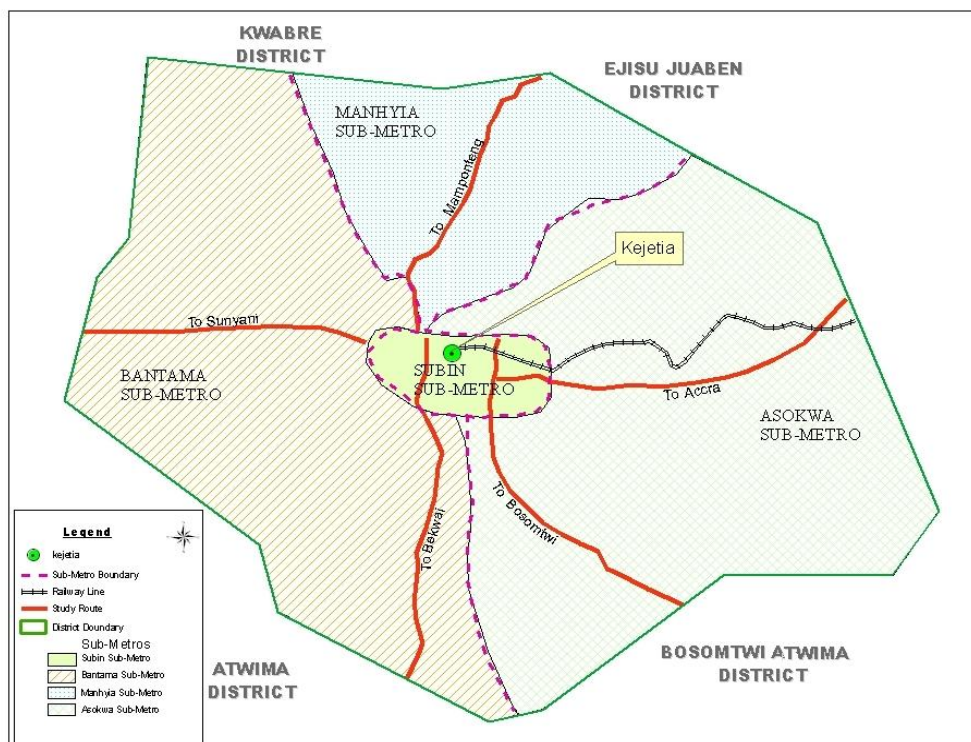
Source: Kumasi Metropolitan Assembly, 2004

Table 1 presents the various unions from which the vehicle operators were selected. The majority were transport operators from the Ghana Private Road Transport union. This is because the membership of the union constitutes about 80 percent of transport operators in Ghana. Data gathered included the hours worked per day, the number of trips made per day, the travel time from an origin to a destination, the travel speed from an origin to a destination, the number of passengers conveyed per trip, and vehicle capacity. The analysis of the data gathered was done using the Statistical Package for the Social Scientists (SPSS) software and has provided the basis for the development of the supply model.

Table 1: Sample of Transport Unions

Transport Unions	Frequency	Percentage
Ghana Private Road Transport Union	73	48.53
Progressive Transport Owners Association	7	4.41
Cooperative Transport Union	42	27.94
Ghana National Transport Owners Association	18	11.76
Concerned Drivers Union	9	5.88
Urban Mass Transit	1	1.47
Total	**150**	**100**

Source: Author's Field Survey, 2008

ANALYSIS AND DISCUSSIONS OF RESULTS

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

The supply function, therefore, reflects the behavior of service providers or vehicle owners whose interest and preference dictate the functional form of the relationship. For this study, supply is equated to the number of vehicular trips per year. The reason for using this is that the actual vehicles operating within the study area is what is available for passengers to use when making trips. Vehicles that were not available for use were, therefore, left out in the data collection and subsequent analysis. Several factors affect the supply of urban public transport services. These factors include the cost of providing the service, profit levels, price of the vehicle used, and the number of passengers to be served by public transport service. These factors provided the basis for the subsequent modeling of the supply function. The subsequent section of the study, therefore, estimates the supply function of urban transport services, as well as defines the variables used in the supply functions.

Definition of Dependent Variable

The number of vehicles available as used in this study refers to the total number of vehicles providing urban public transport services within the study area and serves as a proxy for supply. This is because the number of vehicles available to provide urban transport service affects the supply of urban public transport services. Where the total number of vehicles increases, the supply of transport services also increases and vice versa. In Kumasi, the inadequate number of vehicles has resulted in long queues at the various bus terminals, especially during the peak periods (morning and evening rush hours).

Defining the Independent Variables

Profit is one of the independent variables that influence the supply of transport services and is usually the return on investments transport owners or operators make after deducting their cost from the revenue. The level of profit operators make is one important decision criterion that is considered before investing in the urban transport service industry. It is anticipated that higher profit margins may manifest in increased investment levels resulting in an increase in number of vehicles and vice versa. This was not different from what was observed in Kumasi. Profit levels had a significant relationship with total vehicular trips made along the study routes with a correlation coefficient of 0.283 and a significant probability of 0.000 (Table 2).

The price of the vehicles is another independent variable and is the market price at which vehicle owners purchased their vehicles for their operations. Generally, higher vehicle prices discourage the number of potential investors, who may be willing or have the resources to invest in the industry by purchasing vehicles. From the field visits, vehicle prices ranged from GHS 5, 000 to about GHS 11,500 (exchange rate is GHS 1: US$ 1.5), depending on the age and condition of the vehicle. These vehicles are used and are imported into the country by individuals and dealers.

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

Correlation of Dependent Variable and Independent Variables

The correlation between the independent variables, as presented in Table 2, was to test and resolve any possible problem of multicollinearity. Multicollinearity occurs when two or more predictors in the model are correlated and provide redundant information about the response. The table presents the correlation matrix, which is the correlation between the dependent variable and independent variables.

Table 2: Zero – Order Correlation Matrix of Variables

		Annual Number of vehicular trips	Profit level	Demand	Number of vehicles available	Cost of vehicle
Annual Number of vehicular trips	Pearson Correlation	1	-.283(**)	-.410(**)	-.258(**)	-.477(**)
	Sig. (2-tailed)		0	0	0.001	0
Profit level	Pearson Correlation		1	0.047	-0.04	.489(**)
	Sig. (2-tailed)			0.565	0.626	0
Demand	Pearson Correlation			1	.972(**)	-0.006
	Sig. (2-tailed)				0	0.939
Number of vehicles available	Pearson Correlation				1	-0.13
	Sig. (2-tailed)					0.113
Cost of vehicle	Pearson Correlation					1
	Sig. (2-tailed)					

Source: Author's Field Survey, 2008

** Correlation is significant at the 0.05 level (2-tailed). N = 150

For example, from Table 2, it can be seen that the demand level and the number of vehicles available have a very strong association and is supported by the correlation coefficient of 0.972. This relationship was expected since as demand level

increases, the number of vehicles available also increases. This relationship presented a problem of multicollinearity, which led to the dropping of the number of vehicles available from the final model. The reason is that the inclusion of the demand level provides an improved correlation coefficient and coefficient of determination than the number of vehicles available in the final model.

The Supply Model and Interpretation

After the correlation analysis, the supply model was developed. This model is expected to be used in estimating the supply level of urban transport services in the study area as well as helping to determine the key variables and their contributions to the supply of urban transport services. The multiple stepwise regression method was used in estimating the supply model. The criterion for selecting or dropping an independent variable from the final model was based on significant probability. Independent variables with significant probability of less than or equal to 0.05 were entered, while those with significance probability greater than 0.05 were dropped (Garson, 2006).

Based on the criterion, four variables, cost of providing urban transport service, profit level, demand level, and cost of vehicles, were selected as being key to the supply of urban transport services. These independent variables were selected because of their significant probability of 0.000, 0.000, 0.000 and 0.006, respectively.

From the model results, it was realized that the cost of vehicle is the main independent variable, contributing almost about 47.7 percent to the entire coefficient of determination (R^2) of the model. This implies that, for investors, the cost of the vehicle is the most important factor to consider before investing their resources in the urban transport service industry. The next variable to be picked by the model is the demand for the service, which contributes 17.1 percent of the model. This also implies that investors consider the availability of market opportunities for their products, for example, transport services, before investing in the industry. The cost of providing urban transport service contributes 16.5 percent to the variability in the supply of urban transport services, while the profit level contributes 2.2 percent.

Table 3 presents the summary of the multiple stepwise regression analysis for the supply model. From the table, it can be seen that the regression coefficient is 0.9138. This indicates a reasonably strong relationship between the annual number of vehicular trips as a dependent variable and the following independent variables: the cost of the vehicle, the demand for transport services, and the profit level. The coefficient of multiple determination (R^2) of the model is 0.835, implying that about 84 percent of the variability in the supply of urban transport services can be explained by the four independent variables. The F value of the model of 51.161 is also significant at less than 5 percent, implying an overall significant relationship between the annual number of vehicular trips and the independent variables in the model. In addition, the t-values for the independent variables are significant, as can be seen in Table 3, at the cut-off criterion of 0.05, implying that the selection of these independent variables in the final model was critical and did play a crucial role in the variation in the supply of urban transport services.

Table 3: Summary of Multiple Stepwise Regression Analysis for Supply of Urban Transport Services

Independent variables	Unstandardized Coefficients	Standardized Coefficients	t values
Constant	59.503		0.061
Demand for Service	-8.470	-2.329	-8.749[**]
Log Profit levels	507.508	0.246	2.805[**]
Cost of Vehicles	-5.6753	-0.431	-4.489[**]
Cost of providing urban transport service	123.76	0.197	2.142[**]
Observations	150		
R	0.9138		
R^2	0.835		
F	51.161		

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

From Table 3, the final output for the supply model obtained from the multiple stepwise regression analysis is given as:

$$\text{Supply} = 59.503 - 8.470 \times D + 507.508 \times \text{Log\_p} - 5.6753 \times Cv + 123.76 \times Cs \dots\dots\dots\dots (1)$$

where

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

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

POLICY IMPLICATIONS AND ISSUES FOR FUTURE RESEARCH

The analysis and development of the supply model brings to light some very important issues, which require attention in the urban transport service industry in the Kumasi Metropolis. These issues have been discussed as follows:

i. Cost Recovery during Pricing of Urban Transport Services

According to Viegas and Macario (2003), transport pricing has been a highly debated topic for several years now, and there is a growing awareness that to achieve a sustainable balance between the private and public transport, means of mobility and pricing policies have to be able to send the correct signals to induce an adaptive behavior from the users,

which in turn will, through the demand levels, provide the system with a reliable feedback on the needs for further investment, and the expansion of transport facilities.

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

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

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

Congestion is gradually becoming a major obstacle to efficient urban transport services in the study area. This congestion is a result of the increase in the use of small capacity vehicles in the Kumasi Metropolitan Area. The result is the decrease in the expected benefit from public transport services. Because of this challenge, there is the need to begin exploring the possibility of encouraging institutions and investors to invest in the provision of urban public transport services using large capacity vehicles. More importantly is the need to encourage the use of new vehicles in the operation of public transport services since it is one of the surest ways of reducing the cost of providing the service, which serves as an inhibiting, factor in investing in the industry. The use of large capacity buses is gradually gaining grounds within the inter-urban transport service industry and the same can be done within the intra-urban transport service industry. Currently, the Metro Mass Transit Limited is operating in some of the major cities, but due to the demand, there will be the need to seek for more investors to invest in the industry.

iii. Need to introduce Fair Competition in Service Delivery

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

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

One of the requirements for an effective competition is the establishment of performance input and output indicators to check the operations of transport operators within the country. These indicators can be reviewed periodically through research in the operations within the urban transport industry.

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

The study findings brings to the fore questions which will require further studies in finding the way out in ensuring effective and efficient urban transport service supplies in the study area. These issues include establishing whether the use of large capacity vehicles will help reduce the cost of providing urban transport services and subsequently make the services affordable. This is important because public transport systems may be characterized as a combination of 'formal' bus services, which are planned and regulated and 'paratransit', which is sometimes called 'informal' transport, is often unregulated, and may operate illicitly. In many cities, a range of services provides supply. Some are formal, that is, they run scheduled services, while others are informal, running unscheduled, often flexible, and use small vehicles. In an increasingly large number of cities, paratransit services are a major, or dominant, mode, and these pose particular challenges for the development of the use of large capacity buses.

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

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

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

CONCLUSION

Urban mass transportation is one of the key priority areas for urban planners because transportation is a very important input for the distribution of goods and services in urban areas. In addition, they transportation facilitates the developments of every society and is crucial to sustainable development, especially if investments in the sector are well targeted and planned. An increase in the supply of urban transport services provides the platform for urban transport services in most cities. Urban mass transport through franchises and concessions, can mobilize low-cost operations to provide the best quality of service and the best price for any resource capability. Findings of this paper have highlighted the factors influencing the supply of urban transport services. Four main factors have been identified as influencing the supply level in the study area. These variables include the cost of vehicles, the cost of providing urban transport services, the demand level, and the number of vehicles available in the study area. These findings have provided some useful policy direction such as ensuring cost recovery during pricing of urban transport services, encouraging the use of large capacity buses in urban transport service industry, introducing fair competition in the service delivery, and setting input and output indicators to monitor and penalize poor transport operation in Ghana to help government's efforts in providing urban transport services in Ghana.

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