International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 3, Issue 6 (June 2014), PP.01-08

Parking Management in Metropolitan Cities in West Africa Case Study of the Kumasi Paid Parking Scheme, Ghana

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Abstract: - This paper examines the changes in parking turnover and duration for the Adum paid parking scheme in Kumasi, four years after implementation. The objective was to compare the performance in the fourth year with an earlier evaluation by testing the null hypothesis on average duration and turnover at 5% significance level. Trained observers undertook parking utilization surveys at lots on selected road sections. The survey times, location and procedures followed were similar to earlier surveys to enable comparison by before and after analysis. The results show that the proportion of vehicles that park for more than two hours has almost doubled for all the study locations. Average duration has increased on some roads and decreased marginally on others whilst turnovers have reduced slightly. The hypothesis testing concluded that there is not enough evidence to indicate that the average duration and turnover rate has changed significantly. The parking charges are low and occupancy rates are high. This situation makes congestion worsen on the study roads as shoppers cannot easily find parking. The scheme is an alternative income generation measure that can be replicated in busy commercial districts of metropolitan cities in developing countries to generate revenue and manage congestion.

Keywords: - *Average duration, Paid Parking, Parking management, Revenue, Turnover*

I. INTRODUCTION

Parking is an integral part of trip making by any means of transport. In most urbanized cities around the world, increasing car ownership and utilization, high land values in central business areas and inadequate parking supply have compounded the parking situation. Business owners and residential dwellers compete with shoppers and patrons of businesses for available spaces to park their vehicles at on street locations where on street parking is free. Parking management schemes that employ fiscal charges have become a major part of most congestion pricing schemes in major urban centres and central business districts (CBD). In many cities in Europe, pay and display on street parking schemes are a common sight.

The Adum paid parking scheme was established in June 2006 with the objective to reduce congestion through reduction of parking duration and increase in turnover. Prior to its inception, various studies Kumordzi (2003), ACON/BCEOM (2005) had reported low turnovers and high duration of parking. Parking demand has increased as a result of gentrification, a phenomenon whereby old residual units are being demolished and replaced with new 5-6 storey office / commercial buildings. Also Adum does not as yet have parking garages for off street parking. Two surface car parks are operational but shoppers prefer to park on street because of convenience and closeness to one's destination. Adams et al. (2008) reported on an evaluation of the scheme one year after inception and concluded after a before and after analysis of variance tests that turnovers and average duration had improved significantly at 5% significance level. The authors however remarked that the data used for the comparison (before) were more than three years old and there could have been some improvement in the situation prior to inception. They recommended that the data generated by a comprehensive study by Sefiamor (2007) and further analysed by Adams et al (2008) should be regarded as baseline.

This paper makes an assessment of the trends in the parking indices such as turnover, duration of parking and occupancy as well as their effect on revenue, with recommendations for the improvement of scheme management. The following null hypothesis were tested in a before and after analysis at 5% significance level; a) average parking duration has significantly reduced since 2007, b) average turnover rate of space has increased for the parking stalls.

II. LITERATURE REVIEW

- **Management of Parking Facilities**

Parking Pricing means that motorists pay directly for using parking facilities (VTPI, 2005; Shoup, 2005). This may be implemented as a parking management strategy (to reduce parking problems), as a mobility management strategy (to reduce transport problems), to recover parking facility costs, or to raise revenue for any purpose (such as funding local transport programs or downtown improvements). It is often intended to achieve a combination of objectives (Litman, 2013).

As an alternative to tolling, parking pricing (or parking management) systems are growing increasingly attractive to manage congestion and generate revenues. Parking management systems can take on many different forms, but the guiding principle behind all parking management systems is the idea that there is no such thing as free parking (Naparstek, 2007). There are many hidden costs associated with these free parking spaces, including; 1) Congestion: Vehicles circle in search of free parking spaces, spending excess time on the road, affecting through traffic and leading to increased congestion, 2) Environmental impacts: As congestion increases and vehicles spend more time on the roads, the amount of vehicle emissions also increases, 3) Financial burden on the owner or operator (such as the municipality): The owner or operator must come up with funds to maintain parking areas (example, paving, debris removal, regulation enforcement), and 4) By charging an explicit fee for parking spaces through meters or permits, revenues are generated, which can help to offset capital and operating costs. Moreover, these systems can help to manage parking demand and availability to improve the parking experience for all, including providing increased convenience and easier location of parking for drivers, decreased congestion on the roadways, and increased turnover for area businesses (Battelle et al., 2011).

In the many cities of the developed world, various technologies are employed in parking management, Thomas (2004) has reported on the Westminster city parking system in London, a limited number of parking pricing systems have been implemented. The city-run parking system in Westminster has evolved into an efficient and technologically advanced example of a parking pricing system. In Chicago, city officials recently leased the city's metered parking spaces to private investors for a term of 75 years to attract capital to upgrade the existing parking system. In San Francisco, local agencies are working to build a system using real-time parking data to manage congested streets and relieve a parking shortage (Battelle et al., 2011).

The Port of San Francisco had previously conducted a pilot on-street parking study in 2006, which found that, location and time of day were the biggest factors in parking demand. They also found that a significant number of people only pay for half of their stay, patrons parked an average of 75 minutes, and that there are a high number of disabled placards. Enforcement was also found to be relatively low. Revenue was expected to increase with new parking sensors and payment systems that would assist enforcement efforts. After conducting the study, the Port of San Francisco worked with SFMTA on SF*park* so that parking rates between the two project areas could function under a single system (Moyer, 2008).

Beginning in February 2009, the operation and maintenance of roughly 36,000 metered parking spaces in Chicago were transferred to a private investment company, Chicago Parking Meters, LLC (CPM), through a concession agreement with the City of Chicago. CPM was a consortium led by Morgan Stanley Infrastructure Partners. Within this consortium, parking operations were handled by the concessionaire, this was the first private concession for a publicly owned U.S. parking system (Martin, 2008). For more than two-thirds of the city's meters, the hourly rate at the time of the concession had been fixed at $0.25 for over 20 years. By early 2010, parking rates increased to $1.25 per hour, representing a 400% rate increase (Battelle et al., 2011).

The Kampala City Council awarded a contract for the management of paid on street parking in the central business district to the private sector in 1997. This was in response to the ever increasing congestion in the central business district. The price of parking was UGX 400 (US$ 0.17) per hour. A new ticket was purchased every hour up to 3 hours after which parking is illegal. After a recent increase in parking fees in Shenzen, China, a remarkable 30% drop in demand was recorded. The benefits associated with this was short lived as the policy was reversed in 2007 and the demand soared so that the central business district was gridlocked. There is considerable technology available for managing on street parking, including mobile phones, ticket machines, camera enforcement, information technology for record keeping systems, et cetera, but in most cities in low income countries, manual collection systems are used (Rye, 2011).

In many areas in Ibadan North East local government in Nigeria, motorists suffer stress in searching for parking spaces at destinations such as Agodi-Gate, Oje, Beere, Idi-Ape Orita-Aperin and Oremeji of the local government area. Lack of loading or parking bays cause illegal on-street parking by motorists which has already reached crisis proportion in the area. Roadside hawking and trading along the road reduces road lane capacity. Rapid increase in the number of motor vehicles in the area has led to serious traffic congestion at peak hours of the day. The problems of on-street parking has made the area inaccessible and reduced the traffic speed and thus increasing traffic congestion as well as increasing journey time. In order to derive the maximum benefits from transport, there is the need to urgently address the challenges of on-street parking which has become an epidemic to the environment. It affects smooth flow of traffic and causes traffic congestion, lateness to work, accidents and hampering of other economic activities (Asiyanbola and Akinpelu, 2012).

- **Parking Management Scheme at Adum, Kumasi**

The Adum Paid Parking scheme became operational in June, 2006 after some three (3) months intensive public awareness campaign on local radios, posters and fora for stakeholders and interest groups. The Kumasi Metropolitan Assembly (KMA) engaged Gold Street Real Estate limited the scheme operator through an open competitive bidding process for 40% of gross incomes. Although other paid on street parking schemes are operational in Accra and Takoradi, the Kumasi scheme is so far established. The area where the scheme is operational has a concentration of shops, restaurants, banks and offices which can best be described as a pedestrian open mall. There are 1200 on street stalls and three (3) off streets sites with total capacity of 1400; The Prempeh Assembly Hall (capacity of 200 vehicles) and KMA Central Car Parks (1200) are very remote from the CBD. Patrons of the Central Car Parks are transported in a bus procured from the scheme proceeds. The Prisons car park is within Adum but is the least developed with a capacity of 30 cars. On street parking fee of GH¢ 0.30/hr (US$ 0.32) and off street fee of GH¢ 0.50/day (US$ 0.53) were charged from inception up to May 2010. Rates of GH¢ 0.50/hr (US$ 0.35) and GH¢ 1.0/day (US$ 0.7) for on street and off street parking respectively are currently enforced. The scheme has reduced the number of illegal and wrongful parking in Adum. As of now shoppers perceive that it is easier to find parking at Adum nearer to one's destination, a situation Adu (2005) reported was worsening congestion in Adum as drivers drove slowly for several minutes looking for parking which was usually found at locations remote from their ultimate destinations.

III. METHODOLOGY

Data collection

Data were collected on two weekdays and a weekend (Saturday) in the Adum study area in April 2010 by trained observers. The data collection followed the methods of Adams et al. (2008) to enable trends to be deduced and results compared in a before and after analysis. To determine occupancy, sub hourly (15 minutes) variations were studied and reduced to hourly data. To determine turnover and duration, the last four digits of a vehicle's license plate were recorded. A total of 150 parking spaces out of a total 250 on the selected streets were surveyed constituting over 10% of all on street lots. The streets were representative of roads with brisk business (high demand for parking) and those with normal business. Prempeh II and Guggisberg links are brisk areas; Zongo and Apimpua have normal business. Data collection was undertaken from 7am to 5 pm daily when the scheme is operational. Monthly revenue data for the period 2007-2009 were also obtained from the management contractor. Data collection was completed just before the introduction of the new parking fee of GH¢ 0.50/hr for on street parking introduced in May 2010. This explains why the revenue analysis was terminated with the 2009 data on revenues.

Analysis of data

The data was reduced in an excel workbook and analysed to determine average duration of parking for each street, turnover, accumulation and occupancy for various times of the day. Data was retrieved from Adams et al. (2008) for the before situation in 2007 to aid before and after analysis. Two hypothesis were tested on turnover and duration in a before and after analysis by the analysis of variance technique (ANOVA). Trends in the revenue were analysed for any short falls in revenue. Site observations were used to explain and confirm some of the findings.

IV. RESULTS AND DISCUSSION

Average parking duration and Volumes parked

Four road links were selected for comparison, Tables 1-4 present results of average durations and volumes of vehicles parked before and after the scheme for the Guggisberg link, Prempeh II street, Apimpua road and Zongo road respectively. Parking durations were categorised as short term (up to 2hrs), medium term (2 – 4 hrs) and long term (more than 4 hrs). Table 1 shows that for the Guggisberg link, the average duration for short term parkers on weekdays increased from 49 minutes to 70 minutes. For medium term parkers and long term parkers, the average duration increased from 132 minutes to 184 minutes and 270 minutes to 375 minutes respectively. Average parking duration has increased by at least 35% for weekday and weekend parkers on the Guggisberg link. The situation on Prempeh II street is presented in Table 2, there has been a marginal increase of 8% and 10% in the duration of short term parkers for weekday and weekends respectively. Medium and long term parkers observed at least 14% change in average parking duration.

Table 1 Characteristics of parkers on Guggisberg link road

Category of Parking	Average duration before (2007)		Volume parked before (%)	Average duration after (2010)		Volume parked after (%)
	Weekday (mins)	Weekend (mins)		Weekday (mins)	Weekend (mins)	
Short term	49	20	62	70	31	40
Medium term	132	124	29	184	172	46
Long term	270	249	9	375	337	14

Table 2 Characteristics of parkers on the Prempeh II street

Category of Parking	Average duration before (2007)		Volume parked before (%)	Average duration after (2010)		Volume parked after (%)
	Weekday (mins)	Weekend (mins)		Weekday (mins)	Weekend (mins)	
Short term	36	30	92	39	33	73
Medium term	182	173	6	225	207	21
Long term	401	345	2	508	396	6

Table 3 Characteristics of parkers on the Apimpua road

Category of Parking	Average duration before (2007)		Volume parked before (%)	Average duration after (2010)		Volume parked after (%)
	Weekday (mins)	Weekend (mins)		Weekday (mins)	Weekend (mins)	
Short term	47	28	63	33	15	50
Medium term	182	171	24	131	135	36
Long term	400	345	13	260	307	14

Table 4 Characteristics of parkers on the Zongo road

Category of Parking	Average duration before (2007)		Volume parked before (%)	Average duration after (2010)		Volume parked after (%)
	Weekday (mins)	Weekend (mins)		Weekday (mins)	Weekend (mins)	
Short term	37	46	85	34	27	69
Medium term	153	275	5	110	139	20
Long term	358	345	10	251	294	11

Table 3 and Table 4 show the results of average duration for Apimpua and Zongo roads in Adum. Unlike the two previous streets, here the average duration for parking has generally reduced for all categories of parkers. Parking duration has reduced by between 8% and 46% respectively for weekdays and weekend for short term parkers, more than 21% for medium term, and the change for long term parkers were between 11% and 35%.

On Prempeh II and Guggisberg link roads, the volume of vehicles parked has declined in the after survey suggesting that parkers spend more time in the parking stall than it was in the before situation in 2007. This has implications for revenue and congestion on adjacent road links. The policy at Adum was to ensure high turnover of spaces and reduced parking duration. Prior to the inception of the pay parking, vehicles searching for parking often contributed significantly to congestion as they slowed down to look for available on street stalls. The increase in duration and reduction in volume could be attributed to the low parking charge, which was not punitive enough to reduce maximum occupancy, or poor monitoring of tickets which encourage parking assistants to collude with parkers to pay less money than they have parked. This situation has also been reported by Battelle et al. (2011).

Occupancy rates and Trends

Occupancy rates give an indication of the extent of utilisation of the facility at any time of the day, occupancy rates for Apimpua road are shown in Figure 1. Higher occupancy rates have been reported in 2010. Maximum occupancy values were 70% and 60% for weekday and weekends respectively in 2007; these have increased to 90% for both weekdays and weekends in 2010. Occupancies of 40% were experienced in the mornings at 9:00 am on weekends in 2007; this has gone up to 60% in 2010. The significant increases in occupancies indicate how busy the facility is operating. This represents a tremendous improvement in the parking situation as compared to the before situation (2007).

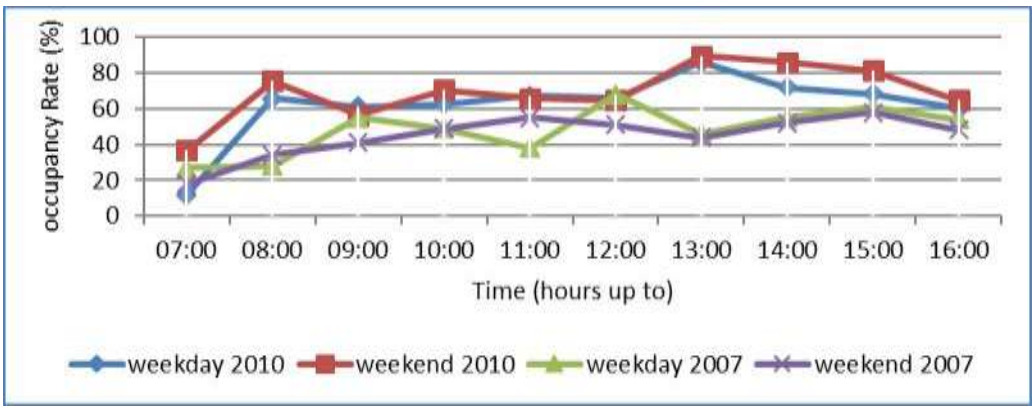

Figure 1 Occupancy trends on Apimpua road

Figure 2 presents the occupancy rates for the Prempeh II street, the results show marginal reduction in occupancy with weekday changes being more. Peak occupancy values of 91% - 95% for weekdays and 100% for weekends have decreased marginally to 66% - 79% and 91% respectively. It is important to observe that on this road which is one of the busiest streets in Adum, there has not been much deterioration in occupancy. As may be expected weekend occupancies are high (more than 80%) from 11:00 to 16:00 hrs. At Adum several shops start closure around 14:00 hrs because many shop owners and shoppers give prominence to attendance to funerals which often peaks on Saturdays from 14:00 hrs to 18:00 hrs.

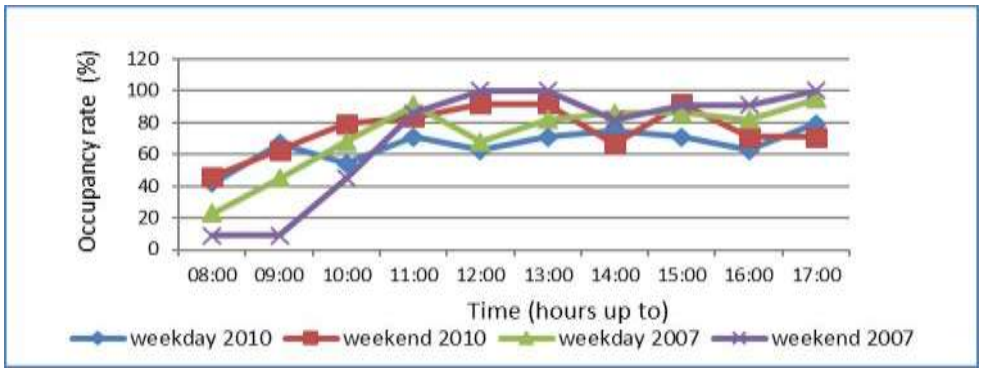

Figure 2 Occupancy trends on Prempeh II street

The high and sustained occupancy from 11:00 hrs to 15:00 hrs is indicative of a congested situation whereby shoppers and patrons cannot easily find parking near their destination. Battelle et al. (2011) states that in some states in the USA, a maximum occupancy of 0.85 is required and therefore parking charges are set to encourage drivers to limit their time in the CBD to a critical limit.

Before and After Comparison of Parking Turnover rate of spaces

A before and after analysis of the average turnover of space were tested at 5% significance level to determine the effectiveness of the scheme using the measured rates before and after the introduction of the parking scheme as given in Table 5.

Table 5 Average daily turnover rate of space before and after paid parking scheme

Description	Average Daily Turnover Rate (veh/bay)			
	Before (2007)		After (2010)	
	Average	Weekday	Average	Weekday
Prempeh II street	6.5	6.0	7.6	7.8
Guggisberg Link	5.0	4.0	5.4	6.0
Apimpua road	4.0	4.0	2.73	2.8
Zongo road	6.0	5.0	5.3	5.7

An analysis of variance between the before weekday rate of turnover and the after weekday turnover gave an F – value of 0.52 which was smaller than the F-critical value of 5.99 with a p –value of 0.497 which was also bigger than the 5% significance level. Thus, the null hypothesis could not be rejected. There is no strong evidence to infer that there is a difference between average weekday turnovers for the streets before and after the introduction of scheme. When an analysis of variance was also performed on the average values of turnover rates before and after introduction of the scheme, an F- value of 0.01 was obtained which was far smaller than the F-critical value of 5.99, the p – value of 0.921 obtained was also bigger than the 5% significance level, thus there is no significant change in the average turnover rate of space before and after the introduction of the parking scheme in Adum.

Before and After Comparison of Average Parking Durations

A before and after analysis of the average duration of parking for weekday, and the average daily parking duration were tested at 5% significance level to determine the effectiveness of the scheme using the measured average duration of parking for each street as given in Tables 6.

An analysis of variance between the before and after average weekday durations gave an F - value of 2.37 which was smaller than the F - critical value of 5.99, furthermore the p – value of 0.175 was greater than the 5% significance level. Thus there is no significant difference between the mean weekday duration of parking before and after the introduction of scheme. When an analysis of variance test was performed on average values of the parking duration before and after introduction of the parking scheme this time including weekends, the F-value was 0.49 which was also smaller than the F- critical value of 5.99, with a p – value of 0.512. Thus there is no significant difference in the average parking durations on the studied streets before and after the introduction of the parking scheme.

Table 6 Average duration of parking before and after paid parking scheme

Description	Average Duration (hours)					
	Before (2007)			After (2010)		
	Weekday	Weekend	Average	Weekday	Weekend	Average
Prempeh II street	0.90	0.65	0.78	1.12	0.84	0.98
Guggisberg Link	1.03	0.93	0.98	1.56	1.03	1.30
Apimpua road	1.33	1.25	1.74	2.06	2.14	2.10
Zongo road	1.27	1.15	1.21	1.23	1.21	1.22

It is worth noting that in fact, if we considered the means of the parking durations for both the weekday and average parking durations, one would observe that the mean durations after the introduction of the parking

scheme are higher than those measured in the before scenario (though not significant), thus drivers may be tending to actually park for comparatively longer periods after the introduction of the parking scheme. This may be indicative of low parking fees, poor enforcement and even corruption.

Effect of Parking Indices on Revenue

The revenue generated from parking consists of fees from on street and off street stalls, as well as penalty fees from wheel clamping or towing of illegally parked and over staying vehicles. Figure 3 shows the trend in revenues from January to December for three years. From Figure 3 we observe that the monthly revenues for 2008 were consistently higher than 2007 for all months except December 2008. For the period January to June 2009, the scheme was performing very poorly in revenue collection as the values were same or lower than the previous year. We recall that this period (December 2008 – June 2009) coincides with national elections and could be the result of changing metropolitan supervision staff. It is regrettable that even with the private sector management, the effect of politics generally felt within six months after elections has a profound effect on revenue mobilization.

As regards parking charges, the fee of GH¢ 0.30/hr ($ 0.32/hr) which was set in 2006 at the inception had reduced in real value due to the declining rate of the national currency and lost value to $ 0.21/hr in March 2010. This in part explains the increase in parking duration and the proportion of long term parkers.

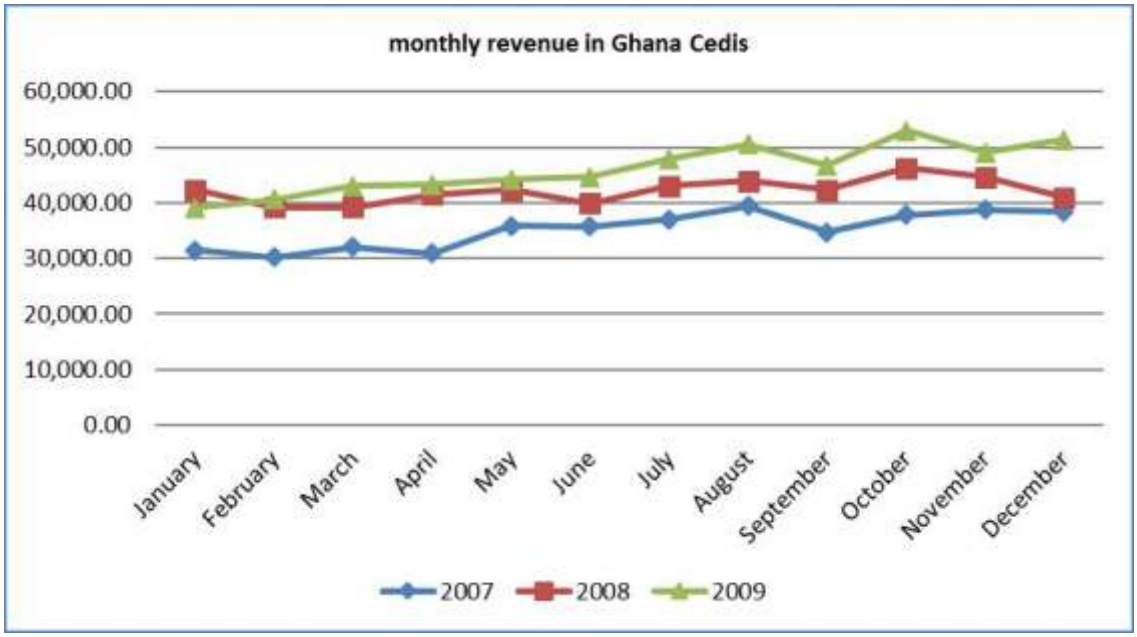

Figure 3 Trends in revenue collection from January 2007- December 2009

From the record of monthly receipts, the proportion of annual revenue from towing and clamping of illegally parked vehicles have decreased from 5.5% in 2007, to 5.1% and 4% in 2008 and 2009 respectively. This indicates a reduction in the extent of illegal parking with increasing turnover and availability of space. This shows that in real terms, fees collected from parking have increased over the period. The annual revenue for the period has been GH¢ 35,204.83 (US$ 37,451.95), GH¢ 42,151.67 (US$ 39, 765.73) and GH¢ 46,102.69 (US$ 32,696.96), for 2007, 2008 and 2009 respectively representing an average of 20% increase from 2007 to 2008 and 9% increase from 2008 to 2009. As can be observed, there is a disproportionate reduction in revenue when we compare the change in turnover with the reduction in revenue.

V. CONCLUSION AND RECOMMENDATION

Conclusions

The paper has assessed the paid parking scheme by testing two hypothesis on turnover and average duration in a before and after study. For the selected roads the study concludes that Average duration has increased on Prempeh II street and Guggisberg link and declined on Apimpua and Zongo roads. However at 5% significance level turnover and duration have not significantly changed. The increase in average parking

duration has not resulted in significant increases in revenue. The parking charges are too low to deter parkers, this helps to aggravate congestion on the adjacent streets.

The Adum pay parking scheme is still performing very well, but there is some evidence of slight deterioration in parking indices and some parameters. Turnovers have declined slightly and average parking duration has increased. There is not enough evidence to support the assertion that the scheme has deteriorated significantly. The proportion of parkers who park for more than two hours has gone up by 71%, while those who park for two to four hours only have gone up by 92%, these increases have not reflected as significant revenue. Intensive monitoring of the scheme, vigilance and close supervision will be required to keep the parameters from declining.

Recommendations

The following recommendations have been made from the study, the parking charge should be revised since it's too low and encourages long term parking. Monitoring and enforcement should be intensified to ensure that revenues are not leaked. A technology based parking charge collection and monitoring system can increase the revenue collection. An independent periodic evaluation and monitoring should be made part of the scheme management.

ACKNOWLEDGEMENT

I wish to thank my students who put in a lot of effort to collect the data during their graduate and undergraduate dissertations especially, Dzefi Sefiamor, Frank Fomenya, Juliet Adu, and Kate Amissah.

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