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An Emphatical Approach Traffic Congestion under Different Formulations- A Review

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Abstract
While studies has shown that traffic congestion may cause company operations to be disrupted and productivity levels to be reduced, it has also demonstrated that it can serve as a sign of economic prosperity in certain cases. As the economy expands and real income of households rises, the number of vehicles on the road increases dramatically, leading to traffic congestion, especially in urban areas. Given the vital relevance of productivity growth to the development of the Gross Domestic Product (GDP), it is both economically profitable and important from a policy standpoint to acknowledge the negative impact of traffic congestion on productivity growth. The purpose of this research is to determine the degree to which traffic congestion reduces worker productivity. The research focuses on the transportation system of Hyderabad Metropolis, which is located in India. It was decided to conduct the study in Kumasi owing to the city's vital position as a transit centre connecting the city's northern, southern, central, and western regions, which renders it prone to traffic congestion. The survey approach used in the research was used to five key road connections in the city. The primary data was gathered via the use of a questionnaire instrument. To analyse the data, descriptive statistics were utilised in conjunction with the Statistical Package for the Social Sciences (SPSS) (SPSS). According to the findings of the study, mobility in Hyderabad Metropolis is constrained as a consequence of traffic congestion, which results in unnecessary travel delays, especially during peak hours, and has a detrimental impact on employee productivity. As a result, improving the transportation infrastructure in the metropolis, as well as improving the traffic management and control system, should be prioritised in order to enhance the transportation system in the metropolis This would raise worker productivity, which would eventually result in a rise in GDP.

Key words: Transportation system, Traffic congestion, worker productivity.

1. Introduction

Increasing the well-being of citizens is the goal of any country. For decades, the government's long-

term objective has been to increase the quality of life of all Hyderabadians to the middle-income level. When we talk about economic and social progress, it's hard not to bring up the topic of transportation. Providing access to a wide range of activities is the goal of transportation, which is a living process in itself (Arasan 2012).

A well-functioning transportation infrastructure is critical to maintaining economic development in today's world, according to Eddington (2006), since it connects various sections of the nation with the rest of the globe. Logistics, supply chain and international commerce are all supported by this infrastructure. It is not only essential for national growth, but it also acts as a stimulant for economic progress in countries. As a result, productivity is linked to mobility (Lu et al. 2009).

Transportation is at the heart of human life's economic and social activities. It has a direct impact on almost every part of the economy. Transportation is essential to almost every aspect of our lives. Trade within and across areas is critical to economic growth, and transportation is a major factor in this process (Kulash 1999, World Bank 2002). As a result, transportation's role in society's development cannot be overstated. According to Broadstock (2011) and Pacione (2005), there has been an increase in automobile ownership due to an increase in income and population and the availability of vehicle lending facilities. It's safe to assume from the above statement that the prevalence of private automobile use, especially in urban areas, will grow even more as family incomes rise, resulting in increased traffic and higher fuel consumption.

Cars and taxis rule the city's transportation scene once again in Kumasi. There are too many automobiles and taxis in the Central Business District (CBD). Even though cars and taxis account for 77% of total traffic, people only use them for 30% of their journeys (Urban Roads 2004). As a result, the city's logistics system and commercial operations have been adversely affected by the city's chronically congested traffic, particularly in the CBD. The purpose of this article is to investigate the impact of traffic congestion on worker productivity in the Hyderabad Metropolitan Area.

2. UrbanTransportation

The term "urban transportation" refers to the network of roads, rails, waterways, and airways that connects and moves people and products inside cities. Public transportation, non-motorized transportation (pedestrians and cyclists), and freight are all components of urban mobility. The quality of life and economic vitality of a city are directly linked to its transportation infrastructure. By using public transit in cities, people have the ability to more easily access both critical services and enjoyable social activities (Arasan 2012, Rodrigue et al. 2009, Lu et al. 2009). Customers, workers, and suppliers all rely on urban transit networks to get around. A wide variety of vital social and economic functions are served by urban transportation services, such as travel for pleasure and business, transportation to and from work or school, and the transportation of goods. A city's need for accessibility may be met by implementing efficient urban transportation (Okoko 2006). Another component that directly impacts metropolitan transit capacity is transportation infrastructure, according to Rodrique and colleagues (2008) and Arasan (2012,) respectively. Roads, parking lots, cars, and transit terminals make up the majority of the transportation infrastructure. Additionally, a city's traffic control and distribution may be improved with the implementation of an urban traffic management system.

3. Factors of Effective and Efficient TransportationSystem

According to Eddington (2006), the city's transportation system is influenced by a variety of

elements, including the availability of an appropriate transportation network, an efficient traffic management and control system, and a dependable mass transit system. According to Nadiri (1998), an investment in suitable transportation infrastructure enhances transportation efficiency in terms of higher productivity, and this includes a well-developed road network, adequate bus stops, and parking places with traffic signals. Mass transit, according to Shapiro et al. (2002), is a pre-requisite for an urban transportation system that saves energy, reduces traffic, and protects the environment. They claim that a successful mass transportation system is based on the availability, accessibility, and dependability of buses. The urban transportation system relies on a well-designed traffic control and management system. Management and regulation of traffic lights, roadways as well as parking spaces and road users are all part of this process (Arasan 2012; Jones 1999).

4. The Impact of Transportation onProductivity

Productivity has to deal with the ratio of volume measure of output to the volume measure of input. It measures the extent to which production input is utilized to produce output in the production process. Economic growth and business competitiveness is underpinned by productivity growth (Organization for Economic Co-operation and Development (OECD) 2006; Nadiri 1996). Nadiri (1996) argues that the input of productivity is a state or national investment in transportation whilst the output is gross domestic product (GDP) growth. An effective transportation system is therefore key in sustaining economic growth in the contemporary economies by its capacity to link people to job, deliver products to markets where there is demand, drives supply chain and logistics and enabling domestic and internationaltrade.

Again improvement in transportation efficiency can influence cost of doing business, travel time, forecast reliability, comfort, safety and security of commuters. The direct benefit of an efficient and effective transportation system reflects in the reduced travel time, which translates into cost saving, increase in output and ultimately GDP (Kulash 1999, World Bank 2002). Eddington added that travel reliability is critical to some business sectors, especially those that deal with perishable goods as well as those that rely on just- in- time (JIT) deliveries. That is, to some businesses, productivity growth is underpinned by what they termed as predictable and time- critical deliveries. This view is further shared by Weisbrod and Reno (2009), when they state that effective transportation system increases productivity in terms of job creation, reduction in business operation cost, improved output, expanded market and increase in economiccompetitiveness.

They continue to suggest that effective transportation system contributes to productivity by improving business ability to provide goods and services, improving people's ability to access education and health services, create employment and reduce vehicle operation cost as well as emission and safety benefits. Thus effective transportation system improves productivity which is a key determinant of economic growth and living standards.

5. Traffic Congestion

Roger et al. (2009) believe that congestion is inevitable due to limited transportation infrastructure such as road space, parking lots and traffic management. They claim that urban congestion affects two modes of transport: people and freight. Thus, traffic congestion arises due to overuse of road infrastructure, resulting in slower speeds, longer journey times, and greater vehicle waiting.

According to Downie (2008), traffic congestion occurs when vehicle traffic exceeds available road capacity, a condition known as saturation. He lists particular factors that create or exacerbate

congestion. Most of these situations include a loss in road capacity at a particular location or length, or an increase in the number of vehicles necessary to convey people and cargo. A tremendous growth in vehicle numbers has overwhelmed transportation infrastructure, generating congestion on city highways, according to Downie (2008). According to Rodnique et al. (2009), commute patterns drive most urban congestion, not truck traffic. They also blamed rising population density, road accidents, and damaged automobiles for limiting road capacity and disrupting traffic flow.

Parking, according to Herman (2001) and Downie (2008), contributes to congestion. He believes that excessive road parking has become a land problem, increasing demand for urban property and producing congestion. He adds that high urban mobility rates exacerbate congestion. Massive vehicle usage not only causes traffic congestion but also reduces the efficiency of public transportation, making city commuting difficult. The over-reliance on vehicles has raised demand for transportation infrastructure. Sadly, transportation infrastructure has never kept pace with rising mobility demands. As a consequence of traffic congestion, some cars spend most of their time in gridlock (Yan and Crooks 2010).

According to Urban Roads (2004), traffic congestion in Kumasi is caused by inadequate road capacity, parking, malfunctioning road signals, driver conduct, vehicle breakdowns, and an overpopulation of automobiles. Rodnique et al. (2009) provide various solutions to the congestion problem. They highlight traffic signal synchronisation, incident management, congestion pricing, and public transportation as possibly viable solutions to cope with congestion, notwithstanding its obstacles.

6. Traffic Congestion andProductivity

A city's economy is seldom free of traffic congestion. In order to alleviate commuters from the challenges caused by traffic congestion, local authorities must design strategies to assist manage congestion on an economical basis (May and Marsden 2007, Yildirim 2001).

They claim that there is little agreement on the sort of policy that may be employed to reduce urban congestion and that there is no obvious answer. People who live in cities have become used to traffic congestion as part of city life. They maintain that traffic congestion in cities is a sign of successful socio-economic growth — more business, employment, and culture. These factors encourage enterprises to locate in cities to achieve economic advantage.

However, May and Marsden (2007) claim that congestion restricts our freedom of movement, disrupts city business, and diminishes productivity. Congestion slows traffic progress. For example, transportation mobility can best supply a broad variety of activities, services, commodities, and marketplaces in cities. According to the survey, unstable transport circumstances inside cities impair production by increasing inventory holding by manufacturers and merchants. Logistics delivery is vital to business activity. However, transportation congestion in cities reduces freight flow and consequently productivity.

Weisbrod et al. (2003) state that rising traffic congestion costs passengers and businesses. Business that rely on inbound deliveries are particularly impacted by traffic congestion, which reduces production. Thus, traffic congestion raises company costs. Delays in time-sensitive logistics may increase inventory and logistics costs. Congestion reduces the responsiveness of lean management systems like just-in-time.

According to Weisbod et al. (2003), traffic congestion reduces worker and customer access to jobs and shops, reducing output. Crowther et al (1963) claim that halving traffic congestion would have

enormous economic benefits. This remark supports the claim that traffic congestion reduces productivity. In fact, from August 14 to 26, 2010, traffic congestion in one of China's provinces, Habee, spanned above 100km (Hickman 2010). This condition clearly affects productivity and overall socio-economic growth.

A challenge faced by 21st century industries is ensuring reliable just-in-time deliveries for increased productivity and competitiveness, according to Lewis and Downie (2008). Poole (1998) and Eddington (2006) claim that the economic costs of congestion include lost time due to travel delays and unreliable transit, additional fuel, environmental harm, and health costs.

Figures 1 and 2 provide a graphical depiction of Hyderabad's transportation scenario and possible outcomes. It tries to explain how rising money leads to more car ownership, which leads to more traffic congestion. High energy consumption, environmental implications, and reduced productivity are possible outcomes of this circumstance, affecting the national socio-economic growth. However, good infrastructure, traffic control, and public transit will lead to a successful transportation system. This will enhance energy efficiency, logistics, and individual and national production.

Methodology

Deduction approach was used for this study. The study used survey with multiple cases of road links. Primary data was collected using questionnaire instrument. Commuters working in the formal sector within Hyderabad Metropolis and drivers that use passenger vehicles constituted the study population

The Study Population, Sample size and samplingtechniques

The population for this study included drivers that use passenger vehicles (taxis and mini-buses) that ply the roads within Kumasi and commuters. These groups were purposively targeted with the view that they could provide relevant information in relation to the research question since they constitute major stakeholders in passenger transportation within the city. There are twenty-one selected key road links in the metropolis with their respective levels of congestion records (Urban Roads 2004).

It was realised that using all the twenty-one key road links for the study would present practical challenges. In the light of this, the researcher sampled the first five out of the twenty-one (21) key road links. Purposive sampling was used in this selection to enable the researchers select road links with high traffic congestion records. The five key roads understudy is presented in table 1. Since the number of various vehicles plying the five road links understudy has not been fully established, it was impossible to construct a sample frame for the drivers and commuters. For this reason the researchers used quota sampling techniques. The average traffic volume of the five road links understudy, as has been established by Urban Roads Department (2004), was 63.46 vehicles per minute. This is presented in table2.

Based on this, and the fact that the five road links bore similar characteristics in terms of the vehicles that ply them, a quota of sixty (60) drivers of passenger vehicles was allocated to each of the five roads to make a sample size of 300 for the drivers. The quota distribution rate for each road comprised of forty-one (41) taxi drivers and nineteen (19) mini bus (trotro) drivers. This was based on the distribution rate of traffic mix in the metropolis as established by urban Roads, Kumasi. This is presented in table 3. The respondents from each category were selected using systematic random sampling based on every third driver met at the terminals. The drivers were given higher quota than the commuters due to the technical information required which could best be provided by them.

Again a hundred and fifty (150) commuters working in the formal sector were involved in the study with a quota of thirty (30) from each road. The 30 respondents from each road were also selected randomly so that each has an equal chance of being selected. Thus making for a total respondent of four hundred and fifty-five (450).

Table 1-Volume of Traffic Flow Analysis

Road Link	Peak Total Volume Per Hour	Peak Total Volume Per Minute
Manpong Road	5,394	89.9
Sunyani Road	4,219	70.3
Antoah Road	3,860	64.3
24th Feb. Road	3,202	53.4
Harper Road	2,148	35.8
Wtd. Average	3,764	63.46

Source: modified from Urban Roads Report(2004)

Table 2 - Key Roads in Order of Congestion Level

Rank	Name of Road	Functional Class	Study Length (km)	Congestion Index (CI)
1	Mampong Road	Principal Arterial	5.0	13.8
2	Suyani Road	Principal Arterial	3.3	8.9
3	Antoa Road	Pricipal Arterial	5.5	6.0
4	24th Feb. Road	Principal Arterial	5.4	5.8
5	Harper Road	Principal Arterial	2.5	5.6

Source: Urban Roads Report(2004), Kumasi.

Table 3- Distribution of trafficmix

Type of Vehicle	Number of Vehicles
Private vehicle	33 %
Taxi	44 %
MinBus(Trotro)	19 %
Large Bus	4 %
TOTAL	100 %

Source: Urban Roads Report.(2004)

Table 4- Category ofRespondents

CATEGORY	SAMPLE SIZE
Driver	300
Commuter	150

Total	450

Source: Researcher's field work (2012)

Table 5- Sample and Response Rate

Respondents	Sample Size	Response Rate
Drivers	300	300(100%)
Commuters	150	135(90%)
Total	450	435(96.7%)

Source: field data (2012)

7. Method of Data Collection andAnalysis

Primary data used for the study was obtained from the researcher's field data where four hundred and thirty-five

(435) out of four hundred fifty (450) drivers and commuters from the five key road links under the study gave responses from sets of questionnaire. Both self-administered and interviewer-administered questionnaires were used for the study. This allowed for responses from the respondents with varying characteristics, some of whom required further assistance in providing responses.

The questionnaires used were closed ended with five point likert scale, ranging from 1= Strongly Disagree to 5= Strongly Agree. Respondents were given the chance to tick or rank the most appropriate response(s). The researchers used two different sets of questionnaires. The first was used to collect information from taxi and 'trotro' drivers whilst the other was used to collect responses from commuters. The questionnaires were delivered to the respondents by the researchers. Where necessary, the researchers read out and explained the questions to the respondents whose literacy level were low and were unable to read and understand for relevant responses. The researchers used descriptive statistics of simple averages to analyse the field data with the aid of statistical package for social sciences (SPSS) and Microsoft ExcelSoftware.

8. Results andDiscussions

8.1 The Effect of the Transportation System on Worker Productivity (mini-busDrivers)

Table 6 - Effect of the transportation system on Driver's Productivity

ariables/ca tegories	**Expected no. of trips (Off Peak Traffic Hrs.) (%)**	**Actual No. of trips (Peak Traffic Hrs.) (%)**	**Expected Income (Gh¢) (OffPeak TrafficHrs.)(%)**	**Actual Income (Gh¢) (Peak Traffic Hrs.)(%)**
10- 15 trips		81		
16- 20 trips	82.6	19		

More than 20 trips	17.4	-		
TOTAL	100	100		
35-40				78.8
41– 45			79.3	21.2
46 – 50			20.7	
51 – 55				
TOTAL			100	100

Source: Researchers field work, 2012

Table 6 shows the average number of trips and income generated by mini-bus (Trotro) drivers based on in the situation where there is less or no traffic and in situation of intense traffic. The respondents were asked the number of journey trips and income they were able to make on the normal day based on the current transportation situation in the Hyderabad Metropolis and what they were expected to make. 81% of the trotro drivers indicated that on the average, they made a maximum of about 15 journey trips instead of 20 trips expected as a resultof the traffic situation in Hyderabad Metropolis. With respect to income, 78.8% indicated that, on the average they made a maximum of between GH¢35 and GH¢ 40 instead of between GH¢46- GH¢50 expected due to the traffic situation in Hyderabad Metropolis. The drastic decrease in expected income of the mini-bus (trotro) drivers shows the magnitude of loss they incur due to the traffic congestion situations in the Hyderabad Metropolis.

Table 7 - Effect of the transportation system Productivity (Taxi Drivers)

Variables/categories	Expected no. of No Traffic) (%)	Actual No. of trips (During Traffic) (%)	Expected Income (Gh¢) (No Traffic)(%)	Actual Income Gh¢) (During Traffic)(%)
10- 15 trips		86.2		
16- 20 trips	82.5	13.8		
More than 20 trips	17.5	-		
TOTAL	100	100		
20 – 25				88.6
26 – 30			83.8	11.4
31 – 35			16.2	
TOTAL			100	100

Source: Researchers field work, 2012

Table 7 shows the average number of journey trips and income generated by taxi drivers based on in the situation where there was less or no traffic and in situation of intense traffic. The respondents were asked the number of trips they were able to make on the normal day as well as the income level based on the current transportation situation in the Hyderabad Metropolis and what they were expected to make. 86.2% of the taxi drivers indicated that on the average, they made a maximum of

about 15 journey trips instead of 20 trips expected as a result of the traffic situation in Hyderabad Metropolis. With respect to income, 88.6% indicated that, on the average they made a maximum of between GH¢20 and GH¢ 25 instead of between GH¢30- GH¢35 expected due to the traffic situation in Hyderabad Metropolis. This represents an average income loss of 14.3% to the taxi drivers captured. The drastic decrease in expected income of the taxi drivers shows the magnitude of loss they incur due to the traffic congestion situations in the Hyderabad Metropolis.

Table 8- the effect of transportation system in productivity (FormalSector Workers)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Mandated hours of work	135	7.30	12.00	9.34	1.21
Report late	135	.25	1.00	.88	.22

Source: Researchers field work, 2012

0.8759 x 100 = 9.4%
9.3422 hours.
Table 8 shows the average mandated number of working hours public and private workers (Commuters) surveyed by the researcher. It was identified that workers work for an average of nine (9) hours and thirty-four (34) minutes. But they waste an average of fifty-two minutes and eight seconds (52.8) because they report late for work. This represents an average of 9.4% of work time per day. This is identified as a significant productive period wasted because of late arrival to work due to the transportation situation in the Hyderabad Metropolis. This corroborated the findings from the observation and the key informants about how the transportation system in Hyderabad Metropolis affects workerproductivity.

9. Conclusion

9.1 The informal Sector Productivity (TroTro and TaxiDrivers)

The main objective of the study was to assess the extent to which congestion affects worker productivity. The analysis of the study revealed that congestion in the Hyderabad Metropolis has negative effect on worker productivity in the informal sector. More than78% of the mini-bus drivers indicated that, on the average they made a maximum of between GH¢35 and GH¢ 40 instead of between GH¢46- GH¢50 expected representing an average income loss of 21.9% due to the traffic situation in the Hyderabad Metropolis.

The case of taxi drivers was no different. More than 88% of the taxi drivers contacted indicated that, on the average they made a maximum of between GH¢20 and GH¢ 25 instead of between GH¢30- GH¢35 expected due to the traffic situation in the Hyderabad Metropolis. This represents an average income loss of 14.3% to the taxi drivers captured.

9.2 The Formal Sector Productivity

In the formal sectors, the negative effect of the transportation system in the metropolis on worker productivity was evident. The study revealed that the average mandated number of hours of about 9 hours a day was reduced by 0.88 of an hour (52.8 minutes) a day, which represents an average of 9% loss of productive hours a day and loss of over two working days in a month. This has obvious

implications on the economy. Thus the traffic congestion in the Hyderabad Metropolis is negatively affecting worker productivity, confirming the existing theory by researchers like Eddington, (2006), Weisbrod (2010), May and Marsden, (2007) and Nadiri (1996) that traffic congestion has negative effect onproductivity.

10. Recommendations

Based on the findings and the conclusions drawn from the study, the following recommendations are made by the researchers:

1. The authorities of urban road transport in the metropolis should embark on regular education campaign to sensitise the road users on effective utilization ofroads.
2. They should also construct additional bus stops and expand those with narrow lay-byes to prevent packing and stopping at unapprovedplaces.
3. Again, they should fix all dysfunctional road signals at various intersections and ensure regular maintenance to check effective trafficflows.
4. Policy makers of the road transport management should initiate the provision of well equipped quick traffic response unit to deal with frequent vehicle breakdowns on theroad.
5. The metropolitan authority must be improved upon the satellite markets in various sub-metros and communities within the metropolis and new ones constructed in order to decentralise the economic activities in the metropolis and to ultimately reduce the volume of vehicular inflow to theCBD.
6. Further studies into the mass transit system and how it can reduce traffic congestion isrecommended

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