Research Article

Determinants of Traffic Congestion in the Metropolis of Douala, Cameroon: An integrated approach.

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Abstract

Urban transportation has had a cardinal role in enhancing economic growth especially in the advanced countries of the World. This might not be true in developing countries where traffic congestion especially in urban metropolises is highly recorded. It is on the bases of the problem associated with poor growth in most developing countries that this work was conceived to investigate into the determinants of traffic congestion in the Douala metropolis, the economic capital of Cameroon. To achieve the goal of this study, a survey research designed was adopted on the bases of which primary and secondary data were collected and analyses. While the Primary data were observed at points of traffic congestion in Douala, the secondary data were obtained from the World Bank Database. The secondary data were analysed using the Vector Auto Regressive (VAR) technique. Based on the VAR technique, the study reveals that economic growth has a causal positive influenced on its self, real fuel consumption and further urban agglomeration. On the other hand, urban agglomeration used as a proxy for traffic congestion has a negative effect on urban growth and economic growth. Based on the above results, it is recommended that a remedial infrastructural development plan and a sustainable polycentric land use pattern with alternative efficient mode of public and private transportation be put in place for the future.

Keywords: Urban Transportation, Urban Agglomeration, Road Traffic Congestion, Agglomeration Economies, Monocentricity and Polycentrism.

Résumé

Le transport urbain est considéré comme essentiel dans l'amélioration de la croissance économique, notamment dans les pays développés. Cela pourrait ne pas être vrai dans les pays en développement où la congestion du trafic, en particulier dans les métropoles urbaines est fortement observée. C'est sur cette base que ce travail est effectué en vue d'étudier les déterminants de la congestion de la circulation dans la métropole de Douala. La présente recherche est effectuée à partir d'une combinaison de données primaires et secondaires de la base de données de la Banque mondiale. Les données secondaires ont été analysées en utilisant le vecteur autorégressif (VAR). Sur la base du VAR, l'étude révèle que la croissance économique urbaine est influencée positivement par la croissance du revenu par habitant, la consommation réelle de carburant et une autre agglomération urbaine. D'autre part, l'agglomération urbaine, utilisée comme un proxy de la congestion du trafic, a un effet négatif sur la croissance urbaine. C'est sur la base des résultats ci-dessus que cette étude recommande la mise est place d' un plan de développement des infrastructures de rattrapage et un modèle d'utilisation des terres de polycentrisme plus durable comme mode alternatif efficace de transport public et privé .

Mots clé : Transport Urbain, Agglomération Urbaine, Congestion du Trafic, Agglomération Économique, Monocentrisme et Polycentrisme

INTRODUCTION

Traffic congestion seen as part of urban economics has over the years gained credible attention. This is basically, because urban centres have grown into metropolises with their reluctant numerous serious problems among which are traffic congestion, pollution, increase cost in fleet maintenance and fuel consumption. These different problems have become the foundation for the new area in Economic Geography championed by Paul Krugman and Masahisa Fujita(2004) especially in trying to explain issues on development in major metropolis. The goal of this new area of knowledge is to explain the formation of a large variety of economic agglomeration or concentration in geographical space. This agglomeration or clustering of economic activity occurs at many geographical levels with a variety of compositions. According to Fujita and Krugman (2004) there is need for a general equilibrium model that explains this agglomeration and dispersion because they are all embedded in the global economy, which tends to produce a dualism of North-South Structure. The theories of the new economic geography evolved from the works of Solow and Vickrey (1971), Solow (1972), Kanemoto (1976), and Arnott (1979), forming the basic macroscopic model of traffic congestion into the monocentric city model of the new urban economics.

Cities especially those in Africa have grown rapidly around ports or rail stations for the purpose of trade. However, there are new factors introduced in the models of agglomeration economics where theories like Coarse theorem, the Von Thünen theory as well as other international trade theories of specialization have failed to explain. Thus, the dynamics of agglomeration or concentration economics have evolved in recent times seriously and the net result is traffic congestion. Consequently, there is the need for a general equilibrium model which is expected to discuss both the centripetal forces of agglomeration or concentration and the centrifugal forces of dispersion especially in the advent of industrialization policies of multiple Centre Business Districts (polycentricism) and changing land uses as it is the case in Douala. As such, some considerable amount of controversies still lingers in two folds about the impact of road improvement as way of reducing traffic congestion. That is, will an improvement in road infrastructure induce real economic growth or will it function as a lead or lag factor in real economic growth? While attempts have been made to answer the above question by policy makers in different rapidly grown cities in the world, no clear cut conclusion has been arrived at in developing countries thus creating a huge research gap in this area.

African cities mostly rely on road transport system considering that it handles about 80 % of the movement of goods and passengers respectively within the continent (UTIP, 2010). This makes the road transport system very vital in the land use pattern and the growth of African metropolis. On the other hand, the distribution of road network within the continent shows that out of Africa's total road network of 2,423,393km, just over 580,066km (23.9 percent) has been paved (UTIP, 2010). The distribution of this 23.9 % revealed that Northern Africa ranks highest followed by Southern Africa with 49 and 27 % of paved roads respectively. The last three segment include; West Africa with 13%, Eastern Africa with 10% and Central Africa with just 1% of paved roads (World Development Indicator, 2008). Although the above statistics are old, by the speed of adjustment between 1970 till date, none of these zones in Africa has improved upon its situation for more than 1 period of pervious value. Furthermore, a study by NEPAD in 2006 and reported in UTIP, 2010 showed that there were over 20 million road vehicles in Africa; 58 percent

in Southern Africa, 21 percent in Western Africa, 11 percent in Eastern Africa and 2 percent in Central Africa. This indicates a deficiency in road transport facilities within the continent. This is evident as Africa has a road density of 8.3 km per 100sq.Km, a low value compared to those of Asia (over 18km/100sq. Km) and Latin America (over 12km/100sq. Km) (UNESC, 2009).

This has resulted in the proliferation of various modes of road transportation especially with the inefficiency in public transportation due to poor road networks. Consequently, there is the prevalence of motorbikes in major African cities like Douala, Bamenda and Kampala just to name these few. UNESC (2009) reported that, the use of motorbikes for commercial transport started growing significantly in Douala and Kampala since 2000 due to the inefficiency of the bus and taxi services arising from poor roads. However, the nature of the cars used as commercial buses and trucks in Africa with an average age of 20 years as opposed to the average of less than 10 years from industrialized countries (UNESC, 2009) is also a call for concern. These and many more are predicted to have accounted for traffic congestion in African cities. In spite all theses identified factors traffic continue to remain a major problem in African cities with Douala being no exception. It is for this reason that this study seeks to identify the determinants of traffic congestion in the Douala Metropolis so as to recommend a sustainable strategy. Specifically the study investigated the extent to which infrastructure, urbanisation and economic growth among other factors influenced traffic congestion in the economic metropolis of Douala and the most efficient approach that can be adopted in order to tackle the problem. Upon completion, this study shall be of immense benefit to the Transport and logistics industry, Ministry of Town Planning and Urban Development, the private firms and the Government of Cameroon at large.

THE STUDY AREA

Douala the economic capital of Cameroon determines a lot about the growth and development of Cameroon. Due to her position as a sea port town, Douala has attracted a lot of manufacturing firms producing for domestic consumption and exportation. The speed at which production and distribution are expected to flow are retarded because of traffic congestion. The demand for mobility or transportation services is sequel to the day to day demand for critical economic services, as labour services are required daily to power the various sectors: business ideas are shared on face-to-face business interaction and goods and services are also required to be delivered on just-in-time basis. All of these utilities put together depend on road transports services especially in the port city of Douala. This explains why road transport efficiency affects regional/national economic growth. It is in this light that the Industrial Free Trade Zones of Bonaberi, Bassa and Ndizengué were established. However, the economic crises of the late 80s that resulted in austerity measures and retrenchment pushed many people into the public transport sector with no corresponding increase in the road transport infrastructure. This has increased the demand for used cars as taxis to compensate for the fallen income. It has also affected the activities of the Douala port as the activities of the port dropped from 4.5 million tonnes – 3.7 million tonnes of cargo by 1993 (UTIP, 2010). By 1995, the Douala City Council (CUD) in collaboration with the central government created the *Société des Transports Urbains du Cameroun* (SOTUC) in an attempt to improve on public transportation and make it cost efficient on the principle of economy of scale. However, due to the poor nature of the roads the company faced out by 2000 with stiff competition from over 10,000 illegal taxis (UTIP, 2010) as her activities were no longer competitive and mismanagement had plagued the institution. By 2001, the government liberalized the public

transport sector, without increasing the paved road network of Douala which stood at 1,800km squared just about 470km square had been paved giving Douala a road density of 0.7km/1000 inhabitants, less than that of Kinshasa, Brazzaville and Lome with 0.9, 1.10 and 1.7 km/ 1000 inhabitants respectively (UTIP, 2010). Despite the replacement of the "City Contract" with the "Contract of Objective" as well as the ad hoc measures of clearing houses and business extension to the roads such as payment of fines for poor parking, wrong usage of roads, ban to motorbikes for using some parts of the roads, nodal congestion, parking congestion and many other forms, traffic congestion remain a major menace to the economic growth of the region and the nation. However, besides the poor nature of the roads, many other factors associated with land use such as lack of parking lots, poorly planned markets, and non functionality of some traffic control lighting system are common characteristics of Douala. This problem of traffic congestion in Douala and its corresponding effects on regional/national economic growth in the metropolis of Cameroon therefore necessitates this study to critically examine the determinants of traffic congestion in the metropolis of Douala.

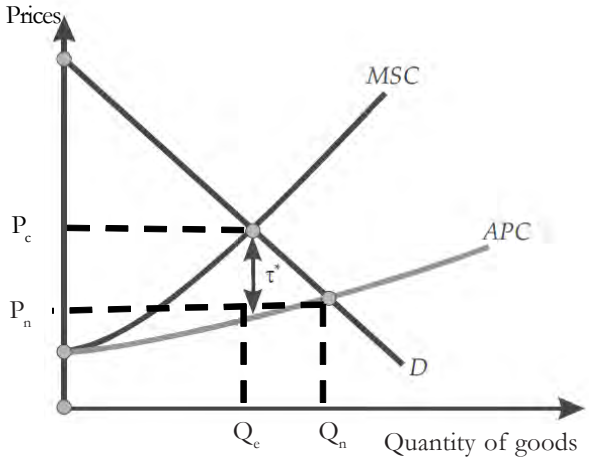
Looking at the morphology of the Douala metropolis, most activities seem to be centralised in Akwa and Bananjo. Akwa has a concentration of commercial activities while Banajo has a concentration of administrative functions. Despite the 1990 Free Trade Zone Legislation which should have produced a polycentric morphology of the Douala metropolis, the poor nature of road and the insufficient road infrastructure only made the bottleneck element of roads in Douala worse with the classic examples of Bonaberi and Ndogpassi which have heavy traffic from the South West Region and periphery towns of the Littoral Region besides the industrial Free Trade zone of Bonabéri and flows from Yaoundé besides the Industrial Free Trade Zone of Ndizengué – Edea respectively.

Theoretical Literature

People as rational beings always want to maximise the utility gotten from a product or service. Likewise all economic agents seek profit maximisation and/or cost minimisation. This is the one attitude that guides economic agents when taking decision about locations of business activities or the supplies of labour. This justifies the centripetal forces within metropolis that is either agglomeration or concentration economies - monocentricity. However, an efficient transport system which is reliable and cost efficient serves as a centrifugal force of a metropolis that is monocentric. Thus, the availability of alternative transport modes with poor accessibility will be inefficient and redundant. In other words the essence of transport service is easy accessibility for the free flow of goods and services. It is in this light that congestion economics become central for regional and national economic growth. Traffic congestion therefore refers to recurrent congestion, non–recurrent congestion and the pre –congestion dimensions. This classification is based on the predictability of congestion by Brownfield et al., (2003). However, there are other elements or categorization of traffic congestion which is the nodal congestion. This refers to urban travel intersection congestion and freeway entrance and exit congestion (Fujita and Krugman, 2004). Other forms of congestion include pedestrian-car interaction, entry into and exit from parking, merging, and phenomena deriving from the physical length of cars such as gridlock and from the interaction between different vehicle types (Fujita and Krugman, 2004). In addition, all of these forms of congestion are summed up as transport services efficiency. This includes the microscopic model decision of drivers wanting to maximise travel by avoiding points of nodal congestion or charging higher fare (Fujita and Krugman, 2004). The

choice of road transport service has been justified by other scholars to be due to the central role that road transport service plays in the intraurban travel and the nodal congestion that inter urban transport faces. All of these play a key role in the level of economic activities. This thus translates itself into the rate of the growth of the region and even the nation especially when the centrifugal forces exceed the centripetal forces of agglomeration and concentration (Fujita and Krugman, 2004).

The volume of economic activities in an economy makes up the sum total of income earned or the sum total of expenditures on goods and services within this economy for a given period of usually year (Jhingan, 1990). A reduction in the volume of economic activities due to delays in traffic congestion actually reduces the level of economic activities and thus the real gross domestic product of that economy (Jhingan, 1990). Also these delays sometimes results in artificial shortage and cause the price to increase without a corresponding improvement in the quality of the transport service (Jhingan, 1990). In sum, the factoring (internalising) of congestion cost in the production function only inflates the nominal gross domestic product (GDP) with no corresponding increase in the quality of the good and service in the presence of Monocentricity when considering the Coase Analysis (Jhingan, 1990). Most urban economists argue in favour of a traffic toll so as to restore efficiency in the economy. However, traffic toll only get back the congestion costs excess of the price but does not correct the economic behavioural especially when the factors of inertia are better than the traffic toll (Fujita and Krugman, 2004). Monocentricity is the key element that introduces industrial inertia or agglomeration inertia. Borrowing from the basic model of Beckmann *et al.*, (1956) as presented in figure 1. In the Basic Model of Beckmann *et al.*, (1956), the analogy is limited to driver's decisions and how the government intervenes. However, with an Augmented Basic Model, this study extends the theory beyond the implication of government intervention to mode of transport choice and location decision of firms.



Pc = Congestion Price, Non-Congestion Price, MSC=Marginal Social Cost, Average Private Cost, Tð Congestion Pigouvian Tax, D = Demand for urban transport

Figure 1: An Augmented Canonical Basic Model

Considering Douala as a nodal because transport modal terminal, meaning that the institution of a toll τ^* to take care of the shortage created by centripetal forces moving the equilibrium from P_n to P_c and the volume of economic activities from Q_n to Q_e. In the presence of monocentricity in the morphology of the metropolis of Douala, this toll will only become a visa for usage. But if there are alternatives, the toll will restore efficiency consequently making this nodal less competitive. If there is no toll, the congestion cost will only make this nodal less competitive and still push out trade/travels for those activities with alternative. Thus, this is why congestion within the Douala metropolis has always affected the activities of the port especially as it gives a wrong market signal in terms of prices for transport and logistics and pushing most import trade to neighbouring Calabar port with a better road network. This analogy is synonymous with the implication of taxes on substitute goods in terms of consumers response captured by their elasticity (Beckmann *et al*, 1956). Thus, the efficiency of a traffic congestion toll of is the improvement of transport facilities and town planning as well as

decentralization of the Centre Business District (CBD). A traffic congestion tolling system will be more efficient with an improved transport system and a decentralized (CBD) which will push road users to other alternative network restoring efficiency in transport and market at point P_n. Although the Augmented Basic Canonical Model can be criticised for it over generalisation on road user behaviours, it gives an expected average behaviour of how firms and roads users may tend to behaviour in the presents of traffic congestion or a traffic toll system especially in the absence of an improvement on the road accessibility of a metropolis like the Douala metropolis.

METHODOLOGY

Secondary data was obtained from the World Bank Database of 2010 on the proxy for traffic congestion, urban agglomeration and economic growth (GDP) Road transport services (Tnx) and Road Sector Fuel Consumption (Te). A time series data for all these variables were obtained for the 2010 World Bank Database.

To address the objectives, this study adopts a restricted augmented aggregate demand function specified thus:

$$\Delta Y = a_0 + a_1 Tnx_t + a_2 Ua_t + a_3 Te + \varepsilon_t \ldots\ldots 3.1$$

Where: ΔY is growth rate in regional Gross Domestic Product (GDP); Tnx is the net export of goods and services proxy for road transport services of the port city of Douala; Ua is Urban agglomeration for the Douala metropolis which does not only capture urban growth but goes further to capture of land use pattern in terms of agglomeration; Te is the road transport sector fuel consumption for the Douala metropolis and; t, is the time frame which ranges from i = 1990 to T= 2012; α_1, α_2 and α_3 are estimated coefficients for the variables defined above.

In this model both net export of goods and services and urban agglomeration affect the demand for transport service and the growth of economic activities (ΔY) positively or negatively. The premise made economic growth endogenous. This is because economic growth as a proxy for the demand for economic growth is measured with an error. $\Delta Y = DT + \varepsilon_t \ldots\ldots 3.2$

The usage of growth in GDP as a proxy for the demand for transport service is because this study seeks to interpret the impact of growth GDP as a factor that attracts labour and can influence the land use pattern especially in the absence of an efficient transport network with limited or no alternative mode of transport. Econometric theory provides that in order to correct for endogenity with the contemporaneous error term, lag variables need to be introduced.

The number of selected lag is justified by the lag criteria of Akiake Information Criteria, Schwarz Information Criteria and the Langrange Multiplier test. Furthermore, the introduction of the lags also enables this study to trace the implication of policies affecting the variables included in the models and show how they impact on economic growth and the demand for transport services using the Impulse Response Function (IRF). Thus a priori expectation by the argument of the travel cost and housing cost trade off theory justify the fact that people and firms agglomerate due to agglomerated economies. This is supported by the transport efficiency assumptions that, if the transport system is efficient, the volume of net export trade will increase and this has accounted for regional or national growth (Fujita and Thisse, 2002). In the case of high transport cost due to traffic congestion or the pigouvian toll, firms and households will tend to agglomerate near the CBD and introduce competing land uses in a bit to maximise the cost of the high rents.

Due to the huge critique on the micro measures of congestion such as speed, travel time index, this study used the macro measure of agglomeration to capture the pressure on urban land with resultant congestion outcomes such as poor location of market, buses stops, manoeuvres, and poor driving habits on the poor and inadequate

road transport facility as described in Figures 4.2 below. The study adopts the VAR methodology of estimation with distributed lags to take care of the autocorrelation in evaluating the determinants of traffic congestion in the Douala metropolis. Consequently, model 3.1 and 3.2 take the generic form with distributed lags as;

"$Y=\sum_{t=1990}^{2012} \alpha_i X_t + \sum_{t=1990}^{2012} \alpha_i X_{t-n} + \varepsilon_{1t}$ 33

Where; *X* is the exogenous variables Tnx, Te, "Y and Ua; *t-n* is the distributed lag of the exogenous variables with n numbers of lag been defined by the lag criteria and; ε_t is the stochastic term for both models.

RESULTS AND DISCUSSION

Figures 4.2 to 4.9 give clear pictures of the determinants of traffic congestion in the Douala Metropolis.

Figure4.2: Non functionality of traffic control Lighting and the non categorisation of users at Tunnel Ndokotti

Figure 4.3: Narrow nature of Major Entrance into Douala at Tunnel Ndokotti with multiple users
Source: authors' Archive

Figure 4.2 &4.3 portray how the nature of the road to the major entrance at Ndokoti with the absence of functioning traffic lights results in pre-congestion and full congestion at the Ndokoti crossroad (Tunnel Ndokoti, 2009). This crossroad has four routes with about 8 meter width each. The 8m wide roads serve as a two-way lane with no pedestrian path or motor cycle path. This crossroad is expected to handle the huge traffic flow from the Bassa Industrial Zone in terms of freight as well as the commercial inter-urban transport flow from Yaoundé, Yabassi, and all the East Mungo towns. The situation is made worse by the carefree movement of commercial motorbike riders who transport the settlers in this part of the town especially as they do not respect the traffic flow control lighting. Thus, the narrow nature of the roads and the absence of a proper traffic control lighting system, results in recurrent congestion at this spot. Traffic congestion at this point is recurrent and results in long hours of delays ranging between 4 and 8 hours on average. Most often, freights and persons are stuck in traffic at this point for long hours during rush hours. However, this shows the pre-congestion and congestion conditions based on the reliability of the transport system in the economic growth process indicating that potholes on roads not properly addressed and in time, widens and results in induced travels congestion.

Furthermore, the Bonabéri Bridge that is also a major link between the CBD and Yaoundé, Yabassi is 1,800m long and about 6m wide combining both the road and railway feeding the Douala port and with a motorisation rate of about 40 vehicles per 1000 inhabitants make the flow high beyond it carrying capacity during rush hours. This major entrance also handles inter-urban traffic flows from the South West Region to other towns west of the Littoral Region heading for Centre Region and towns east of the Littoral Region.

The nature of road poses huge cost in terms of vehicle and freight management, slowdowns or limited markets. The poor nature of the roads limits the volume of economic activities and thereby limiting the scope of economic activities. This usually results in induce travel as the nature of the road drive traffic flow to already congested roads. The poor nature of these roads at New Bell drives traffic flow to the already congested Akwa stretch. This increases the traffic flow on this stretch and makes the stretch always congested especially as it has a lot of business centres which use part of the road as a car park as well as extension of their shopping centres to the road making the road always congested.

Figure4. 4 Deplorable nature of roads at New Bell

Figure4. 5 Large potholes which has widen over time during the rainy season
Source: Authors' Collections

Figure 4.4 and 4.5 depict the pre – congestion conditions as a result of potholes from poorly paved segments of the road. This road serves as a major feeder road between "Marche Centrale" and "Marche Congo" which are major shopping centres in Douala. This road links the huge Muslim community of New Bell to Akwa and Mboppi. In avoiding traffic congestion, most workers prefer to live in Akwa and New Bell for the purpose of easy accessibility to these shopping centres and other business avenues in the Central Business District. Hence, the continuous increase of settlers in these areas results in increased demand for transport services.

Given the poor nature of the paved roads and inadequate maintenance, small potholes grow wider and deeper making motorcycles the most reliable means of transport in these areas. This is because of the fear of being stuck in traffic by most taxis due to slower traffic flow as a result of bad roads that destroy these taxis. Consequently, induced driving behaviours manoeuvre can be noticed by both taxi drivers and motorcycle riders to manage the bad road and slowdowns (Pre-congestion). This often results to slowdown as drivers do not respect drivers' code. Figure 3.6a above shows motorbike riders diverting to pedestrian path or culvert coverings that is very risky and may lead to accidents and consequently traffic congestion. The ability to predict this recurrent congestion conditions results in induced travel. That is, using other roads which tend to increase the road density and slow down traffic flow especially at Deux Eglise crossroad at Akwa, among others. Urban agglomeration results in competing Land use such as car parks, markets or other commercial centres. This is the case with the Mboppi market as settlers agglomerate around BASSA industrial zone and this has introduced competing land uses such as the bus stop at Ndokoti competing with the road as this activity

extends to the road and causing recurrent traffic congestion at the former Total fuel station in Ndokoti.

Figures 4.6 & 7 *Market Extension induce driving behaviour and Traffic Congestion at the Mboppi market stretch.*
Source: Authors' Collections

This is the true with the Mboppi market especially as the agglomeration clearly needs a market, which is currently lacking due to the absence of proper town planning, which would have made provisions for a proper car park, shops and transportation. The absence of these facilities has forced users to set up their business activities on the roads thereby causing recurrent traffic congestion at this point. See figure 4.7 above. Figures 4.8 and 4.9 are some illustrations of how potholes on the road produced pre-congestion conditions, which grow to full congestion and even hyper congestion because of the constant inflow of road users. This occurs most especially at rush hours beginning from 4:00pm and sometimes by 2:00pm. This is the case at the Rail market at Bonabéri, which is the main entrance into the interurban transport from the South West, West and North West regions. Figures 4.8 to 4.9 illustrate the phases involved in the congestion process.

Figure4. 8-10 Potholes and Pre-Congestion conditions at Rail - Bonabéri. Source: Authors' Collections

Figure 4.9 The role of Potholes in the Pre-congestion and Congestion conditions at the major Entrance (Rail – Bonaberi); source: Authors Collection

This is common at Rail-Bonabéri section of the main road, especially when the potholes grow wider and deeper. This is in conformity with the view of Newbery (1989), which looks at road damage externalities and user charges. During these incidents, there is a continuous traffic flow and congestion starts to grow from the pre-congestion condition as travel speed continues to drop. This may even grow to the level of hyper congestion. Congestion grows from the fact that after a crash, the road capacity is reduced as both parties involved in the crash, wait for a police situation report to be established. The time taken to have a police officer to draw up the crash situation report results in the second and third phase of congestion as shown in figure 4. 8. Consequently, the speed of entering the jam is greater than that of leaving, thereby producing congestion as presented in figure 4.8 & 4.9.

In sum, figures 4.2 to 4.9 show the inadequacy of the road transport facilities such as paved roads, non functional traffic flow control lighting, narrow roads, and single narrow entrance and exit points. This fact is supported by the evidence that of Douala's total road network of 1800km, just over 500km has been paved with a road density of 0.72 km per 1000 (UTIP, 2010).

The effects of these determinants are statistically confirmed by the VAR results as shown in Table4.1 below.VAR estimation of the major determinants of traffic congestion in the Douala Metropolis build the grounds for the synthesis of the determinants of traffic congestion in the Douala metropolis. The equation for economic growth DLOG(GDP) reveals that a percent growth in the volume of net Export reduces the contemporaneous of the economic by 0.09 and 0.7 percent respectively. This is an indicative efficiency of the road network system and services. The finding corroborates to the study of Maoh and others that found that firms' locations are influenced by agglomeration economies besides other factors such as distance from the CBD, and highway, household density, population size among others.

Table4.1.VAR Estimation of the Major Determinants of Traffic Congestion in the Douala Metropolis

PARAMETER	DLOG(GDP)	DLOG(NTX)	DLOG(UA)	DLOG(TE)
DLOG(GDP(-1)	1.934503* [2.78852]	-2.982783* [-2.78873]	-6.063213* [-2.28346]	1.935320* [3.78886]
DLOG(GDP(-2)	-7.276843* [-3.78953]	1.855457* [2.30598]	2.288967* [4.28485]	-7.271878* [-6.78900]
DLOG(NTX(-1)	-0.093808* [-7.78970]	0.781726* [5.29445]	0.973087* [8.28489]	-0.089168* [-6.78852]
DLOG(NTX(-2)	-0.764820* [-11.7883]	0.992845* [8.66335]	2.398394* [2.28332]	-7.655458* [-7.78845]
DLOG(UA(-1)	-8.114220* [-6.93548]	0.119850* [3.85457]	-0.154643* [-4.42308]	-0.115405* [-7.93579]
DLOG(UA(-2)	-6.276186* [-2.43994]	0.085962* [3.39090]	1.383172* [3.11205]	-6.276282* [-4.43995]
DLOG(TE(-1)	-1.934583** [-1.78853]	2.982937 [0.78875]	6.062985* [2.28344]	-1.935399* [-3.78887]
DLOG(TE(-2))	0.257109* [3.78863]	-1.852787* [-3.30616]	-0.281018* [-4.28431]	7.252143* [2.78810]
Constant	4.403688 [1.22056]	-0.005915 [-1.06362]	-0.008318 [-0.26444]	4.403826 [1.22061]
R-squared	0.947611	0.999979	0.939882	0.954058
Adj. R-squared	0.843401	0.999961	0.858000	0.831223
F-statistic	9.911610	53.85468	8.883506	9.935660
Observations	22	22	22	22

Note:* statistically significant at 1 percent á – level, ** statistically significant at 5 percent á – level

The equation for net export (Tnx) shows that a percent growth in the road sector fuel consumption results in a 2.9 percent growth in the volume of net export in the first lag year but a 1.85 percent decrease in the volume of net

export in the second lag year because traffic congestion would have set in. This is further supported by how fast congestion determining factors can set in given the competing land use within the Douala Metropolis. This result is also consistent with view of Kanemoto 1980 that asserted that there is a strong interdependence between urban transport and land use pattern in the presence of monocentricity

The results for urban agglomeration, an explanatory variable for traffic congestion reveals that, a percent increase in economic growth (GDP) actually result in 6.06 percent decrease in urban agglomeration in the first lag, but the second lagged, due to limited, narrow and few road infrastructure with poor connectivity, urban agglomeration will increase by 2.28 percent. This finding also corroborates the finding of Fujita and Krugman 2004 who studied returns variation as a function of transport cost and concluded that increasing returns determines the land-use pattern in its spatial distribution forms

The explanatory power or goodness of fit of the various distributed lag for net road export (NTX), urban agglomeration (UA) and road transport sector fuel consumption (TE) ranges between 83 to 99 percent showing that the models explain to a larger extent the dynamics of economic growth and traffic congestion in Douala. The explanatory power 0.84, 0.99 0.86 and 0.83 ascertains the fact that the respective models of economic growth, road transport service, Urban agglomeration and Road sector per capita fuel consumption best explains the dynamics of traffic congestion and economic growth. These results are statistically reliable as they have F-Statistics ranging from 8.88 to 53.54 which is statistically significant at the 1 percent á - level. This justifies the reliability of the results in explaining the causality between the variables and in highlighting the major determinants of traffic congestion in Douala and setting the basis for policy recommendations to improve on the situation. With the support of the granger causality tests and the impulse response function not presented in this work due to space, the established causality of the estimated parameters accentuates the figures above as the complementary determinants of traffic congestion in the Douala metropolis in particular and Cameroon in general.

RECOMMENDATIONS

Based on the integrated findings and as a strategy to reduce congestions in Duala metropolis, the study recommends the following short (1), medium term (2) and long term (3 & 4) strategies:

1. The Urban Council of Douala should ensure the improvement of road transport infrastructure which includes well defined bus, taxi and motorbike stops should be done by the relevant agencies of Government. In order words, let there be a well define system of linkages between the various modes of transportation. That is, motorbikes should feed the ancillary roads, where taxis run, and large buses for purpose of economies of scale should serve the various districts. This will not only restore sanity in the public transport and logistics sector, but will also improve on the efficiency of the public transport sector in the Douala Metropolis.

2. The industrial free zones even though established to promote industrialisation, should incorporate elements of specialisation. The purpose of industrial specialisation is polycentrism of the Douala metropolis. That is, all weight losing firms and industries should be located at the suburban and all the weight gaining firms and industries should be located at the CBD. The arterial road should link the various urban centres of the Douala Metropolis while all the urban roads should be the motorways. In other words road types design and construction should be guided

by the estimated settlement population and the purpose of the road. Furthermore, their maintenance should be designed by law to be carried out promptly as needs arise or at given intervals by a particular specialised authority like is done elsewhere in developed countries such as the Road Act in the United Kingdom.

3. Government should construct many major entrance/exit roads or separate the interurban entrance/exit roads from the intra-urban entrance/exit roads which link the suburbs of Kotto, Bonaberi, Bassa and Ndizengue and the CBD of Akwa and Banajo. This is so because since Douala road network handles inter-urban travels as well intra-urban transport. It would be logical and transport efficient if there is the creation of a road network that links periphery towns of the Littoral Region that does not necessary passes through the CBD of Douala. For example constructing a road that links the South West and West Region to the centre region without passing through the Douala metropolis.

4. Finally, the institution of Automatic Traffic flow Counters (ATC) is recommended to facilitate the planning and management of road transport given that the demand for mobility is an induced demand from economic growth. This will give room for continuous planning which is consistent and more sustainable than the ad hoc road planning, development and maintenance strategies currently put in place by various authorities both at local and central government levels. This will make the market mechanism of the demand and supply for road transport infrastructure more efficient in terms of pricing and the estimation of congestion cost.

CONCLUSION

Based on the findings of this study, urban agglomeration and metropolis' polycentricity are very necessary for efficient economic decision of regional and urban growth as the play key role in determining the spatial distribution of metropolis. Thus, their feedback effect emphasises trade-off between the CBD growth –urban agglomeration and regional economic growth. Douala is capable of feeding itself, other parts of Cameroon and the CEMAC zone if free circulation of goods and persons is guaranteed. All hands therefore must be put in hands to achieve the above listed recommendations.

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