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Road Traffic Accidents and Macroeconomic Conditions in Ghana

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The main objectives of the study are to determine the impact of road traffic accidents on economic growth and also examine the effect that macroeconomic variables have on road traffic crashes in Ghana. The ordinary least squares method of statistical estimation was used in this study. The results obtained were very robust and valid. The study revealed that road traffic accidents affect economic growth negatively and the degree of the negative effect is 0.209588%, implying that, increase in road traffic accidents in Ghana, is a greater cost to the nation, all other things being constant. The study showed that, the major macroeconomic variables that affect road traffic accidents in Ghana are the size of the Ghanaian economy (GDP), standard of living of the citizens of Ghana (GDP per capita) and government spending. The study recommended that the use of safety helmet and belt must be enforced as well as strict rules regarding license issuing and ban of using mobile phone while driving.

Keywords: Road Traffic Accidents, Macroeconomic Conditions, Ordinary Least Squares Method of Estimation,

INTRODUCTION

The main objectives of the study are to determine the impact of road traffic accidents on economic growth and also examine the effect that macroeconomic variables have on road traffic crashes in Ghana.

The services sector is the main channel through which the primary and the secondary sectors of the Ghanaian economy operate. Since the year 2008, the Ghanaian economy has been performing better than the later years (Ghana Statistical Services, 2011). The driver of these impressive performances since 2008 is the services sector which the transportation sector forms a subsector. The transport sector is the main part of modern economic growth and development. That is, the Transportation sector has had positive impacts on the Ghanaian economy. For instance, it has contributed to GDP growth of the Ghanaian economy, created employment, transportation of goods and services within and out of the nation, generation of government revenue through the establishment of road toll booths at intercity borders and many more.

There has been improvement in road infrastructure in recent years across the globe which Ghana is a part. This has enhanced connectivity between rural and urban areas. For instance, in China, by the end of 2005, the total mileage of highways excluding HK, Macao and Taiwan reached 1.931 million km. The density of the road network reached close to 20.1km/100km^2 (Zhao, 2009). In Ghana, the total road sector fund was US$235.67 million in 2004. This figure increased to US$272.41 million in 2005 and further increased again to US$332.58 in 2007 (Ministry of Transportation).

Transport needs are continuously increasing due to two factors. These factors are public mobility and the growth of cargos/cars transportation. The number of cars in Western Europe has increased three times for the last 30 years. That is, in 1992, there were 234.4 cars per 1000 Lithuanian inhabitants, in 2002, the number increased to 397.3 (Pakalnis, (nd)). In China, the share of passenger-km by highway has increased from 32% in 1980 to 53.2% in 2005, while the share of freight ton-km by highway has increased from 6.4% in 1980 to 10% in 2005. According to the National Road Safety Commission, Ghana annual report of 2011, the total vehicle population has increased more than 12% from 1.03 to 1.2 million from 2009 to 2010 (NRSC, 2011). Railway and waterway are still major modes for transporting goods and services from one zone to the other in Ghana.

Worldwide, considering that population continues to increase, it implies that the number of vehicle – kilometers greatly increase also (Mwatelah, 2001). This has caused road traffic accident (RTA) to emerge as a serious public health problem (Islam and Al Hadhrami, 2012; Khan and Tehreem, 2012). The reason is that, this has led to heavy loss of valuable man-power and human resources, along with a corresponding drain of potential economic growth. Therefore, the main questions that come to mind here are, (1) what is road traffic accident? (2) What are the causes of road traffic crashes? (3) What are the effects of road traffic accidents? (4) By how much do road traffic accidents influence economic growth in Ghana? The first three (3) questions have been investigated into by other writers already.

Road traffic accident has been defined in so many ways. According to Goswami and Sonowal (nd), "accident is an event, occurring suddenly, unexpectedly and inadvertently under unforeseen circumstances". Wikipedia defines road traffic accidents as "an accident that occurred on a way or street open to public traffic; resulted in one or more persons being killed or injured, and at least one moving vehicle was involved. Thus, a road traffic accident is collision between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles".

An accident is defined in the Encarta English Dictionary as "a crash" (an incident involving a moving vehicle that results in property damage, personal injury or death), "a mishap" (an unplanned and unfortunate event that results in damage, injury or upsets of some kind), "a chance" (the way things happen without any planning, apparent cause or deliberate intent) (Appia, nd).

The Health and Safety Executive (HSE) in UK defines an accident as "any unplanned event that results in injury or ill-health of people, or damage or a loss to property, plant, materials or the environment or a loss of a business opportunity (Appiah, nd)".

Singh et al. (2012) defines "accident as an event, occurring suddenly, unexpectedly and inadvently under unforeseen circumstances".

Oppong (2012) defines "road traffic accident as any activity which distracts the normal trajectory of a moving vehicle(s), in a manner that causes instability in the free flow of the vehicle".

Therefore, from the above definitions, this study defines road traffic accidents as single vehicle either colliding with fixed objects (vehicle – pedestrian, vehicle – bicycle, vehicle- motorcycle or multiple vehicles colliding.

Studies have demonstrated that road traffic injuries are a major cause of death and disability globally even more than diseases such malaria, HIV/AIDS, cholera and even the current outbreak Ebola, with a larger number occurring in developing countries (Banthia et al., 2006). WHO reports that about 38,848,625 people were injured through motor vehicle crashes in 1998? Out of this figure, 5.8 million people died of injuries, 1,170,694 (20%) died as a direct result of injuries sustained in motor vehicle crashed (Boakye et al., 2013). In 2002, road traffic accidents kill about 1.2 million people a year and injuring or disabling 20 to 50 million people more, costing the global community about US$518 billion (Peden et al., 2004; Atubi, 2012). Out of them 5 million became permanently disabled (Nasar, 2003). The World Health Organization (WHO) has estimated that nearly 85% of fatalities due to road traffic crashes occur in low and medium-income countries (Murrary and Lopez, 1996; Peden et al., 2004; Sleet and Branche, 2004). The global road mortality rate is 19.0 per 100,000 populations (Hajeeh, 2012). Road traffic accidents are predicted to increase globally by 67% by 2020 and rank second as a leading fatality cause (Hajeeh, 2012). It has been estimated that over 300,000 persons die and between 10 and 15 million persons are injured every single year in road accidents throughout the world (TRL and ODA, 1991).

The number of traffic fatalities in the U.S was 3.5% in 1981 and 10.8% in 1982 (Wagenaar, 1984). The report of the Economic Commission for Europe 2007 shows that, the rate of accidental deaths per 1000 vehicles in Liechtenstein was 19.0 followed by France at 15.8 in the year 2003.While, in Ghana, according to the latest WHO data published in April 2011, road traffic accidents in Ghana formed 5,023 or 2.68% of total deaths. The age adjusted death rate of 28.11 per 100,000 of population, ranks Ghana at number 41 in the world. Available crash data in Ghana suggest that about 1,900 persons are killed annually in road traffic crashes while 15,000 are seriously injured, robbing the nation of some precious lives, thereby dwindling Ghana's scarce labour force in the country (Afukaar et al., 2008).

According to Building and Road Research Institute, there were 12,299 road accidents in the year 2009 (Afukaar et la., 2009). There were total of 18, 496 casualties with 2,237 of them losing their lives, while 6,242 sustained serious injuries (Oppong, 2012). In the National Road Safety Commission (2011) reports, there are 19 fatalities per 10,000 vehicles in Ghana, 43% of the fatalities involved pedestrians with about 23% representing children below the age of 16 years. In 2012 alone, 2,249 Ghanaians lost their lives while 14,169 got injured through Road Traffic Accidents (RTA) (Road Safety Commission, 2012). The estimated economic costs of road accidents as a percentage of Gross National Product (GNP) in most African countries range from about 0.8% in Ethiopia and 1% in South Africa to 2.3% in Zambia and 2.7% in Botswana to almost 5% in Kenya (Odero et al., 2003). In 2007, the National Road Safety Commission of Ghana estimated road traffic accidents to cost 1.6% of gross domestic product which translated to US$165 million (NRSR, 2007). The report indicated that motorcycle accidents accounted for 4% of all road traffic accidents in Ghana (Kudebong et al., 2011).

These human losses have some effects on the families and the nation at large. The effects could be morbidity, mortality and disability, traffic congestion, environmental pollution, property destruction and so on (Tarimo, 2012; Mwatelah, 2001). In developed countries, RTA is the most common cause of death below the age of 50 years (Singh et al., 2012). Road traffic crashes put huge burden on the economy. One of such burdens is destroying lives and livelihoods. WHO (2002) estimated that, there were 180500 children killed as the result of road crashes. Some 97% of these child road deaths occurred in low-income and middle-income countries (WHO, 2004). Another is hampering economic prosperity and development (that is, traffic crashes impact on developing countries at an estimated cost of 1 -2 % of a country's GNP per annum, as a result of morbidity and property – related costs (fouracre and Jacobs, 1976; Jacobs and Sayer, 1983; WHO, 1989; Jabaan, 1989 and 1990; Downing, 1991)). It also leaves millions in greater vulnerability; it further creates congestion and noise to individual citizens during the collision; there is Pollution from burning substances (Cater and Walker, 1998). More so, many families are driven deeply into poverty by the loss of breadwinners and the added burden of caring for members disabled by the road traffic injuries (Aderamo, 2012). Further, there is labor lost to the nation's economy which

consequently results in low productivity (Aderamo, 2012).

From the aforementioned, both developed and developing countries, statistics have proven that more people die out of road traffic accidents than any other diseases found in the world currently, which cost the various economies greatly in terms of human resource capacity losses and the growth of the overall economy as whole. What then, are the causes of road traffic crashes? This has called for more research investigations into this area of study in order to come out with appropriate measures for the prevention of these accidents.

These factors below have been identified by some researchers as the causes of road traffic accidents. They are; Machine failure; Rushing and negligence; Increased length of roads (km); Presence of road safety corps and increased population; Not using seat belt while driving; Using mobile phone while driving; Careless driving; Excessive speed (over speeding); Tyre failure; Distractions inside the vehicle and outside the vehicle; Smoking while driving; Anxious driving (drivers not leaving enough distance between their car and the car in front); Minimal enforcement of road laws and traffic regulations by the police; Poor driving skills; Broken down vehicles on our roads; Drivers driving on worn/second hand tyres; The unworthiness of some cars on our roads (i.e. The rickety vehicles which ply on our roads); Over-loading of vehicles beyond their expected gross weights; Fatigue driving; Drink driving; Disregard for traffic regulations by most drivers; Location of the accident; The age and sex of the casualty; The type of vehicle involved in the accident; Nature of the road (i.e. Skid and road surface defect); Weather conditions (eg Heavy rainy season during the month of July to September); The day of the week; The time of the day; Wrong over taking; Poor road network; Lack of proper judgment of drivers; Inadequate experience; Recklessness; Intoxication (i.e. High alcohol content in the blood stream of the driver); Dazzling and defective light; Boredom; Unwillingness to alight from motion object; Level crossing and obstruction; Failure to buckle the seat belt; Bribery and Corruption; Poor vision of drivers; Road design (Non-existent road markings and signs) and Poor road maintenance (See, Atubi (2012); Mohammadi (2011); Abbes (2004); Bener and Crundall (2005); Ratrout (2005); Lam (2002); Koushki et al. (2003); Koushki and Bustan (2006); Al-Hemoud et al. (2010); Khan and Tehreem, 2012; Ayeboo (20099); Ocansey (2011); Ung Chun (2007); Okyere (2006); Chitere and Kibua (2004); Khayesi (1997); Lamba et al (1986); Afukaar (2009); Kumar et al (2008); Jha and Agrawal (2004); Mehta (1968) and Ghosh (1992); Tarimo, 2012; Jorgensen and Abane, 1999; Komba, 2006)).

Also, the causes of death of casualties in road accidents have been identified. They are: secondary collision; improper handling of casualties; inadequate emergency services; Failure of drivers and vehicle occupants to put on seat belt; Riders failing to put on helmet; Drowsy driving; the age of the vehicle in an accident; The size of the vehicle; Young drivers and young passengers; Drink-driving and Anoxia-loss of oxygen supply (see, Strohl et al. (1998); Afukaar et al.(2009); Homes and Reyner (1995); Allan et al. (1995); Zomer (1990); Broughton (2007); Britain and Wales (nd); Kumar et al. (2008); Salgado and Colombaje (1998); Shadev (1994); Henriksson (2001); Clarke et al. (2007); Zomer et al. (1990); British Red Cross (1997)).

Numerous studies in Ghana have identified the causes, effects, economic costs and recommendations to road traffic accident in Ghana (Boakye et al. (2013); Oduro (2012); Kudoyor (2011); Kudebong et al. (2011); Siaw et al. (2013); Ofori et al. (2012); oppong, (2012); National Road Safety Commission (2009); Salifu (2004); Afukaar and Debrah (2007), Ackaah (2011)). In addition, Oppong (2012) has modeled the causes of road accidents and its contributions to the death and survival of casualties in Ghana. Hesse and Ofosu (2014) have also discussed the morbidity and mortality of road traffic accidents and other empidemiological variables of road traffic accidents in Ghana between 1991 and 2011. The analysis of the regional distribution, patterns and forecast of road traffic fatalities in Ghana has also been looked at by Ofosu and Hesse (2014). The comparative analysis of regional distribution of the rate of road traffic fatalities and a regression model for predicting road traffic fatalities have been studied by Hesse and Ofosu (2014) also. What is lacking in the road traffic accidents literature in Ghana now is, the relationship between road traffic accidents and macroeconomic conditions. As a result, the goal of this study is to examine the relationship between road traffic accident and macroeconomic conditions in Ghana.

RELATIONSHIP BETWEEN ROAD TRAFFIC ACCIDENTS AND MACROECONOMIC CONDITIONS

Observationally, as an economy grows more than population growth, per capita GDP increases as well. This is likely to be followed up by an increase in the number of vehicles acquired by citizens since their standard of living will improve. The reverse is also true (Iwata, 2010).

In addition, World Bank has established that economic development of regions and nations correlates with an increase in the number of injuries and deaths from road traffic crashes (Kopits, et al., 2005).

Kuznets curve hypothesis can also be used to explain this scenario. That is, as the GDP per capita of developing countries increases, the peoples' taste and preference for the purchase of vehicles increases alongside forgetting about their safety of driving the vehicle purchased. This leads to more road traffic accidents which lead to injuries and death. However, as time progresses and their per capita income continuous to increase, the people now begin to think about their safety and hence reduction in road traffic accidents (Grossman and Krueger, 1991; Kellenberg and Mobarak 2008; Andres, 2006).This hypothesis has been tested by some scholars.

Iwata, K. (2010) examined the relationship between traffic accidents and economic growth in China. The study employed the semi parametric partial linear model in order to observe the flexibility of the relationship. The estimation results showed that the peak of traffic fatality and injury in China were $1500 and $4000, respectively.

Aderamo (2012) assessed the effect of road traffic injuries on productivity in Nigeria among 36 states. The methods of correlation and regression analysis were employed by the study. The regression results revealed road traffic accident injuries has a positive relationship with manpower in parastatals, employment in crop farming, registered teachers, police service and private farmers. On the other hand, the results showed that road traffic injuries has negative relationship with manpower in ministries and national unemployment in Nigeria.

Wagenaar (1984) investigated the effects of macroeconomic conditions on the incidence of motor vehicles accidents in USA. The study was designed to identify the relationship between changes in economic conditions, as reflected in the rate of unemployment, and motor vehicles crash involvement. The influence of vehicle miles traveled was also examined. ARIMA and dynamic regression time series modeling procedures were used to assess the direction, magnitude, and lag structure of the relationships. The study revealed a significant concurrent inverse relationship between the rate of unemployment and the frequency of crash involvement, and a significant lag 1 positive relationship between unemployment and crash involvement (see Van beeck et al. 2000; Kopits and Copper 2005; Bishai et al. 2006; Anbarci et al., 2009).

Road traffic accidents are identified to negatively affect economic growth in developing countries because of the high cost related with them. That is road accidents lead to the loss of man-power and human resources and finally drain potential economic growth (Apparao et al., 2013). The issues to investigate are (1) to what extent do road traffic accidents impact on Ghana's economic growth? And (2) what macroeconomic variables influence road traffic accidents in Ghana?

TRENDS OF ROAD TRAFFIC ACCIDENTS IN GHANA

Insert Figure 1 here

More people die in Ghana when there is an occurrence of road traffic crashes as compared to other selected developing countries. This raises a serious public health concern which Ghana needs to address.

Previous epidemiological studies on Ghana have found the following about Ghana:

- The most people who die in road traffic crashes are with the ages of 16 – 45 years (the active labor force).
- More men die in road traffic crashes than women within the active age which is between 16 years and 45 years. The reason is that majority of the men in this age bracket drive more and recklessly.
- More female die in road traffic accidents within the ages of 45 years and above. The reason is that they travel more at this age to visit their sons and daughters in school and other places.
- November and December are the months that most road accidents occur in Ghana.
- Saturdays are the days that most road traffic crashes occur in Ghana.

- Pedestrians are the most agents to be injured or killed in road traffic accidents than all the other road users.
- In term of risk of dying, Northern, Volta and Eastern regions have been found to be the highest accordingly.
- Greater Accra region has been identified to be the highest in term of vehicles registration, yet it has the lowest average rate of fatality.

(Hesse and Ofosu, 2014; Ofosu and Hesse, 2014, Oppong, 2012; NRSC, 2011 report)

Insert Figure 2 here

As population growth remains the same, the number of vehicles registered fluctuates. Statistically, there is a positive association between population and the number of vehicles registration in Ghana. The degree of the association is 0.034922. Shockley, if population should increase by 1%, then the number of registered vehicles will go down by 0.48%, all other things being equal. The reverse is also true.

Insert Figure 3 here

Visually, as population grows, road traffic crashes also increases. Statistically, there is a positive association between road traffic accidents and population growth rates in Ghana. The degree of the association is 0.109066. If population should increase by 1%, then road traffic accident will go up by 3.05%, all else equal. The reverse is also true.

Insert Figure 4 here

Observationally, as the number of registered vehicles increase, road accidents also increase. Statistically, there is a positive association between road accidents and registered vehicles in Ghana. The degree of the association is 0.313406. If the number of registered vehicles should increase by 1%, then road traffic accident will go up by 0.64%, all things being fixed. The reverse is also true.

Insert Figure 5 here

A look at figure 5 shows that as the numbers of accidents grow, injuries increase alongside. Statistically, there is a positive association between road accidents and injuries in Ghana. The degree of the association is 0.412641. If road accidents should increase by 1%, then injuries will shoot up by 1.26%, all things being equal. The reverse is also true.

Insert Figure 6 here

Visually, as the number of road accidents goes up, the number of casualties moves in the same direction. Statistically, there is a positive association between road accidents and casualties in Ghana. The degree of the association is 0.795972. If road accidents should increase by 1%, then casualties will shoot up by 0.66%, ceteris paribus. The reverse is also true.

Insert Figure 7 here

A quick look at figure 7 shows that, as the number road accidents increases, fatality rate also increase. There is a positive association between road accidents and fatalities in Ghana. The degree of the association is 0.659629. If road accidents should increase by 1%, then fatalities will increase by 0.767%, ceteris paribus. The reverse is also true.

Road traffic accidents, injuries and fatalities in Ghana have been threatening the quality of life in Ghana. That is, it has adverse effect on dependency ratio, labor force (professionals), production, market size, aggregate demand and the national economy as a whole. It is argued by Wagenaar (1984) that when GDP increases, road traffic accident increases as well and when GDP falls road traffic accident fall also. According to Eyer (1977) death rates for accidents, heart disease, liver cirrhosis, influenza, and other causes (with the exception of suicide and homicide) rise during periods of business expansion, and fall during recessions. As a result, the aim of the study is to ascertain whether general economic conditions significantly influence road traffic accident and fatalities rates in Ghana. The results might be taken into account when assessing the success or failure of current prevention efforts.

MATERIALS AND METHODS

Model specifications

The Impact of Road Traffic Accidents on Economic Growth

The model specification followed the neoclassical production function. The model specification was stated as:

$$GDPPC_t = AL_t^{\beta_1} K_t^{\beta_2} RTA_t^{\beta 3} e^{u_t} \quad \text{.....(1)}$$

The logarithm transformation of equation 1 became:

$$\ln GDPPC = \ln A + \beta_1 \ln L_t + \beta_2 \ln K_t + \beta_3 \ln RTA_t + u_t \quad \text{.....(2}$$

$\beta_1 > 0; \beta_2 > 0; \beta_3 < 0$

$\beta_1, \beta_2, \beta_3$ were the elasticities

u = error term, normally distributed with zero mean and constant variance.

Macroeconomic Determinants of Road Traffic Accidents

The equation of the road traffic accidents was not linearly related to the explanatory. Therefore the log linear form of the equation was specified.

$$RTA_t = BK_t^{\delta_1} GDP_t^{\delta_2} GDPPC_t^{\delta_3} GE_t^{\delta_4} e^{u_t} \text{.....(3)}$$

Logarithm transformation of equation 3, equation 4 was obtained.

$$\ln GDPPC = \ln B + \delta_1 \ln K_t + \delta_2 \ln GDP_t + \delta_3 \ln GDPPC_t + \delta_4 GE_t + u_t \text{.....(4)}$$

$\delta_1 > 0; \delta_2 > 0; \delta_3 > 0, \delta_4 < 0$

$\delta_1, \delta_2, \delta_3, \delta_4$ were the elasticities

U = the stochastic term

Insert Table 1 here

Sample size

The study period was from 1991 to 2011. This was the period that data was available. Consequently, the sample size of the study was 21 which were less than 30 as against the acceptable limit of at least greater and equal to 30. Reader must take this into consideration.

Methods of Estimation

The Ordinary least squares method of estimation was used to determine the values of the respective parameter estimates.

Coefficient of Determination

The coefficient of determination was used to indicate how the independent variables included in the models best explain the total variation in the dependent variables. The closer it is to 1 be it positive or negative the better. The main weakness of the unadjusted R^2 is that it does not take the degrees of freedom into account, this weakness is corrected by using the adjusted R^2 (Mukras, 1993).

The P-Value for Each Explanatory Variable

The p-value for each explanatory variable was used to check whether each coefficient is significantly different from zero or not. Its value should be lower than 0.05. If each explanatory variable of the models has a p-value inferior to the 0.05 critical values, then it confirms that all the explanatory variables have a significant impact upon the dependent variable. To quickly judge whether the models exhibited the problem of multicollinearity, the p – values were used. If the parameter estimates prove to be statistically significant, then it will mean that the problem of multicollinearity does not exist.

The F-Test

The F-test test was used to test if all the model coefficients were significantly different from zero. If the p-value for the F-test test is lower than the 0.05 critical value, then it means that all the independent variables included in the model have a statistically significant impact on the dependent variable or otherwise. That is the overall multiple regression equation and the parameters estimates are statistically significant and the regression line performs well.

Durbin Watson Statistic (DW)

The DW was used to test for the presence of autocorrelation. The traditional benchmark is 2.0. If DW lies between 1.5 – 2.5 means the assumption of linearity is not violated.

Durbin Watson (DW) and R—Squared (R^2)

According to Granger and Newbold, if the value of the R-squared is greater than the value of the DW (R^2> DW), then there is a good rule of thumb to suspect that the estimated regression is spurious. The R^2 and the t-statistic from such a spurious regression are misleading, and the t-statistics are not distributed as t distribution and, therefore, cannot be used for testing hypotheses about the parameters.

Statistical Software Used

The statistical software package used for this study were excel and gretl.

RESULTS AND DISCUSSION

The Influence of Road Traffic Accident on Economic Growth in Ghana

Model 1: OLS estimates using the 21 observations 1991-2011

Insert Table 2 here

The value of the adjusted R^2 is 94%. Statistically, this model is well fitted. Economically, this value indicates that approximately 94% of the total variation in economic growth is explained by labour, capital and road traffic accidents. The contributions of the remaining factors not included in the model are 6%. About 67% of the independent variables are statistically significant which a good representation since it is greater than 60%. Overall, this model is statistical significant since the p-value of the F-statistic is less 5%. The value of the Durbin-Watson Statistic is 1.79 which lies with the range of 1.5 and 2.5 which is an indication of no autocorrelation. No multicollinearity was present in this model since the values of the variance inflation factor were less than 10. Heteroscedasticity is not a worry since the study took the logs of all the variables considered. Finally, the model is sensible and acceptable since the value of the DW (1.79) is greater than the value of the R^2 (0.92). The

error was normally distributed and thus meaningful analysis can be made from it.

Labor force is known to influence economic growth positively. This expectation was achieved by this study. That is, as the labor force in Ghana increases, an economic growth will be experienced. However, if labor force reduces, an economic decline will occur in Ghana. This further indicates that Ghana is a labor intensive economy. Statistically, a 1% increase in labor force, will lead to 1.24% increase in economic growth. This effect is an elastic effect. This means that a smaller increase in the labor force will lead to a greater increase in Ghana's economic growth, all things being fixed. The parameter is statistically significant since the p-value is less than 5%. The implication is that labor force is a factor that influences economic growth in Ghana.

Capital is another factor that influences economic growth positively. However, a negative expectation was achieved by this study. This means that as capital increases, economic growth decreases, ceteris paribus. This could mean that though Ghana will acquire the needed machine, she might not have the technical men to operate the man-made tools effectively and efficiently. This is because her tertiary education is centered more on theoretical orientation and not on practical orientation. That is, a 1% increase in capital will cause economic growth to decline by 0.04%, all else equal. The effect is inelastic. This means that a greater increase in capital will lead to a smaller decrease in economic growth emphasizing that Ghana is not a capital intensive economy. This parameter estimate is statistically insignificant since the p-value is greater than 5%. This implies that capital is not a key factor that influences economic growth in Ghana.

Road traffic accidents was expected to impact negative on the Ghanaian economy, since when there is road traffic accidents, the quality of labour force is affected adversely, human capital is loss, market size is reduced and finally suffocates potential economic growth. Statistically, a 1% increase in road traffic accidents will cause economic growth to decrease by 0.21% approximately. This effect is inelastic. This means that a greater increase in road traffic accidents will cause a smaller decrease in economic growth in Ghana, all other things being equal. This parameter estimate is statistically significant implying that road traffic crashes is a factor that influence economic growth in Ghana.

From the above, it has been identified that road traffic accidents affect economic growth negatively and the degree of the negative effect is 0.209588%, all other things being constant.

Macroeconomic Determinants of Road Traffic Accident in Ghana

Table 3: Model 2: OLS estimates using the 21 observations 1991-2011

Insert Table 3 here

The value of the adjusted R^2 is 81%. Statistically, this model is well fitted. Economically, this value indicates that approximately 81% of the total variation in road traffic accidents is explained by capital, the size of the economy, per capita income and government expenditure. The contributions of the remaining factors not included in the model are 19%. About 75% of the independent variables are statistically significant which a good representation since it is greater than 60%. Overall, this model is statistical significant since the p-value of the F-statistic is less 5%. The value of the Durbin-Watson Statistic is 1.88 which lies with the range of 1.5 and 2.5 which is an indication of no autocorrelation. Multicollinearity was present in this model but the do nothing solution was applied. Heteroscedasticity is not a worry since the study took the logs of all the variables considered. Finally, the model is sensible and acceptable since the value of the DW (1.88) is greater than the value of the R^2 (0.81). The error was normally distributed. Therefore meaningful analysis can be made from it.

Observationally, as capital increases, road traffic accidents are expected to also increase. In other words as physical development in terms of road construction increases, more road traffic accidents are likely to occur. Specifically, a 1% increase in capital will cause road traffic accidents to increase by 0.064%. This influence is inelastic. It means that a greater proportionate increase in physical development like major roads, will lead to a smaller increase in road traffic accidents in Ghana, all other things being equal. The reverse is also true. This parameter estimate is statistically insignificant since the p-value is greater than 5%. The implication is that capital development in terms of road construction is not all that a major contributory factor of road traffic accidents in Ghana all though the impact is positive.

Also, as the size of the Ghanaian economy expands, businesses activities increases, purchasing of vehicles increases, drivers are in a rash, miles of traveling

increases and road traffic accidents are likely to occur along side. This intuition was wished by the study. That is, a 1% increases the size of the economy caused road traffic accidents to increase by 2% approximately, ceteris paribus. This impact is elastic meaning that a smaller increase in the size of the economy will proportionately cause a greater increase in road traffic accidents. This value is statistically significant since the p-value is less than 5%. This implies that the size of the Ghanaian economy plays a major role in the causes of road traffic accidents in Ghana.

It has been proven that as per capita income of developing countries increases, initially, the peoples' marginal utilities for the acquisition of vehicles increase, but as per capita income continues to increase; they now turn to how to protect themselves by driving the vehicles. This argument is wished in the Ghanaian economy. That is, a 1% increase in per capita income causes road traffic accidents to decrease by 3% approximately, all else being equal. This effect is elastic implying that a smaller increase in per capita income causes a greater reduction in road traffic accidents, all other things being fixed. This parameter estimate is statistically significant since the p-value is less than 5%. This indicates that per capita income is a key macroeconomic determinant of road traffic accidents in Ghana.

If government spends in productive areas like the transportation sector, it is expected to reduce road traffic accidents. This scenario was wished in Ghana. Specifically, a 1% increase in government expenditure caused road accidents to decrease by 0.4% approximately, ceteris paribus. The influence is inelastic. This shows that a greater increase in government spending will cause a smaller reduction in road traffic accidents in Ghana, all things being fixed. This value is statistically relevant since the p-value is less than 5%. This implies that government spending plays a major role in the macro factors that influence road traffic accidents in Ghana.

From the aforementioned, the major macroeconomic conditions that affect road traffic accidents in Ghana are the size of the Ghanaian economy, standard of living of the citizens of Ghana and government spending.

Therefore, the following policies are recommended by this study.

1. The use of safety helmet and belt must be enforced as well as strict rules regarding license issuing, ban of using mobile phone while driving and so on.
2. The government and Non-Governmental Organisations must create public awareness to prevent road accidents by organizing seminars, road dramas, and plays and so on.
3. Mass behavior modification and education regarding road safety should be imparted from the school level.
4. The marking of dividers and speed breakers must be done. Immediate steps to remove all the aged and damaged vehicles off from the roads will definitely be a welcoming step.
5. Experience drivers must be reeducated on driving rules and regulations.
6. There should be strategies that will eliminate corruption at the D.V.L.A to make sure the right thing is done. That's issuing of fake driving license and also license to individuals who haven't gone through the driving test by the D.V.L.A.
7. Passengers should also be vigilant enough to check drivers when they are over speeding and driving under the influence of alcohol. Police men and women should help in playing major role to check drivers do the right thing to eliminate road accidents.
8. Enforcements of appropriate legislation to make sure that all commercial and private drivers are well trained before they attain driving license to drive on the streets.
9. The Ghana Police should also make sure that all broken down vehicles are towed off the streets.
10. The erection of median barricades on certain roads can help reduce the number of accidents.

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Table 1
Variable, Measure and Sources

Variable	Measure	Source
Road traffic accident (RTA)	All accident (total)	Building and Road Research Institute (BRRI)
Labour force (L)	Labour force (total)	World development indicator (WDI)
Capital (K)	Gross fixed capital formation as a percentage of GDP	World development indicator (WDI)
Size of the Economy (GDP)	Gross Domestic Product (constant 2005 US$)	World development indicator (WDI)
Per Capita Income (GDPPC)	Gross domestic product per capita (constant 2005 US$)	World Development Indicator (WDI)
Government expenditure (GE)	GE as a percentage of GDP	World Development Indicator (WDI)

Table 2
Model 1: OLS estimates using the 21 observations 1991-2011
Dependent variable: lnGDPPC

Variable	Coefficient	Std. Error	t-statistic	p-value	VIF
const	-11.49	1.38668	-8.2859	<0.00001	
lnL	1.23608	0.117614	10.5096	<0.00001	4.297
lnK	-0.0434002	0.022698	-1.9121	0.07287	2.017
lnRTA	-0.209588	0.0739891	-2.8327	0.01149	3.604

Statistics based on the weighted data: Sum of squared residuals = 63.7163; Standard error of residuals = 1.93598; Unadjusted R^2 = 0.93541; Adjusted R^2 = 0.92401; F-statistic (3, 17) = 82.0698 (p-value < 0.00001); Durbin-Watson statistic = 1.792575; First-order autocorrelation coeff. = 0.401857; Akaike information criterion = 90.9037; Schwarz Bayesian criterion = 95.0818; Hannan-Quinn criterion = 91.8104; Statistics based on the original data: Mean of dependent variable = 6.15386; Standard deviation of dep. var. = 0.161592; Sum of squared residuals = 0.044317; Standard error of residuals = 0.0510576

Table 3
Model 2: OLS estimates using the 21 observations 1991-2011
Dependent variable: lnRTA

Variable	Coefficient	Std. Error	t-statistic	p-value	VIF
const	-17.6062	7.1138	-2.4749	0.02490	
lnK	0.0637475	0.0625815	1.0186	0.32353	1.966
lnGDP	2.00688	0.610423	3.2877	0.00464	90.340
lnGDPPC	-2.98854	1.15343	-2.5910	0.01970	85.735
lnGE	-0.398508	0.150619	-2.6458	0.01762	1.232

Mean of dependent variable = 9.19893; Standard deviation of dep. var. = 0.205499; Sum of squared residuals = 0.129661; Standard error of residuals = 0.0900211; Unadjusted R^2 = 0.84648; Adjusted R^2 = 0.80810; F-statistic (4, 16) = 22.0555 (p-value < 0.00001)

Durbin-Watson statistic = 1.87555; First-order autocorrelation coeff. = 0.0145137; Log-likelihood = 23.6195; Akaike information criterion = -37.239; Schwarz Bayesian criterion = -32.0164; Hannan-Quinn criterion = -36.1056

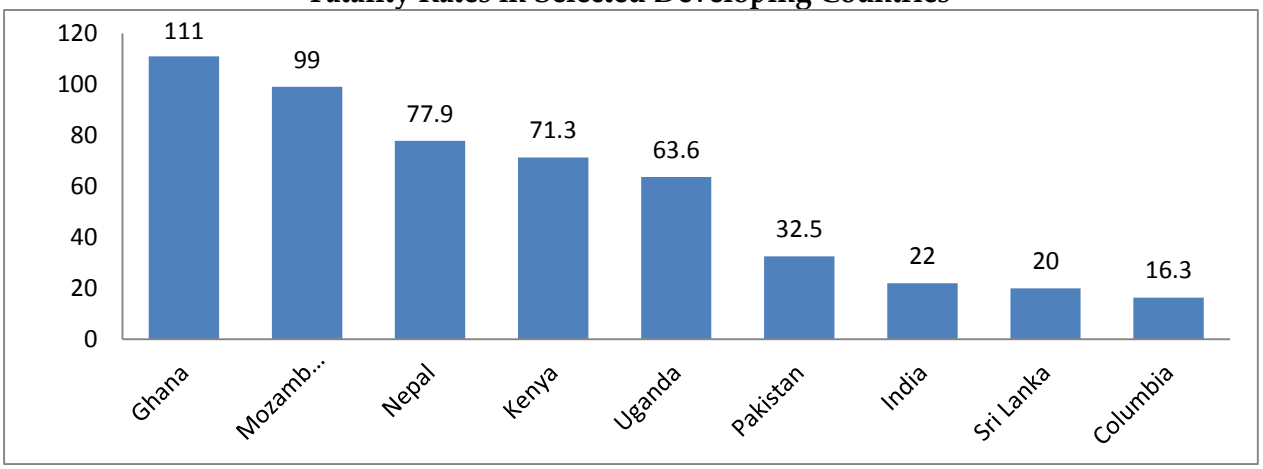
White's test for heteroskedasticity - Null hypothesis: heteroskedasticity not present; Test statistic: LM = 14.9373; with p-value = P (Chi-Square (14) > 14.9373) = 0.382453

LM test for autocorrelation up to order 1 - Null hypothesis: no autocorrelation; Test statistic: LMF = 0.00338486; with p-value = P (F (1,15) > 0.00338486) = 0.954374

Test for normality of residual - Null hypothesis: error is normally distributed; Test statistic: Chi-square (2) = 1.35547; with p-value = 0.507766

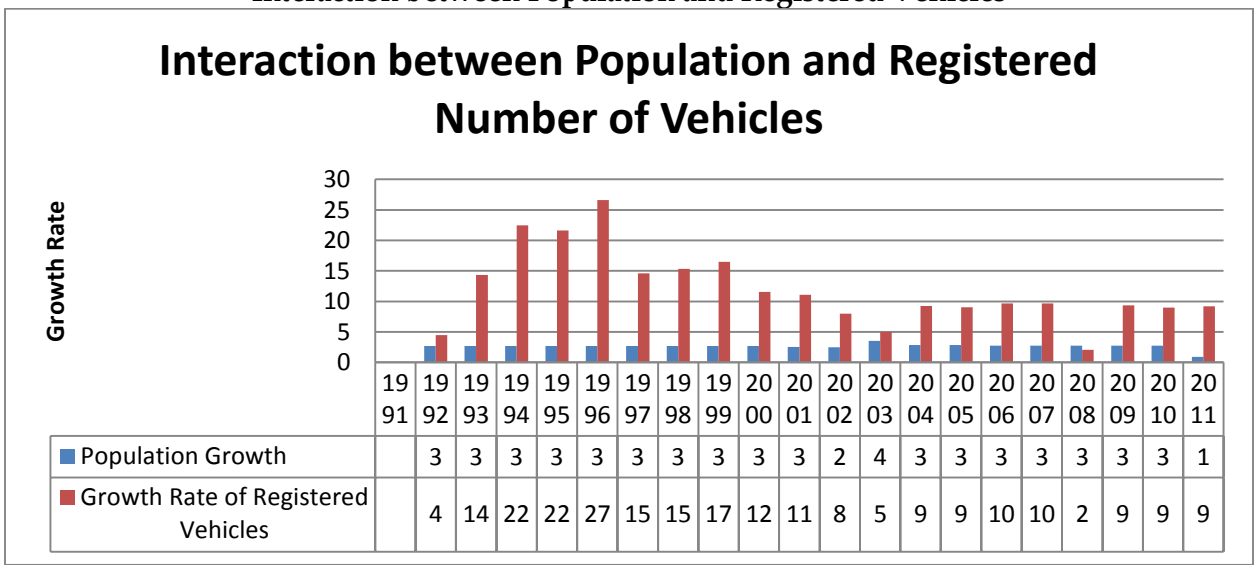
APPENDIX: FIGURES

Figure 1
Fatality Rates in Selected Developing Countries



Source: Manual for Safety in Road Design, 1998

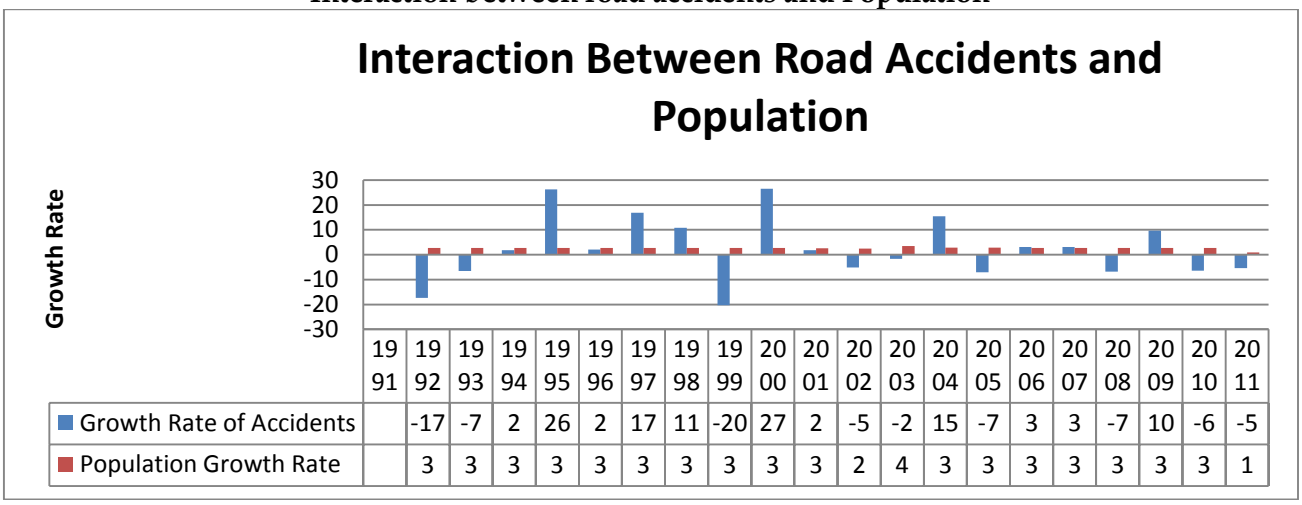
Figure 2
Interaction between Population and Registered Vehicles



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Population Growth		3	3	3	3	3	3	3	3	3	3	2	4	3	3	3	3	3	3	3	1
Growth Rate of Registered Vehicles		4	14	22	22	27	15	15	17	12	11	8	5	9	9	10	10	2	9	9	9

Source; NRSC, 2011

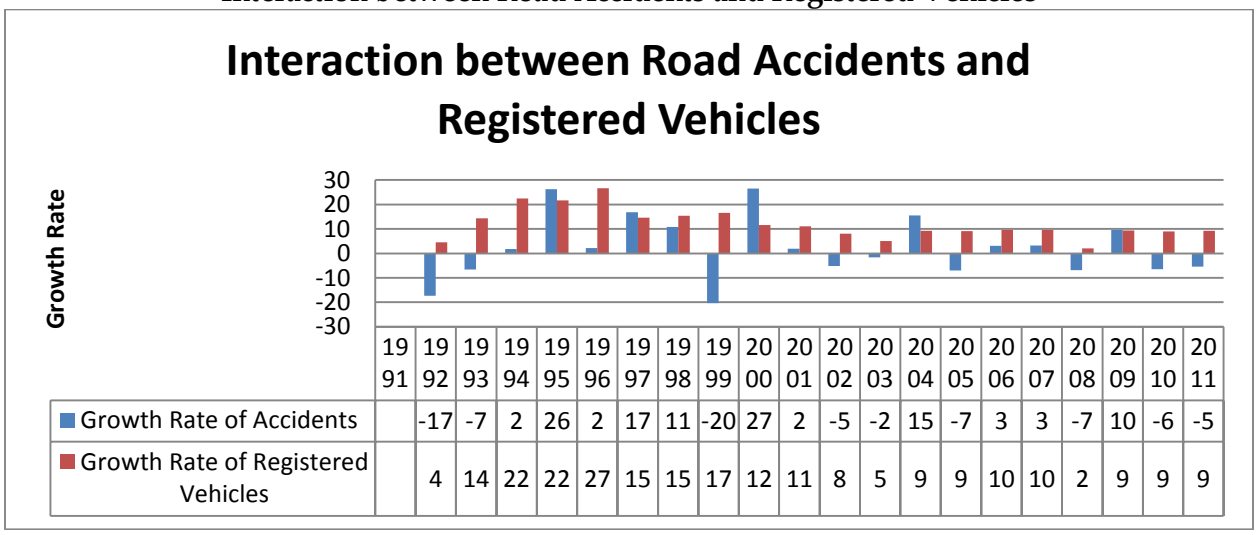
Figure 3
Interaction between road accidents and Population



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Growth Rate of Accidents		-17	-7	2	26	2	17	11	-20	27	2	-5	-2	15	-7	3	3	-7	10	-6	-5
Population Growth Rate		3	3	3	3	3	3	3	3	3	3	2	4	3	3	3	3	3	3	3	1

Source; NRSC, 2011

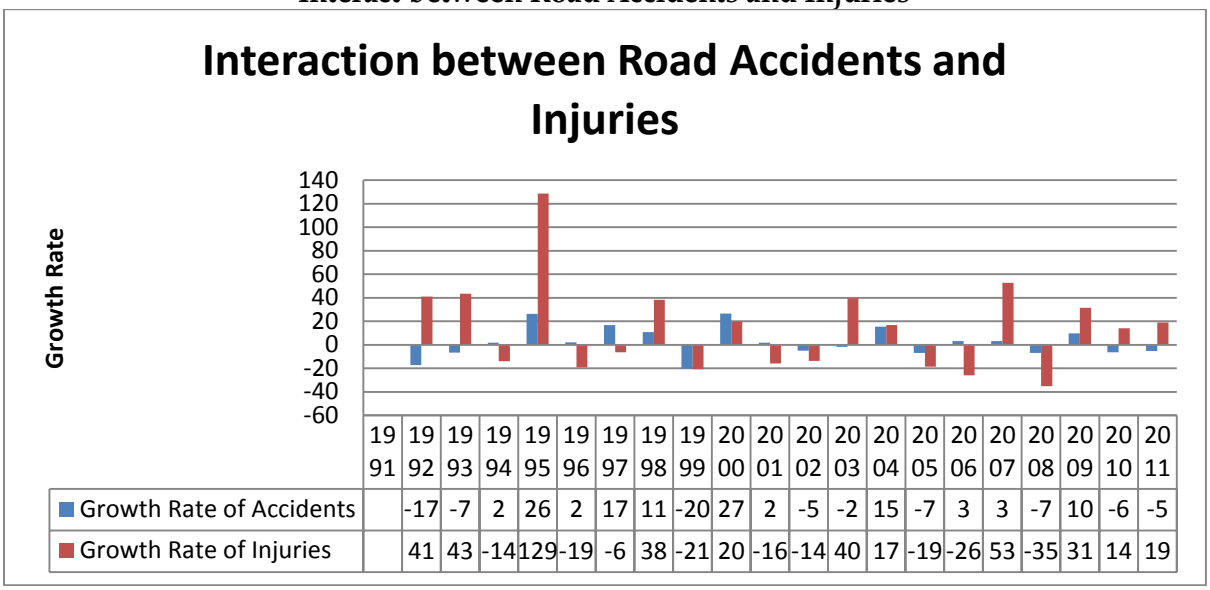
Figure 4
Interaction between Road Accidents and Registered Vehicles



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Growth Rate of Accidents		-17	-7	2	26	2	17	11	-20	27	2	-5	-2	15	-7	3	3	-7	10	-6	-5
Growth Rate of Registered Vehicles		4	14	22	22	27	15	15	17	12	11	8	5	9	9	10	10	2	9	9	9

Source; NRSC, 2011

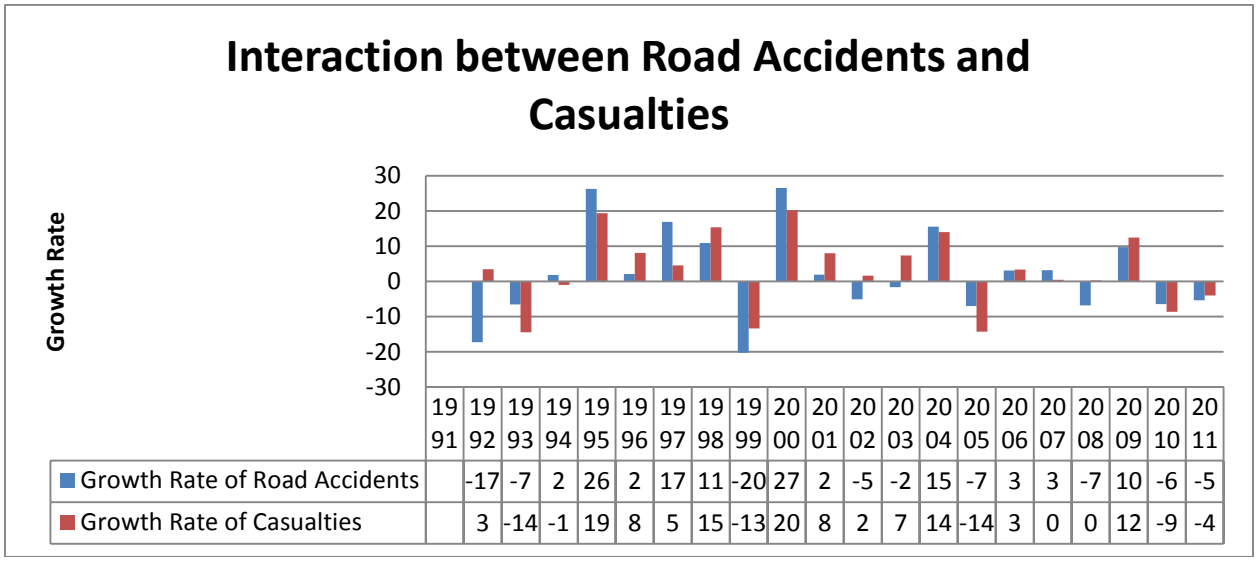
Figure 5
Interact between Road Accidents and Injuries



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Growth Rate of Accidents		-17	-7	2	26	2	17	11	-20	27	2	-5	-2	15	-7	3	3	-7	10	-6	-5
Growth Rate of Injuries		41	43	-14	129	-19	-6	38	-21	20	-16	-14	40	17	-19	-26	53	-35	31	14	19

Source; NRSC, 2011; MTTU Annual Report, 2011

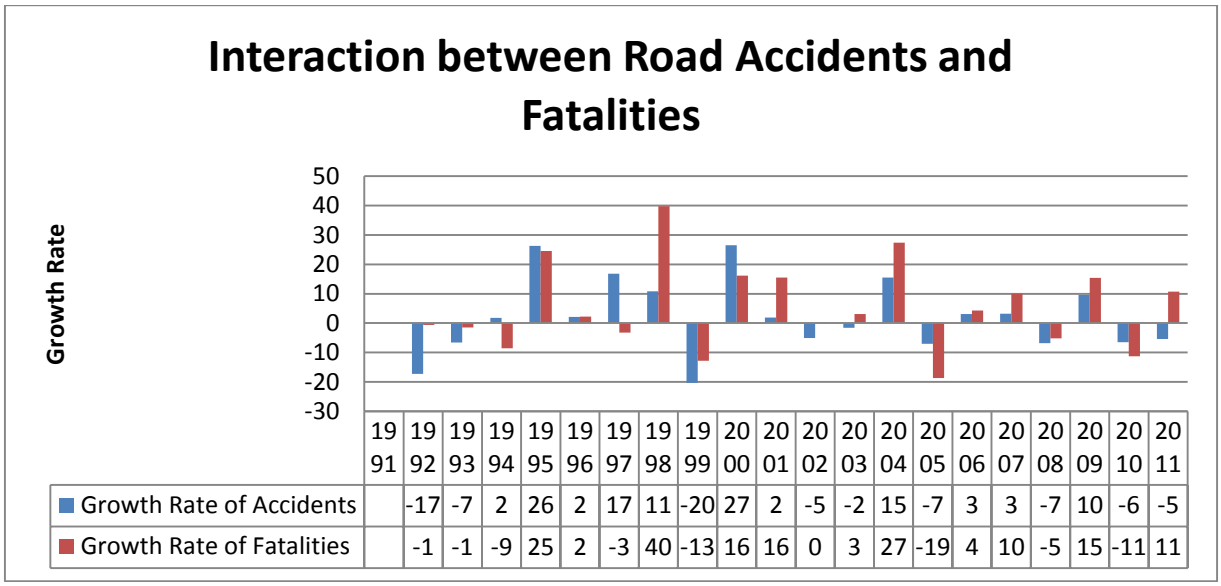
Figure 6
Interaction between Road Accidents and Casualties



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Growth Rate of Road Accidents		-17	-7	2	26	2	17	11	-20	27	2	-5	-2	15	-7	3	3	-7	10	-6	-5
Growth Rate of Casualties		3	-14	-1	19	8	5	15	-13	20	8	2	7	14	-14	3	0	0	12	-9	-4

Source; NRSC, 20111

Figure 7
Interaction between Road Accidents and Fatalities



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Growth Rate of Accidents		-17	-7	2	26	2	17	11	-20	27	2	-5	-2	15	-7	3	3	-7	10	-6	-5
Growth Rate of Fatalities		-1	-1	-9	25	2	-3	40	-13	16	16	0	3	27	-19	4	10	-5	15	-11	11

Source; NRSR, 2011

Figure 8
Normality of residual for model 1

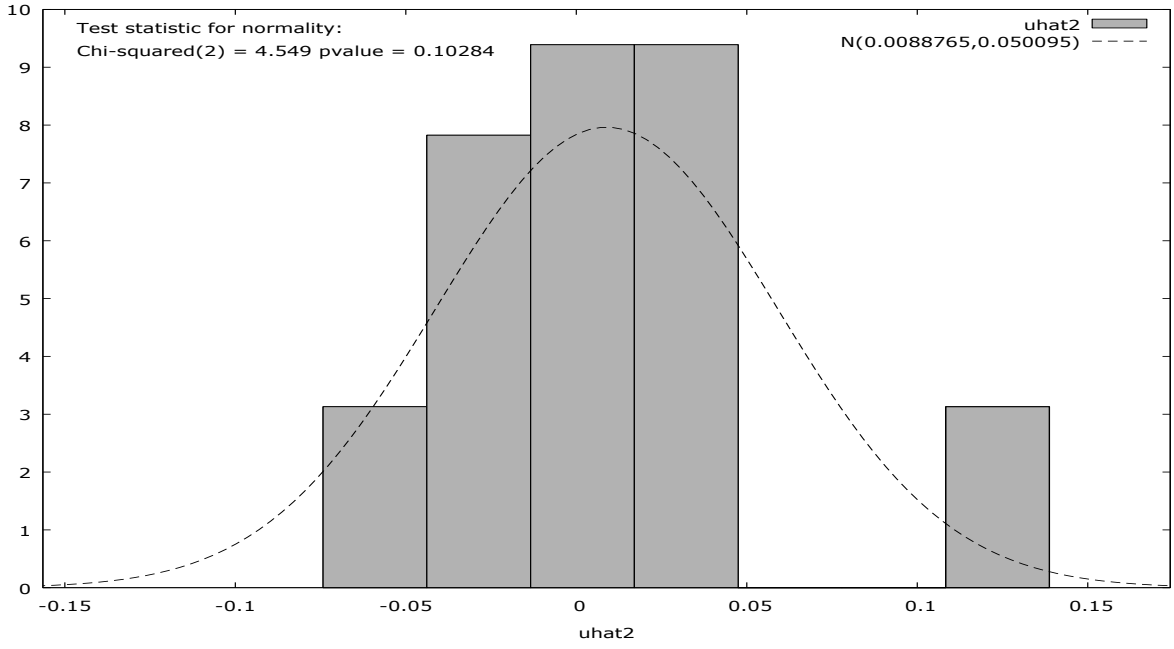


Figure 9
Normality of residual for model 2