The Impact of transportation Infrastructure on Economic growth: Empirical evidence from Saudi Arabia 1988-2017.

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ABSTRACT

Transport is an important sector of economic activity, where it contributes directly to economic activities and employment through bus, rail, road, air and maritime services. Road has a large indirect impact via all the other sectors and activities in the economy. The study aims to investigate the causality relations between road transport and economic growth in Saudi Arabia, the study depends on secondary data collected from Saudi Arabia Monetary Agency and World Bank over the period (1988-2017). The Granger causality test used to investigate the relationship among study variables with Akiake Lag Length Selection Information Criteria. The study also uses Vector Autoregtression (VAR) model in order to find the causality. The study result reveals unidirectional causality for real GDP to road, no evidence to support that transportation infrastructure is the cause of economic growth. The study calls for more attention towards roads system; distribution of this results imply that Saudi Arabia's government should be proactive in the provisions of more infrastructure facilities specifically roads to contribute to the economic growth.

Keywords: Transportation; causality; road; real growth domestic product; *infrastructure; economic growth.*

1. INTRODUCTION

The definition of Infrastructure refers to fundamental facilities and systems serving the country, city, or area, including services and facilities necessary for functioning the economy. It typically characterizes technical structures such as roads, bridges, tunnels, water supply, sewers, electrical grids, telecommunications, and so forth, and defined as, "the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions. (21).

Transport sector is an important component of the economy and a common development tool. This is even more in global economy where economic opportunities increasingly related to the mobility of people, goods and information. A relation between the quantity and quality of transport infrastructure and the level of economic development is apparent. High-density transport infrastructure and highly connected road networks are commonly good signs of high levels of development. At the macroeconomic level, the evidence shows that there is a strong association between infrastructure spending and the growth of real GDP. While investment in infrastructure has a very high return, the importance of particular types of infrastructure declines beyond ascertain level of GDP. At higher income levels - as in developed countries - its power and telecommunication tend to have higher share in GDP than roads and water. At low-income levels, as in developing counties, water shows the highest GDP share followed by transport (1).

Transportation projects have various impacts on a community's economic development objectives. In general, transport projects that improve overall accessibility and reduce transportation costs tend to increase economic productivity and development. Some examples of the effective roles played by transportation:

- A new highway or public transport service increases a community's access to other areas. This increases businesses' labor pool, reduces their costs to obtain input materials and services, and expands their potential market. This may increase "economies of scale" in production processes, which means higher productivity through lower costs per unit of output.
- Improved accessibility may increase workers' ability to access education and employment opportunities (increasing their productivity and income) and increase access to recreation and cultural opportunities (increasing their welfare).
- New transportation links between cities and ports, and new types of inter-modal facilities and services at those locations, make it possible for new patterns of international trade to develop. In some cases, the new links may improve the efficiency of business customer/client visits as well as product deliveries.
- Facing rising demand driven by increased urbanization of populations that creates a challenge for transportation providers in terms of maintaining an efficient and productive transport system in the face of population changes.

One of the key factors that play a pivotal role in a region's economic growth is the presence of a reliable and efficient transportation system. The provision of efficient infrastructure encourages investment in less developed areas by allowing wider movement of goods and people facilitates information flows and helps to commercialize and diversify the economy. Efficient transport systems provide economic and social opportunities and benefits that result in positive multipliers effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities and lower quality of life. At the aggregate level, efficient transportation reduces costs in many economic sectors, while inefficient transportation increases these costs. In addition, impacts of transportation are not always intended and can have unforeseen or unintended consequences. Transport carries an important social and environmental load, which cannot be neglected. Assessing the economic importance of transportation requires a categorization of the type of impacts it conveys. These involve core (the physical characteristics of transportation), operational and geographical dimension. (30).

Investment in less developed areas by allowing wider movement of goods and people facilitates information flows and helps to commercialize and diversify the economy. Efficient transport systems provide economic and social opportunities and benefits that result in positive multipliers effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities and lower quality of life. At the aggregate level, efficient transportation reduces costs in many economic sectors, while inefficient transportation increases these costs. In addition, impacts of transportation are not always intended and can have unforeseen or unintended consequences. Transport carries an important social and environmental load, which cannot neglected. Assessing the economic importance of transportation requires a categorization of the type of impacts it conveys. These involve core (the physical characteristics of transportation), operational and geographical dimension. (30)

Saudi Arabia is a vast country of 2,149,690 km^2, and is the second largest Arab state in Western Asia. The Kingdom has categorized as a high-income state, and it is member of the “Group of Twenty” (G-20) world major economies. With a total population of approximately 32 million, the motor vehicles remain to be the major mean of transportation within, and in-between cities in the country. The country endowed with abundant natural resources that make it well qualified to achieve higher levels of economic development. However, these resources cannot work in isolation from efficient infrastructure most importantly well develop transport system. Because the Kingdom possesses all these ample resources, its need to achieve the desired economic progress (economic growth, trade (imports and exports), domestic capital formation and unemployment reduction and utilization of resources. Against this background, and due to importance of efficient infrastructure systems, the country need to transform Saudi abundant resources into real economic development (36).

The transport sector of Saudi Arabia emerged over the past as a driving force for the economic and social development of the Kingdom. The highway network with over 56,000 km of paved roads facilitates the movement of people and goods across the whole Kingdom (UNDP/SAU10). Ministry of Transport (MOT) of Saudi Arabia in collaboration with international organizations had drafted a National Transportation Strategy (NTS). The NTS, (28) called for developing sustainable transport systems and improving road safety.

Transportation system and intercity movement in mega cities of Saudi Arabia is mainly road transport system. Private vehicles are dominating roads, representing the common transport mean for the majority of the population. The car ownership forecast in Saudi Arabia rise from just 423 per 1,000 people in 2012 to 430 per 1,000 people in 2017 (17). To support the policy makers and to fill the gap in literature, the study will try to analyze the causality between current transportation infrastructure and economic growth in Saudi Arabia over the period 1988-2017. The importance of study takes in consideration the size and abundant resources of Saudi Arabia; it becomes crucial to identify how transport maximized by making the country's infrastructure more efficient. Moreover, it is very important to recognize how transport system can contribute to economic growth rates through exports performance, imports, and high employment rates. Therefore, identifying the causality between transport and economic growth helps to know the extent to which Saudi Arabia could adjust its economic transpot infrastrure to maximize its national benefits and interests.

The study endeavors to achieve two broad distinct with complementary objectives: the first is to analyze the role that played by transport systems in escalating the level of economic development in the country. Secondly, to provide policymakers in the country with a coherent policy guideline in order to promote transport. These objectives can attained by testing two hypotheses; the first will test if there is positive relationship between road infrastructure and economic growth. Second to test if there is positive relationship between economic growth and road infrastructure. VAR model assumes that all variables are endogenous where each variable explained by its own lags and the lags of the others.

The rest of the paper proceeds as follows, next section provides a brief literature review of the related studied, followed by the economic growth of Saudi Arabia and its infrastructure situation. Subsequently the data and methodology will presented, followed by the empirical findings and the last section concludes the paper.

2. MATERIAL AND METHOD:

2.1. LITERATURE REVIEW:

Transport contributes to economic development through job creation and its derived economic activities. Accordingly, a direct (freighters, managers, shippers) and indirect (insurance, finance, packaging, handling, travel agencies, transit operators) employment are associated with transport. Producers and consumers take economic decisions on products, markets, costs, location, prices that are themselves based on transport services, their availability, costs, capacity, and reliability.

Weiss (37) examined the impact of infrastructure on economic growth for a sample of 31 developing counties over the period (1970-1992). He adopted a growth accounting approach with infrastructure proxies by two variables, power capacity per capita and road length per capita. The estimates suggested that infrastructure positively related to output growth, and that the coefficient of the lagged infrastructure variable on current per capita GDP was significant and has a positive sign. In contrast, (10) in their attempt to explain Africa lagging growth using cross section regression found no significant effect of either roads railways or electricity generation on productivity. This is interesting in view of the many studies of Africa, which cite the poor state of its infrastructure.

Most evaluations of Structural Adjustment Programs in Africa point to search deficiencies in infrastructure as a major cause of poor supply response in economics under reforms. Adequate transport links encourage farmers to increase their marketable surplus and to use land more intensively, and to adopt more efficient techniques and modern inputs in the end (22). Furthermore, tested the relationship between infrastructure and per capita GDP involves both sides in terms of the contribution of infrastructure to generate higher demand for infrastructure services (23).

The evidence obtained from Survey of African Businesses, which measures the competitiveness index of 23 African countries, showed strong correlation between the quality of infrastructure and the sentiments of foreign business. The result indicates the importance of infrastructure in business decision and operations; it ranks high on list of complaints for all business and third for foreign-owned firms. Firms overwhelmingly indicate that roads are the most important (1).

Cantos et.al (8) tested the impact of transport infrastructures on the economic growth of both regions and sectors in Spain. An attempt made to capture the spillover effects associated with transport infrastructures. Two different methodologies used: the first one adopts an accounting approach based on a regression on indices of total factor productivity; the second uses econometric estimates of the production function. Very similar elasticity obtained with both methodologies for the private sector of the economy, both for the aggregate capital stock of transport infrastructure and for the various types of infrastructure. However, the disaggregated results for production sectors are not conclusive. The result confirmed the existence of very substantial spillover effects associated with transport infrastructures.

Peterson and Jessup (29) examined the interrelationship between infrastructure and activity using two Washington State highway infrastructure datasets in combination with county-level employment, wages, and establishment numbers for several industrial sectors for a subset of counties from (1990 – 2004). Estimates using vector auto regressions, error correction models, and directed acyclic graphs. Results showed that relationships between infrastructure investment and economic activity are often weak and are not uniform in effect.

Kruger (25) investigated the relationship between infrastructure’s investments and economic activity in Sweden for the period (1980 - 2000). In order to overcome the problem of indigeneity, independent time scales used to analyze the relationship. He also examines the dynamics between the variables by testing for causality in the Granger sense and constructing a vector autoregressive model separately for each timescale. The finding showed the causality nexus between growth and transport infrastructure investment is timescale- dependent since it reverses in a comparison of the short-run dynamics (2 - 4 years) and the longer-run dynamics (8 -16 years). This causality reversal is unique for infrastructure investments compared to investments in other sectors of the economic.

Deng (9) provided an updated survey focusing on estimates of transport infrastructure contributions to productivity and economic growth. The central questions addressed were possible reasons behind the conflicting results reported in the literature on the elasticity of economic output with respect to transport infrastructure investment. The study noted that controversial results attributed to ten causes (grouped into three categories). The first related to different contexts: research period, geographical scale, and country's capability in enabling economic development. Secondly, related to different phenomena that measured: different economic sectors, different types of transport, and different quality levels of transport infrastructure; and third related to distinct ways of measuring a similar phenomenon: measures used to describe the dependent variable and explanatory variable, functional specification, and estimation method of the econometric model. Strong network externalities of transport infrastructure may result in nonlinearity of the relationship between transport infrastructure and economic growth. Moreover, the absence of spatial concerns in infrastructure's impacts is another important source of inconclusive results.

Mohmand et al (27) tested the impact of transportation infrastructure on in economic growth in Pakistan. Panel of data employed using the unit root, conintegration and Granger Causality (GC) model to test whether causal linkages between economics growth and transportation infrastructure exist. The findings suggested that in the short run, there is no causality between the two variables at the national level, however, a unidirectional causality from economic development to infrastructure investment exist in the long run. At the provincial level, bidirectional causality in the rich and much developed provinces exists, whereas a unidirectional GC exists from economic growth to transportation infrastructure in the underdeveloped provinces.

2.2. Transport sector in Saudi Arabia:

Kingdom of Saudi Arabia is a vast country, where the main population centers are not only scattered all over the country, but also separated by deserts, sand dunes, valleys and mountains, fast and reliable means of transportation become more important and essential. The principal aim of road construction in Saudi Arabia is to connect major urban centers with surrounding villages and towns, thereby opening up the entire nation to development and to enable improvements in the quality of life by providing citizens with the ability to commute or move from place to another. Road construction has been a significant feature in the

Kingdom's development, and has dictated patterns of traffic movement. Most development projects, whether for public services, religious purposes, agriculture or industry, have required the construction of new roads (29)

The transport sector of Saudi Arabia emerged over the past as a driving force for economic and social development, all transport modes are rapidly developing. The highway network length with over 56,000 km of paved roads facilitates the movement of goods and people across the whole country. Road fatalities in KSA have increased over the last decade from 17.4 – 24 km per 100,000 population compared with 10 in USA, and 5 in UK. Updated traffic regulations and technology-supported procedures to manage traffic and detect traffic violation have increased road safety and significantly reduced accident fatalities. To improve urban transportation in the major cities of the Kingdom integrated public transport concepts need to be developed, which should include light rail and dedicated bus transportation. The railway network is expanding and thereby creating a regional railway network to facilitate high-speed passenger trains and support multi modal transport of goods. Private sector participation in aviation is enhancing competitive air transport services. (29).

The massive growth in the use of motor transport worldwide witnessed early 20th century and has transformed every country on the planet. However, no country has changed more dramatically than Saudi Arabia, the world’s leading oil producer. At the start of the 20th century, Saudi Arabia’s population was small and the country had few industries while now heavily industrialized with its enormous oil production slaking the world’s demand for fuel. The government has now set aside huge sums of money to develop further its transport infrastructure system. Public and private transportation will both benefit from this massive investment program. Saudi Arabia government’s plan to implement a multimodal transportation system that includes new railways, metros, traffic systems, buses, bridges and roads. Huge infrastructure developed at Riyadh (Saudi capital) where a multimodal transportation system of metros and buses will be ready to use late 2019 (39).

Table a: Transport sector contribution in Saudi’s GDP

Years	Share of Transport Sector in GDP as %	Budget of the transport sector in million (SR)
1995 – 1990	2.11	8,268.1
2000 – 1996	1.99	6,652.2
2001 – 2005	1.36	6,458.4
2006 - 2010	4.02	11,951.3
2011 – 2015	5.46	47,261.4

Source: Saudi General Authority for Statistics (2015).

Considering the Saudi budget for the period 1990-2015, allocations of the transport and communications sector have seen escalating, as shown in Table (a) above. It observed that when the budget for the sector increase, its contribution to GDP increases at a high rate, indicating that the transport sector is a high-productive sector in terms of its growing contribution to the GDP growth of the country. However, there are a series of challenges ahead in the Kingdom's pursuit to meet its Saudi Vision 2030 objective of leveraging its location at the crossroads of three continents. Faced with a decline in the country's ranking among global indices of competitiveness and logistics since 2016, when the national development plan was unveiled, the budget for 2018, includes 86% increase in planned government expenditure on infrastructure and transportation, from SR 29bn ($7.7bn) to SR 54bn ($14.4bn). However, there are a series of challenges ahead to Kingdom's pursuit to meet its Saudi Vision 2030 objective of leveraging its location at the crossroads of three continents.

Saudi Vision 2030 also recognizes that if the nation and its businesses are to play an increasingly significant role in global trade, it must make improvements to its commercial environment and logistics systems. One strategic objective of the document is to increase the country's position in the World Bank's 2016 Logistics Performance Index (LPI). "The LPI is composed of three inputs: customs, infrastructure and service quality. In line with Saudi Vision 2030, Saudi Arabia is aiming to improve its current LPI position of 52nd to 25th." (3)

The Kingdom's cross-border trade systems also feed into the country's performance in another World Bank survey, "Doing Business 2018". In the ease of doing business index, an overview of 190 countries' business environments, Saudi Arabia ranked 161st out of the 190 countries. In terms of transport infrastructure, the Kingdom ranked 53rd for railways, 46th for air transport and 42nd for the quality of its ports, while its roads were ranked 34th – this reflects improving or stable scores in each category. The reforms outlined in Saudi Vision 2030 and the objectives detailed in the NTS should help Saudi Arabia improve its ranking in all of these international indices and comparisons.

3. METHODOLOGY AND DATA:

To accomplish the prescribed objectives and to validate the hypotheses, the study adopts an econometric Granger (13) causality test and Akiake Lag Length Selection information criteria. The study will also adopt Vector Autoregressive Model (VAR) that allows interpretations on the dynamic relationship between the variables, since Granger test and (VAR) Model performed between stationary time's series the stationary (unit root) test used. To make this purpose realizable, a time series secondary macroeconomic dataset comprising annual observations for the periods extended from (1988- 2017) generated from World Bank reports and Saudi Arabian Monetary Agency.

The unit root is a commonly statistical test used to determine whether each data series is non-stationary (that is unit root exist) or stationary (unit root do not exist). The importance of this test stems from the fact that it forms the preamble to the econometric analysis of long-run equilibrium relationships proposed by economic theory. On economic grounds, the conceptual existence of equilibrium relationships proposed by economic theory means that there exists the belief that certain economic variables should not wander freely or be independent to each other, instead, they are expected to move so that, they do not drift too far apart. Therefore, to develop a meaningful relationship between the underlying variables, in a preliminary step, the stationary properties of the data are examined under a univariate analysis by implementing the Augmented Dickey- Fuller (ADF) test for the unit root (non- stationary), on pair of time series of paved roads and real gross domestic product that denoted as (ROAD) and (RGDP), respectively.

Since the critique of Sims (33) in the early eighties of the last century, multivariate data analysis in the context of vector autoregressive models (henceforth: VAR) has evolved as a standard instrument in econometrics. Because statistical tests frequently used in determining inter-dependencies and dynamic relationships between variables, this methodology soon enriched by incorporating non-statistical a priori information. VAR models explain the endogenous variables solely by their own history.

The Stationary Vector Auto Regression Model (VAR) allows interpretations on the dynamic relationship between the variables. The VAR model of paved roads and real gross domestic product, formulated as:

$$RGDP_t=\delta_1+\sum_{i=1}^{P}\beta_{1i}\,RGDP_{t-i}+\sum_{i=1}^{P}\beta_{2i}\,Road_{t-i}+U_{1t} \quad (1)$$

$$Road_t=\delta_2+\sum_{i=1}^{P}\alpha_{1i}\,RGDP_{t-i}+\sum_{i=1}^{P}\alpha_{2i}\,Road_{t-i}+U_{2t} \quad (2)$$

Where:

δ, β, α, are parameters.

RGDP: Real Gross Domestic Product.

Road : Paved Roads.

U_t : are the stochastic error terms.

Assumptions about the error terms:

1. The expected residuals are zero: E (U_{1T}) =E (U_{2t})= 0

2. The vector error terms are not auto-correlated:

E ($U_t U_s$) =σ_i^2 if s= t and

E ($U_t U_s$) =0 if s≠t

Different tests conducted using equations (1) and (2), in order to analyze the dynamic relationship between those variables.

The selected order is lag one (1) according to the criteria of Akaike information criterion, implies that we have VAR (1). The equations (1) and (2) of VAR model becomes:

$$RGDP_t = \delta_1 + \beta_1 RGDP_{t-1} + \beta_2 Road_{t-1} + U_{1t} \qquad (3)$$

$$Road_t = \delta_2 + \alpha_1 RGDP_{t-1} + \alpha_2 Road_{t-1} + U_{2t} \qquad (4)$$

The Granger causality test is statistical hypothesis test for determining whether one-time series is useful in forecasting another, first proposed in 1969. Ordinarily, regressions reflect "mere" correlations, but Clive Granger argued that causality in economics tested for by measuring the ability to predict the future values of a time series using prior values of another time series. Since the question of "true causality" is deeply philosophical, and because of the post hoc ergo propter hoc fallacy of assuming that one thing preceding another used as a proof of causation, econometricians assert that the Granger test finds only "predictive causality".

A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y.

To examine the causal relationship between infrastructures and economic activity, Granger (13) bivariate will adopt causality test. Granger's definition of causality based on two notions. The first is that the future cannot cause the past, while the past and present cause the future. The second notion is that causality exists only between two stochastic variables. It is not possible to talk about causality when the two variables are deterministic. Granger's test utilizes a one-sided distributed lag method, which based on the incremental forecasting value of the past (or past plus present) history of one variable on another. A time series X is said to Granger-cause Y if it can be shown, usually through a series of F-tests on lagged values of X (and with lagged values of Y also known), that those X values provide statistically significant information about future values of Y. The test works by first doing a regression of ΔY on lagged values of ΔY. Once the appropriate lag interval for Y is proved significant (t-stat or p-value), subsequent regressions for lagged levels of ΔX are performed and added to the regression provided that they are significant in and of themselves, and add explanatory power to the model.

The above exercise repeated for multiple ΔX's (with each ΔX tested independently of other ΔX's, but in conjunction with the proven lag level of ΔY). More than one lag level of a variable can be included in the final regression model, if it is statistically significant and provides explanatory power.

The Granger causality test involves estimating the following pair of regressions:

$$y_t = \sum_{i-1}^{n} \alpha_i x_{t-i} + \sum_{j-1}^{n} \beta_j y_{t-j} + \varepsilon_{1t} \qquad (i)$$

$$x_i = \sum_{i-1}^{n} \varphi_i x_{t-i} + \sum_{j-1}^{n} \delta_j y_{t-j} + \varepsilon_{2t} \qquad (ii)$$

With the assumption that the disturbances ε_{1t} and ε_{2t} are uncorrelated. Four cases will distinguished:

1. Unidirectional causality from x_i to y_t is indicated if the estimated coefficients on the lagged x_i in (i) are statistically different from zero as a group $(\sum_{i=1}^{n} \alpha_i \neq 0)$and the set of estimated coefficients on the laggedy_t in (ii) is not statistically different from zero$(\sum_{j=1}^{n} \delta_j \neq 0)$

2. Unidirectional causality from y_t to x_i is indicated if the estimated coefficients on the lagged y_t in the (ii) are statistically different from zero as a group $(\sum_{j=1}^{n} \delta_j \neq 0)$and the set of estimated coefficients on the lagged x_i in (i) is not statistically different from zero $(\sum_{i=1}^{n} \alpha_i \neq 0)$

3. Bilateral causality is indicated when the set of x_i and y_t coefficients are statistically different from zero in both regression equations (i) and (ii).

4. Independence – occurs when the set of x_i and y_t coefficients are not statistically significant in both regression equations (i) and (ii).

In all the four cases, it assumed that the two variables are stationary.

The Granger causality test used in this study to examine whether there are feedbacks between econometric models, paved roads and real gross domestic product, or not (12).

Akaike (2) definition of causality used to determine the optimum lag for each variable. The Akaike Information Criterion (commonly referred to simply as AIC) is a criterion for selecting among nested statistical or the AIC is essentially an estimated measure of quality of each of the available econometric models as they relate to one another for a certain set of data, making it an ideal method for model selection.

The AIC is a number associated with each model:

$$AIC=\ln (s_m^2) + 2m/T$$

Where m is the number of parameters in the model, and s_m^2 (in an AR (m) example) is the estimated residual variance: s_m^2 = (sum of squared residuals for model m)/T. That is, the average squared residual for model m. The criterion may minimize over choices of m to form a trade-off between the fit of the model (which lowers the sum of squared residuals) and the model's complexity, which measured by m. Thus an AR (m) model versus an AR (m+1) can be compared by this criterion for a given batch of data.

An equivalent formulation is this one: AIC=T ln (RSS) + 2K where K is the number of regresses, T the number of observations, and RSS the residual sum of squares; minimize over K to pick K. As such, provided a set of econometrics models, the preferred model in terms of relative quality.

4. RESULTS AND DISCUSSION:

4.1. RESULTS OF THE STUDY:

The ADF unit root tests results are presented in table (1) below illustrate RGDP is stationary in different one with intercept and significance at 10%, and Road is stationary in different one with intercept and significance at 5%.

Table (1): ADF unit root test for paved roads (Road) and Real Gross Domestic Product (RGDP)

Variable	Test for unit root in	ADF Test Statistic	Critical Value
Real Gross Domestic Product (RGDP)	1st difference	-4.135695	1% → -3.689194 5%→ -2.971853 10%→ -2.625121
Paved roads (ROAD)	1st difference	-7.512889	1% → -3.689194 5%→ -2.971853 10%→ -2.625121

Source: Author calculations based on data from WB and. SAMA.

Table (2) explains Akaike information criterion (AIC) by determining the optimum lag length via choosing the lower AIC value, as a result lag 2 is the optimum lag for the period (1988-2017).

Table (2) Akaike information criterion (AIC) for the period (1988-2017)

Lag	AIC
1	44.50*
2	45.46
3	45.48

Source: Author calculations based on data from WB and. SAMA 2017

Table (3) below presents Granger causality tests results for the period (1988-2017). The results recorded unidirectional causality from real GDP to road in lag (1) representing that the correlation was positive at the last years, because the economic activity was consistently increasing during the post (1988-2017). Moreover, there is a strong positive correlation between the two variables R^2=0.78 reflecting the fact that infrastructure playing a tangible role in contributing to economic growth.

Table (3): Granger Causality test results for the period (1988-2017)

Null hypothesis	Observations	F-statistic	Probability	Decision
Lags:2				
ROAD does not Granger Cause RGDP	29	1.69121	0.2049	Don't reject
RGDP does not Granger Cause ROAD	29	8.25450	0.0080	Reject

Source: Author calculations based on data from WB and. SAMA 2017.

Vector autoregressive (VAR) models facilitate the ascertaining of if there are substantial feedback effects and to determine the inter-relationships among the variables. The results present in Table (4) shows that the coefficients of lagged RGDP (-1) and ROAD (-1) are significant in the regression of the RGDP, while coefficients of lagged RGDP (-2), and ROAD

(-2) are insignificant in the regression of the RGDP. While coefficients of RGDP (-1), ROAD (-1) RGDP (-2) and ROAD (-2) are insignificant in the regression of the ROAD.

Table (4): Vector Auto regression (VAR) results for the period (1988-2017)

Dependent Variable	RGDP	ROAD
RGDP(-1)	1.057152 (0.22532) [4.69173]	0.017374 (0.01180) [1.47190]
RGDP(-2)	-0.099995 (0.22476) [-0.44490]	-0.012358 (0.01177) [-1.04961]
ROAD(-1)	6.142121 (4.60106) [1.33494]	0.140884 (0.24103) [0.58451]
ROAD(-2)	-1.631691 (4.61867) [-0.35328]	0.405803 (0.24195) [1.67722]
C	73074.85 (54891.1) [1.33127]	-3484.717 (2875.48) [-1.21187]

Source: Author calculations based on data from WB and. SAMA 2017.

4.2 DISSCUSION:

The results presented in table 4, shows unidirectional causality from real GDP to road in lag (1), representing that the correlation was positive at the last years, because the economic activity was consistently increasing during post the duration (1988 - 2017). Moreover, there is a strong positive correlation between the two variables R^2 = 0.78 reflecting the fact that infrastructure playing a tangible role in contributing to economic growth. In addition, the change in the rate of economic growth doses cause a significant change in transportation infrastructure. The analysis provides sufficient prove that there is a unidirectional causal relationship from economic growth to transportation infrastructure and that real GDP is the Granger cause of transportation development, which means that GDP is a significant cause of development of Saudi Arabia' transportation infrastructure.

The result is in line with the commonly accepted support advocating that economic growth provide necessary financial and technical support for investment in transportation sector. On the other hand, there is no evidence support that transportation infrastructure is the cause of economic growth. Although an investment in transportation sector has a positive impact on economic life in term of production, consumption and welfare of human being.

5. CONCLUSION:

Transport infrastructure investment is a necessary but not sufficient condition for national (and/or regional) economic growth and development: it acts as a complement to other more important underlying conditions, which must also be met if further economic development is to take place. Saudi Arabia expected to maintain its position as the Middle East's largest market by more investment in infrastructure, because of positive association between economic growth and investment in infrastructure. Demand is on the rise for industrial properties, including industrial cities and logistic facilities, and transportation and utilities projects planned. To conclude, the results imply that government should be proactive in the provisions of infrastructure facilities (road) to contribute to the economic growth. Hence, improved transportation infrastructure can enhance the efficiency of goods and labor movement for production. The reduction in time and effort required to produce goods, which translated directly into increased regional productivity. In addition, this notion supported by developed and efficient infrastructure can facilitate a country's economic growth.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

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APPENDIX

Null Hypothesis: D(ROAD) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

Prob.*	t-Statistic		
0.0000	-7.512889	Augmented Dickey-Fuller test statistic	
	-3.689194	1% level	Test critical values:
	-2.971853	5% level	
	-2.625121	10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ROAD,2)
Method: Least Squares
Date: 11/21/18 Time: 20:54
Sample (adjusted): 1990 2017
Included observations: 28 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0000	-7.512889	0.210808	-1.583779	D(ROAD(-1))
0.4111	0.835337	708.8904	592.1621	C

513.1429	Mean dependent var	0.684632	R-squared
6554.002	S.D. dependent var	0.672503	Adjusted R-squared
19.36601	Akaike info criterion	3750.682	S.E. of regression
19.46117	Schwarz criterion	3.66E+08	Sum squared resid
19.39510	Hannan-Quinn criter.	-269.1242	Log likelihood
2.025803	Durbin-Watson stat	56.44350	F-statistic
		0.000000	Prob(F-statistic)

First difference

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

Prob.*	t-Statistic			
0.0034	-4.135695	Augmented Dickey-Fuller test statistic		
	-3.689194		1% level	Test critical values:
	-2.971853		5% level	
	-2.625121		10% level	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP,2)
Method: Least Squares
Date: 11/21/18 Time: 21:08
Sample (adjusted): 1990 2017
Included observations: 28 after adjustments

Prob.	t-Statistic	Std. Error	Coefficient	Variable
0.0003	-4.135695	0.194351	-0.803777	D(GDP(-1))
0.0118	2.708199	17007.48	46059.64	C

-618.8929	Mean dependent var	0.396807	R-squared
85061.00	S.D. dependent var	0.373608	Adjusted R-squared
25.14110	Akaike info criterion	67321.49	S.E. of regression
25.23625	Schwarz criterion	1.18E+11	Sum squared resid
25.17019	Hannan-Quinn criter.	-349.9753	Log likelihood
1.689660	Durbin-Watson stat	17.10397	F-statistic
		0.000328	Prob(F-statistic)

FIRST DIFFRENCE

Pairwise Granger Causality Tests
Date: 11/21/18 Time: 21:15
Sample: 1988 2017
Lags: 1

Prob.	F-Statistic	Obs	Null Hypothesis:
0.2049	1.69121	29	ROAD does not Granger Cause GDP
0.0080	8.25450		GDP does not Granger Cause ROAD

Vector Autoregression Estimates
Date: 11/21/18 Time: 21:21
Sample (adjusted): 1990 2017

Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

ROAD	GDP	
0.017374	1.057152	GDP(-1)
(0.01180)	(0.22532)	
[1.47190]	[4.69173]	
-0.012358	-0.099995	GDP(-2)
(0.01177)	(0.22476)	
[-1.04961]	[-0.44490]	
0.140884	6.142121	ROAD(-1)
(0.24103)	(4.60106)	
[0.58451]	[1.33494]	
0.405803	-1.631691	ROAD(-2)
(0.24195)	(4.61867)	
[1.67722]	[-0.35328]	
-3484.717	73074.85	C
(2875.48)	(54891.1)	
[-1.21187]	[1.33127]	
0.730589	0.981700	R-squared
0.683735	0.978517	Adj. R-squared
2.97E+08	1.08E+11	Sum sq. resids
3591.389	68557.20	S.E. equation
15.59283	308.4587	F-statistic
-266.1926	-348.7682	Log likelihood
19.37090	25.26916	Akaike AIC
19.60879	25.50705	Schwarz SC
11701.21	1732085.	Mean dependent
6386.112	467746.2	S.D. dependent

5.28E+16	Determinant resid covariance (dof adj.)
3.56E+16	Determinant resid covariance
-613.0194	Log likelihood
44.50138	Akaike information criterion
44.97717	Schwarz criterion