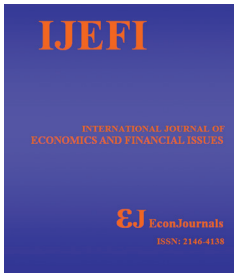

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The Impact of Telecom Infrastructure on the Economic Growth: The Case of Oil-producing and Non-Oil Producing Arab Countries

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ABSTRACT

This study attempts to assess the impact of investment in the infrastructure of the telecommunications sector on economic growth in the Arab countries, using advanced econometric techniques, such as fully modified ordinary least squares, and panel data analysis utilizing cross sectional data covering 12 countries and a period of 20 years 1996-2015. The study finds evidence that investment in infrastructure for the telecommunications sector has a positive and significant effect on economic growth in non-oil producing countries in the long-term; it shows that a 10% increase in the number of telecom subscribers leads to an increase of 3% in real gross domestic product in these countries. The results also show that there is no impact for telecommunication on the economic growth of oil-producing countries. In light of the above findings, policy makers should pay more attention to the telecom sector in the Arab countries, and encourage investment in this sector.

Keywords: Telecom Infrastructure, Economic Growth, Fully Modified Ordinary Least Squares, Oil Countries, Co-integration, Arab Countries
JEL Classification: O12

1. INTRODUCTION

After realizing the importance of telecommunication sector investments in improving economic development, and high mobile technology innovations, telecommunication and information technology investments have flourished in the Arab countries and this is due to a liberalization in the telecommunication markets, which in turn helped boost telecommunication services.

The development in the market structure of telecommunications sector has been quite similar in all Arab countries since 1996. It started with monopoly by one operator, and then most Arab governments, which required the establishment of some regulators to monitor the telecommunication markets, adopted privatization. Those regulators have made some changes in the institutional frameworks, which led to attract more foreign direct investments in the sector. Furthermore, the liberalization helped change the structure to become duopoly and oligopoly in some countries in recent years. These changes triggered fierce competition among operators that led to a dramatic increase in the amount of investment and penetration rate in mobile service in all Arab countries.

The development of telecommunication sector is considered essential to enhance and develop transaction processes, and to decrease transaction and business costs. Furthermore, another advantage of the development of telecommunication services is to lower the cost structure of the value chain of business operations. As a result, the delivery of goods and services to the end consumers will be more efficient with a minimum cost. It can be concluded that telecommunication service is indispensable for economic growth (Watania, 2012).

Due to the importance of telecommunication sector in an economy and its role in developing other sectors, this research will try to investigate the effect of telecommunication development on economic growth, using panel data of twelve Arab countries for a span of 20 years, from 1996 to 2015.

2. LITERATURE REVIEW

The effect of telecommunication infrastructure on economic development has been studied widely by many researchers around the world; the analysis of these studies depends on cross section and time series data (panel) because of the novelty of the telecommunications sector and the need for larger samples. Some of these studies have found that there is correlation (bidirectional) causality between the development of telecommunications infrastructure and economic growth, whereas other studies have found one-way causality relationship between these variables. These studies were conducted on developed countries as well as developing countries.

In industrialized economies, Roller and Waverman investigated the effect of telecommunication infrastructure on economic growth for 21 Organizations for Economic Cooperation and Development (OECD) countries, and 14 newly industrialized non-OECD countries between 1970 and 1990. They estimated jointly a micro model for telecommunication investment with a macro production function; they found evidence of significant positive causal relationship between telecommunication infrastructure and aggregate output; the impact was greater in OECD countries than it was in non-OECD countries (Roller and Waverman, 1996).

In case of the developing countries, Wainaina investigated the relationship between telecommunication infrastructure and economic growth by analyzing the effects of interaction between mobile and landline teledensity, and their effects on economic growth for a sample of 44 Sub-Saharan Africa countries between 1998 and 2010. Using generalized method of moment, the study found out a two-way causality between mobile teledensity and economic growth, while landline teledensity effect economic growth, and not vice versa, in similar manner (Wainaina, 2012).

In addition, Sridhar and Varadharajan analyzed the relationship between telecommunication infrastructure and economic growth, using data from 63 developing countries from 1990 until 2001. They used 3SLS system for equations that endogenizes economic growth and telecom penetration. They found that there is a positive significant effect of increasing mobile penetration and land line penetration on economic growth in these countries (Sridhar, 2007).

Ding empirically investigated the role of telecommunication infrastructure on the long run regional economic growth with a panel dataset for 29 regions of China for a 17 years' period, from 1986 to 2002, using a dynamic fixed effects model for estimation, which enables testing of the relationship between regional economic growth and initial economic condition: Fixed investment, employment, population growth, foreign direct, investment, as well as testing telecommunications infrastructure in this analysis. The results showed that telecommunications infrastructure endowment is a key factor in explaining regional economic growth in China. The results further indicated that the telecommunications investment is subject to diminishing returns, thus suggesting that regions at an earlier stage of development are likely to gain the most from investment in telecommunications infrastructure (Ding, 2006).

Michael and Ward studied the role of telecommunications infrastructure on economic growth, using the provincial dynamic panel data during the period from 1990 to 2010 in China. They examined separately fixed line and mobile telephone subscription level, and developed a method designed to address endogeneity of telecommunications with respect to growth. The results can be summarized as mobile telephone service having a positive effect on growth that is larger during 1990-1999 than 2000-2010. Fixed line services complemented mobile services initially, but had a negative effect later on. Combined, fixed, and mobile services are estimated to have contributed about 2% to China's growth rate during the first decade but only 0.5% in the second decade (Michael and Ward, 2013).

In 2014, Kawaljeet and Neena investigated causal relationship between telecommunication development and gross domestic product (GDP) as well as different sectoral components of GDP in India, using a data over a period of 1976-2012, results revealed long run relationship between telecommunication growth and economic growth at aggregate level as well as at sectoral level in India (Kawaljeet and Neena, 2014).

Because of the lack of research on investigating the relationship between telecommunication infrastructure and economic growth in Arab countries, this paper will examine this matter.

3. DATA AND METHODOLOGY

According to the previous studies, many researchers have applied Cobb-Douglas production function in their analysis. To estimate the effect of telecommunication on economic growth, this study will use cobb-Douglas production function, developed by Solow and Swan in 1956 (Romer, 1996), which contains four variables: Production (Y) as dependent variable, real fixed capital formation (K), work force (L), and knowledge (A), as shown in equation number (1).

$$Y(t) = F(K(t), L(t), A(t)) \quad (1)$$

T: Represents time in the model.

This model characterized by constant return to scale, and technology is determined outside the model; it has been developed by including telecommunication infrastructure; this addition to the neoclassical growth model is welcomed with a support by many economists like, Waverman and Ding (Waverman et al., 2005) and (Ding, 2006). This methodology will be used to estimate the effect of telecommunication infrastructure on economic growth in Arab countries for the period of 1996-2015.

Similar to Chakraborty and Nandi, penetration rate for telecommunication is used as a proxy for telecommunication infrastructure, which is measured by the number of fixed line and mobile subscribers in Arab countries (Chakraborty and Nandi, 2003).[1]

1 Penetration rate: Number of telecom subscribers per 100 inhabitants.

To achieve the objectives of the study, this research will use a panel data, which has many advantages; besides enlarging the sample size, which makes the estimation of the data more precise, it can also facilitate analysis of common dynamic trends. It can also help to solve omitted values (Colin and Trivedi, 2005). The estimation of the model using panel data also allows us to have more degrees of freedom, and it takes account of heterogeneity in the responses from countries and their subgroups. Furthermore, the use of panel data enables us to control for omitted variable bias and to reduce the problem of multicollinearity among the explanatory variables (Arellano and Bond, 1991).

The study uses data published from twelve Arab countries, over the period of 1996-2015; this period witnessed a dramatic increase in telecommunication investments and mobile penetration rate.

Arab countries were divided into two groups based on per capita income[2]; countries with high per capita income (Gulf countries), including Saudi Arabia, UAE, Kuwait, Oman, Qatar, and Bahrain. The other group includes countries with medium per capita income, such as Jordan, Lebanon, Egypt, Algeria, Tunis, and Morocco.

Data on telecommunication penetration were gathered from International Telecommunication Union annual reports, fixed capital formation, and RGDP were gathered from World Bank data bank (WDI), and Labor data were gathered from ILO data bank.

4. ECONOMETRIC MODEL

The study will focus on investigating the effect of penetration of telecom services, (landlines, and mobile) on economic growth using a panel data for 12 Arab countries, for the period from 1996 until 2015. Both mobile and landline will be analyzed jointly toward economic growth, using Cobb-Douglas production function, by adding both penetration rate for Telecommunication Infrastructure variable (TEL) and trade openness (OP) variable to the model, following (Barro, 1996), and (Roller and Waverman, 1996), a production function equation will be as follows:

$$(RGDP)_{it} = \beta_0+\beta_1(L)_{it}+\beta_2(RK)_{it}+\beta_4(CELL)_{it}+\beta_5(OP)_{it}+\varepsilon_{it} \quad (2)$$

i=1,2,….N
t=1,2,….T

By transforming real GDP (RGDP), (RK), and (L) variables into logarithm[3] form; the econometric model to be estimated will be as in equation 3.

$$(LnRGDP)_{it} = \beta_0+\beta_1(LnL)_{it}+\beta_2(LnRK)_{it}+\beta_4(TELL)_{it}+\beta_5(OP)_{it}+\varepsilon_{it} \quad (3)$$

Where,
i: Country.
n: Number of countries.
t: Time.
ε: Error term.
RGDP: Real gross domestic product in US$.
RK: Real Fixed capital formation in US$.
L: Labor, measured by number of workers comprises all persons of working age who, during a specified brief period such as 1 week or 1 day, were in the following categories: (a) Paid employment (whether at work or with a job but not at work), or (b) self-employment (whether at work or with an enterprise but not at work), in Logarithm form.
TEL: Teledensity, the number of telephone per 100 inhabitants, including both fixed line and mobile subscribers.
Op: Trade openness, was the share of trade in GDP (Export+Import)/GDP. It is used as a proxy for the level of openness of the economy.

5. EMPIRICAL RESULTS

This section presents the results of econometrics analysis, to investigate the relationship between telecommunications infrastructure and economic growth in Arab countries, and how the impact of telecommunications infrastructure on economic growth varies depending on the level of income in Arab countries: High-level income countries versus middle-income countries. Many techniques have been applied for this analysis, like unit root testing, co-integration analysis and fully modified OLS to investigate this relationship.

5.1. Panel Unit Root Test

The data and time series variables stability is a necessary condition for the econometric analysis, and lack of stability leads to misleading and unrealistic results before proceeding to co-integration analysis technique.

Therefore, we have used Panel Im, Pesaran and Shin, and Dickey Fuller tests that allow for heterogeneity in the autoregressive coefficient (Im et al., 2003); Table 1 shows the result of the panel, unit root tests, Im, Pesaran and Dickey Fuller.

Results indicate that all variables are non-stationary at level, and when we take the first difference, they become all stationary at 5% level of significant in both tests I(1). The same results were obtained for country groups, oil producing countries group versus non-oil producing countries group, therefore we can apply panel co-integration test to show if there is a long relationship between variables.

5.2. Panel Cointegration Analysis

To examine the existence of a joint integration and long-term relationship between variables, that found stable on the first difference I(1), using each of the Johansen co-integration test (Johansen, 1988) and Kao test (Kao, 1999); Table 2 shows the results of Johansen and Kao co-integration test between study variables.

As shown in Table 2, the Johansen test results, based on the method of Fisher common integration, (trace test statistics)

2 This is based on World Bank classification, High-income countries with 12000 US$ per capita income or more, per capita income in medium income countries is less than 12000 US$ and greater than 4000 US$.

3 The logarithmic transformation of the production function provides a log-linear form, which is convenient and commonly used in econometric analyses using linear regression technique.

Table 1: Panel unit root test for variables in the study

Variable	Im, Pesaran and Shin with intercept		Im, Pesaran and Shin with trend and intercept intercept		ADF with intercept		ADF with trend and intercept		Order of integration
	Statistics	P**	Statistics	P**	Statistics	P**	Statistics	P**	
LNGDP	2.171	0.9851	0.22867	0.59	11.951	0.9804	23.582	0.4857	I (1)
DLNGDP	−6.556**	0	−2.194**	0.014	90.538**	0	42.27**	0.012	
LNL	0.6213	0.7328	−6.757**	0	25.33	0.388	92.706**	0	I (1)
DLNL	−6.079**	0	−5.334**	0	80.990**	0	68.286**	0	
LNRK	3.0929	0.999	1.83224	0.9665	6.955	0.9997	16.9241	0.8519	I (1)
DLNRK	−4.5855**	0	−3.4199**	0.0003	61.702**	0	49.258**	0.0018	
TEL	3.3755	0.9996	−0.9622	0.168	12.7604	0.9699	30.2955	0.1752	I (1)
DTEL	−4.2658**	0	−0.9816	0.1631	59.940**	0.0001	38.811**	0.0286	
OP	−0.561	0.2872	−0.6112	0.2705	25.88	0.3593	30.927	0.1559	I (1)
DOP	−9.965**	0	−7.869**	0	129.62**	0	96.66**	0	

**Shows reject the hypothesis of Unit root at 5% significant level, GDP: Gross domestic product

Fisher panel co-integration test, supports the existence of a long-term relationship between the variables at 5% level of significant, t-statistics and panel t-statistics reject the null of no co-integration at 5% significance level. Co-integration test by Kao (1999) also supports the panel co-integrated model with 0.008 probability value, which means that the study variables are co-integrated, and they move together in the long-term period.

5.3. Fully Modified OLS Results

Unit root testing and Johansen co-integration test support the existence of a long-term relationship between the variables of the study, Therefore fully modified ordinary least square test (FMOLS) (Phillips,1990) is used to estimate the model for both groups: Oil producing countries and non-oil producing countries.

Table 3 summarizes the results of FMOLS analysis for main Arab countries groups, Oil producing countries with high per capita income, and Non-oil producing countries that has medium level of per capita income.

FMOLS method is applied to the middle-income countries, a group of countries with similar average per capita income that ranges between 4000, and 12000 US dollars, such as Jordan, Egypt, Tunisia, Lebanon, Algeria, and Morocco.

The results show a positive and significant effect of telecommunication infrastructure (TEL) on economic growth; the coefficient was 0.302 and it is significant at 5% level. The sign is positive, which means that the result supports the economic theory: A 10% increase in telecommunication penetration (fixed and mobile) in middle-income countries will increase output (GDP) by 3%. Looking closely at the results can also reveal that labor coefficient (L) was positive 0.57 and statistically significant at 5%, which is consistent with economic theory, meaning that if labor force increased by 10%, RGDP would increase by 5.7%. As for the trade openness (OP) coefficient, the results indicate positive and significant rate of 0.10, which means that the increase in trade openness in these countries by 10% would lead to an increased economic growth by 1%. On the contrary, the capital variable (RK) was not significant statistically in affecting RGDP in these countries.

Table 2: Panel co-integration test

Test	Trace test	P value	Max-Eigen test	P value
Johansen				
Non	473.5	0.000	298.3	0.000
Kao				
	t-statistic			
ADF	−2.3757	0.0088		

Probabilities are computed using asymptotic Chi-square distribution, Non: null hypothesis is no cointigration

Table 3: Results of (FMOLS) analysis for both Arab Countries Groups

Country	TEL	OP	L	RK
Oil countries	0.03485	−0.3826**	0.5222**	0.2541**
	(0.3587)	(0.0001)	(0.000)	(0.000)
Non-oil	0.3025**	0.1002**	0.5717**	0.0412
countries	(0.000)	(0.055)	(0.000)	(0.1437)
R^2=0.997367		Adjusted R^2	0.997139	

**5% significant value

For oil-producing countries, a group of high-income countries with more than US $ 12,000, including United Arab Emirates, Saudi Arabia, Oman, Bahrain, Qatar, and Kuwait, the results show that there is no significant effect of telecommunication infrastructure on RGDP although the sign is positive, which is consistent with the economic theory. Such results mean that the telecommunications infrastructure in these countries have no importance on the economic growth because these countries rely heavily on crude oil and gas production, forming an important element in the GDP growth.

Regarding labor force, the results show that the elasticity of the labor coefficient (L) reads 0.522 which is positive and statistically significant at 5% level, and this is consistent with economic theory, meaning that if labor force increased by 10%, this would increase economic growth by 5.2% in Gulf countries. Fixed capital investment has a positive effect on the economic growth in the Gulf countries; the elasticity coefficient is 0.25, which means a 10% increase in real fixed capital formation will lead to 2.5% increase in RGDP.

Unlike medium-income countries, trade openness has negative effect on the economic growth in oil-producing countries, and it is

significant at 5% level, meaning that if trade openness increases by 10%, RGDP will decrease by 3.8%. The result of negative effect is consistent with the outcome of the study that conducted by Romain et al. in 2008, where they studding the effect of trade liberalization and growth on a group of developing countries, whose results were trade has a negative impact on economic growth after trade liberalization in these countries (Romain, 2008).

Comparing the above-mentioned results with the result reached by Waverman et al. in 2005 (Waverman et al., 2005) who, in a study on developing countries, found an increase of 10% penetration rate of mobile phones will lead to an increase of 0.6% on the economic growth in these countries. The impact of telecommunications on economic growth in the non-oil Arab countries is higher than the average impact for developing countries, which means that telecommunications in the Arab countries have a greater importance on economic growth compared with the results for developing countries as a whole.

In comparison, the study results of the effect of telecommunication infrastructure on the economic growth in the non-oil Arab countries are higher than the results of the study conducted by Roller and Waverman in 2001 (Roller and Waverman, 1996) for 21 OECD countries, where they found a 10% increase in the penetration rate of telecommunications services will increase economic growth by 1.5% in those Countries.

In sum, telecommunication infrastructure has a stronger positive effect on the economic growth in the non-oil countries than it has on that in the developing countries and even the developed countries, and there is no effect for telecommunication on economic growth in the oil-producing countries.

6. CONCLUSION

The purpose of this paper is to examine the impact of telecommunications sector, "Fixed and Mobile" on the economic growth in the Arab countries, for the period from 1996 to 2015. Arab countries were divided into two groups, oil-producing countries and non-producing countries.

The results show that there is a difference between these groups in the effect of telecommunication and other variables on GDP. Telecommunication infrastructure has a positive and significant impact on RGDP in non-oil-producing Countries; the elasticity of telecommunication was 0.3%, while the analysis show there is no effect for telecommunication on the RGDP in the oil-producing countries.

These results imply that telecommunications infrastructures play a strong role in countries that do not rely on oil in their economies, while real fixed capital has no significant effect on GDP in these countries. On the contrary, this variable has a positive effect on GDP in the oil-producing countries.

These results may have many policy implications in Arab countries, like reviewing the utilization of telecommunication services, cellular and landline phones, to be more efficient in the business and social life environment if they want to benefit from these services, which may have a positive impact on economic growth in future.

Policy makers have to enhance the use of telecommunications; the result of this study promotes investments and improvements in telecommunications development, especially in sectors that have critical stimulating growth for potential gains from telecommunications by benefiting from the huge access of population to the internet through telecom services. In addition, the telecommunication services can also have an advantage by facilitating the access of population to the government services, as will as other sectors services, like education and health, which rely highly on internet and telecommunication services.

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