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Impact of information and communication technology and financial development on economic growth of OPEC developing economies

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Abstract

The main objective of present study was to investigate the impact of information and communication technology (ICT) and financial development on the developing economies of the petroleum exporting countries (OPEC) for the period 2002−2015 using a panel-GMM type of growth model. The results extracted from the econometric model showed that an increment of one percent in the financial development index and ICT variables caused economic growth to increase by .048 and .050 percent, respectively. Moreover, the impact of variables such as inflation (negative), active labor force growth (positive), investment growth (positive), and growth of gross fixed capital formation (positive) on the economic growth of the countries, were close to theoretical expectations. However, the impact of variables such as trade openness (negative) and government spending size (positive) on the economic growth of the selected countries did not support previous findings, perhaps because of the economic structural differences of the selected countries.

Introduction

Financial development has an undeniable effect on the macroeconomic performance of countries to such an extent that in most developed countries today, a major part of development in the international economy is attributed to these markets. Financial systems reduce transactional costs and improve the allocation of resources, which ultimately results in economic growth from functions such as gaining information concerning investment opportunities, supervision of investments, risk distribution, aggregation of savings, and goods and services exchange facilitation (Demirguc-Kunt & Levine, 1996). However, the conditions are different for developing countries. In most developing countries, financial institutions lack any desirable efficiency due to the governmental nature of a major part of the financial system, inefficient banking services, shortage of resources, the dual (official and unofficial) structure of the financial sector, and the domination of the unofficial sector. Some economists attribute slow economic growth in some developing countries to inefficiency and underdevelopment in the financial sector and they recommend systematic reforms in this sector to achieve faster economic growth (Levine, 1996).

On the other hand, the importance and necessity of information and communication technology (ICT) is such that in the current age, enjoying the relative advantage of natural resources and reserves, which is specific to developing countries, has lost its value against the competitive advantage caused by the technology, which is specific to developed countries (Andrianaivo & Kpodar, 2011). Therefore, investment in the ICT sector not only is followed by high added value, but also it plays a major role in the

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improvement of processes (Pohjola, 2001). The impact of ICT on economic growth and development can be examined from the demand and supply aspect. ICT results in increased demand for new products and services and on the supply side, the growth of ICT and its skills results in the increased efficiency of production factors in economic activities (Nour, 2002). The main objective of this study was to determine the size of the impact of financial and ICT development in the economic growth of the OPEC developing economies.

ICT and Economic Growth

ICT includes the collection, organization, storing, and publication of data including audio, video, text, or figures, which is carried out using computer instruments and telecommunication (Niebel, 2014). Regardless of the various definitions and the broad use of ICT in different parts of human life, it is worth mentioning that the development of ICT seems to be necessary for economic growth and the development of countries for several reasons. First, this technology increases the speed of data transmission and in this way more information is disseminated among individuals. Second, ICT decreases production costs because it is possible to access the generated knowledge at the minimum cost. Moreover, the reduced exchange cost decreases the degree of inefficiency and unreliability. Third, ICT overcomes time and space constraints; as a result, data transmission among buyers and sellers increases and the production process goes beyond national borders. This technology enables all individuals to understand their superiority to others in the market economy which in turn results in a broader market and increased access to the international supply of goods. Fourth, ICT increases market transparency followed by an increase in individual demand for easy access to required data (Quah, 2003). The research studies of Oliner and Sichel (2000), Jorgenson and Vu (2005) and Reuter (2010) showed that there is a significant relation between ICT and economic growth in developed countries after the first half of the 1990s. Furthermore, cross sectional studies conducted by Papaioannou (2004), Inklaar and Timmer (2008), Van Ark, O'Mahony, and Timmer (2008), and Strauss and Samkharadze (2011), showed that ICT development had a determinant role in improving the growth of productivity in developed countries.

Financial Development and Economic Growth

The relation between financial development and economic growth is considered as a challenging topic. Two viewpoints have been stated concerning the coordinated effect of financial development on the economic growth of developing countries. Some economists (conservative economists) disagree that the development of financial instruments would directly increase economic growth. This would mean that the development of actual activities in the economy would increase demand for financial services and this would result in the growth and efficiency of the financial system (Ayadi, Arbak, Ben-Naceur, & De-Groen, 2013). Concordant economists like Hicks (1969), Shaw (1973), Suleiman and Aamer (2007), and Al-Khouri (2007) have studied the historical development of countries and considered financial markets as the main factor in the formation of industrial revolution. Levine and Zervos (1998) showed that banking development was the reason for economic growth. Generally speaking, some of the studies considered finance as the most important factor of economic growth such as Goldsmith (1969) and King and Levine (1993), while other studies have talked of finance as a partial and complementary element in the process of economic growth (Robinson, 1952). Moreover, Schumpeter (1934) named the banking sector as the motor of economic growth and Lucas (1988) placed more emphasis on non banking finance. In this relation, Goldsmith (1969) reported a positive relation in his study between financial development and per capita production. King and Levine (1993) used several indices of financial development to determine their influence on economic growth. Their findings emphasized a positive and significant relation between some of these indexes and per capita production. Moreover, Levine and Zervos (1998) confirmed a positive and significant relation between banking development and the stock market and per capita production. The study conducted by Kenourgios and Samitas (2007) for Poland showed that credits of the private sector were one of the most important indices of financial development affecting economic growth. In their study, Fink, Haiss, and Vuksic (2009) for nine EU countries, and Andrianaivo and Kpodar (2011) for selected African countries, used credits, securities, and stocks variables as financial development indices to study their effects on economic growth and emphasized that the transfer mechanism is different and that financial market sectors have assisted the stability and growth of economies in transmission by relating to the public sector (and not to the stock markets).

Material and Methods

The present research aims to determine the effect of macroeconomic variables with particular reference to the effect of financial and ICT development on economic growth of OPEC developing economies during the period 2002–2015; using Panel Generalized Method of Moment (GMM). Relative annual data (YoY) have been collected from World Bank indicators report (World Bank, 2016) and World Information Technology Services Alliance (WITSA, 2015). Organization of the Petroleum Exporting Countries (OPEC) is an intergovernmental organization, founded in 1960 in Baghdad by the first five members—Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela (Nour, 2002). As of , 14 countries (Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Angola, Ecuador, Equatorial Guinea, Gabon, and Venezuela) accounted for an estimated 44 percent of global oil production and 73 percent of the world's "proven" oil reserves (Mattar, 2004). To identify the effective channels of ICT on economic growth, in this study, Generalized Solow Growth Model in Stable Condition, used by Pohjola (2002) and Liang and Teng (2006), was used to show the relation between ICT and economic growth, with its and its mathematical form shown in Eq. (1):

$$Y = K_1^{\alpha_c} K_2^{\alpha_k} H^{\alpha_h} (AL)^{1-\alpha_c-\alpha_k-\alpha_h} \quad (1)$$

Assuming that a fixed return to the scale is established, the changes are of the Labor Augmented type, and capital is limited to Physical Capital (K_1), Human Capital (K_2), Information and Communication Technology (H) and Effective Labor Force (AL). The index i refers to the country for the period t, while c, k, and h refer to the ratios of capital markets per Effective Labour Force, respectively. By taking logarithms on both sides of Eqs. (1) and (2) is derived:

$$\mathrm{Ln}Y_{it} = \alpha_c LnK_{1it} + \alpha_k LnK_{2it} + \alpha_h LnH_{it} + (1 - \alpha_c - \alpha_k - \alpha_h) Ln(AL_{it}) \quad (2)$$

Since the variables in the estimation model are in logarithm form, the coefficients derived represent the elasticity of the dependent variable with respect to independent variables. Moreover, the Solow Generalized Growth Model illustrated by Beck and Levine (2004), was used again with respect to the key variables of financial development indices in an economic growth model. The linear form of the model can be stated as Eq. (3):

$$\mathrm{Ln}Y_{it} = \alpha + \beta\, \mathrm{Ln}(\mathrm{Finance}_{it}) + \lambda Z_{it} + \varepsilon_{it} \quad (3)$$

where LnY is the log transformation of GDP per capita, Ln (Finance) represents financial development growth, and Z represents the vector of other control variables affecting the growth. In this model, variables are in logarithmic form and the estimated coefficients represent the elasticity of the dependent variable with respect to independent variables. Since ICT and financial development indices affect economic growth according to the Solow Growth Model, by combining both the models in Eqs. (2) and (3), the result can be illustrated as Eq. (4):

$$LnY_{it} = \beta_1 \mathrm{Ln}(\mathrm{ICT}_{it}) + \beta_2 \mathrm{Ln}(\mathrm{Finance}_{it}) + \lambda \mathrm{Ln}(Z_{it}) + \varepsilon_{it} \;;\; (1 - \beta 1 - \beta 2) = \lambda \quad (4)$$

where LnY is the log transformation of GDP per capita, Ln (Fin) represents financial development, Ln ICT is the log transformation of Information and Communication Technology, and Z represents the vector of other control variables affecting growth including the size of investment, the inflation rate taking into account the consumer price index (CPI), the degree of openness of the economy taking into account the size of exports and imports, and government size taking into account total government expenditure. To determine the role of other control variables, according to former studies, other control variables were used in this research to consolidate the relations between variables such as the inflation rate, labor force, government expenditure, degree of trade openness, gross fixed capital formation, investment (credit in the private sector) and other variables with lag, explanatory, and dependent variables.

The final model (linear-logarithm model) is shown in Eq. (5) and was used to estimate the relations between the target variables of the present study:

$$\mathrm{Ln}Y_{it} = \beta_1 \mathrm{Ln}(\mathrm{ICT}_{it}) + \beta_2 \mathrm{Ln}(\mathrm{Fin}_{it}) + \beta_3 \mathrm{Ln}(\mathrm{GS}_{it}) + \beta_4 \mathrm{Ln}(\mathrm{Open}_{it}) + \beta_5 \mathrm{Ln}(\mathrm{Inf}_{it}) + \beta_6 \mathrm{Ln}(\mathrm{H}_{it}) + \beta_7 \mathrm{Ln}(\mathrm{K}_{it}) + \varepsilon_{it} \quad (5)$$

ICT Index (Ln ICT): In order to standardize the ICT indices, the International Telecommunication Union (ITU) proposed the collection of a minimum package of data access indices to all member countries. These indices are selected over time from among a broad range of economic indices and provide the possibility of modeling an economy from another economy.

Financial Development Indexes (Ln (Fin)): In order to explain the effect of the financial development index on the country's economic growth, this study used variables such as domestic investment (DI), oil revenue (OI), the ratio of domestic private sector credit payments to GDP (DCP/GDP), and the ratio of cash debt to gross domestic product (M3/GDP).

Government Expenditures (Ln GS): This variable indicates the final consumption costs of the government in the public sector.

Gross Fixed Capital Formation (Ln (K)): This variable indicates the total value of the acquisition of fixed assets by producers minus the sale or free transfer of fixed assets in a certain accounting period plus the value of what was added by institutional units to the value of non-produced fixed assets.

Active Labor Force (Ln (H)): This variable is defined in terms of the partnership rate of active labor within the age range of 15–64 in terms of a percentage of the total population.

Inflation Rate (Ln (INF)): This variable indicates the general level of prices which is usually indicated in terms of the consumer price index (CPI).

Degree of Trade Openness (Ln (Open)): This variable indicates the degree of trade openness of a country compared to other countries. In other words, the ratio of total imports and exports to the GDP in a country represents the extent of economic openness or closure of that country.

A unit root test was used to investigate the long term behavior and stationary status of the variables. The results in Table 1 show that except for the variable of degree of trade openness, all other variables were non-stationary at level (I_0), while becoming stationary at level (I_1).

A co-integration test was used to show that all variables were co-integrated at level (I_1). In other words, all variables had a meaningful contribution in the model, with no chance of getting false regression results (Table 2).

In order to specify, which form of panel data or pooling data should be selected to estimate the model, Limer-F test was run and the results (Table 3) indicate that the panel method should be used to estimate the model. Further, the Hausman test is designed to determine which of the random or fixed effects is sufficient for good estimation of the models, with the results in Table 4 showing that the fixed effect method was suitable to run the model.

Table 1
Results of Levin, Lin and Chu unit root test

Variable	In level and with intercept	One difference and with intercept	Variable	In level and with intercept	One difference and with intercept
Fixed capital formation	−2.12** (.016)	−5.63*** (.00)	Cash debts	2.68 (.99)	−4.16*** (.00)
Private sector credit	−.31 (.37)	−4.40*** (.00)	Phone users	.36 (.64)	−3.06*** (.00)
Foreign direct investment	−1.048 (.14)	−8.91*** (.00)	Oil revenues	−.36 (.35)	−7.78*** (.00)
GDP	−1.57* (.058)	−4.087*** (.00)	Degree of trade openness	−10.09*** (.00)	−5.59*** (.00)
Internet users	5.66 (1.00)	−5.12*** (.00)	Inflation rate	3.15 (.99)	−1.95** (.025)
Active labor	−.84 (.19)	−8.61*** (.00)	Government expenditure	1.7 (.95)	−4.99*** (.00)

Notes: p-value in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2
Co-integration test of residuals

Co-integration degree	Prob	t
I(1)	.000	−4.291

Table 3
F-Leamer test for selecting among panel data and pooling data methods

Criterion	F	Chi^2	Result
Prob	.000	.000	Use of panel data
Freedom degrees	(12, 97)	12	

Table 4
Hausman test for random or fixed effect

Criterion	Chi^2	Result
	43.01	Use of fixed effect
Prob	.00	
Freedom degrees	12	

Results

In order to estimate the simultaneous effect of ICT, financial development, and other control variables on the economic growth of the selected economies, the results of model estimation are summarized in Table 5, which indicate that the signs of the coefficients of the explanatory variables—economic growth in the past year (significant), financial development (significant), ICT development (significant), active labor force (significant), credibility of private sector (significant), and establishment of fixed capital (insignificant) were positive and the signs of the explanatory variables—degree of trade openness (significant) and inflation rate (significant) were negative and the results of the Sargan test indicated the suitability of the selected instrumental variables in the estimated model.

Discussion

Among the mentioned variables, the inflation rate and degree of trade openness had a negative and significant effect on economic growth and variables including government expenses, degree of trade openness, establishment of gross fixed capital, and investment had a positive and significant effect on economic growth. Sensitivity of economic growth due to a change in the inflation rate of 1% resulted in a change in economic growth of −.0015 which shows the inverse and partial effect of the inflation rate on the economic growth of the OPEC countries. Sensitivity of economic growth due to a change in the degree of trade openness of 1% resulted in a change in economic growth of −.15%. This relation, despite the theoretical expectation, indicated inverse effect of the degree of trade openness on economic growth, in contrast to most studies conducted for developed countries that reported this sign as being positive. The reason for this contrary result could be attributed to the large portion of GDP in the OPEC countries from their huge windfall oil revenues as well as the extensive support of governments from export goods. Sensitivity of economic growth to an investment change of 1% resulted in a change in economic growth of .046%, indicating the importance of investment in the private sector in parallel with progressing national economic growth. Sensitivity of economic growth to a changes in the entry of active manpower to the labor market of 1% resulted in a change in economic growth of .158, indicating the importance of this variable in affecting the economic growth of countries.

Table 5
Results of model estimation (Panel-GMM)

Independent variable	(1)	(2)	(3)	(4)	(5)
Log GDP per capita (−1)	.13** (2.47)	.26*** (3.75)	.27*** (4.19)	.33*** (3.5)	.35*** (3.99)
Log finance development	.14*** (13.55)	.07*** (5.58)	.086*** (7.47)	.064*** (4.42)	.048** (2.025)
Log ICT	.034*** (2.65)	.021 (1.25)	.021** (2.16)	.047** (2.52)	.050*** (2.65)
Log government expenditure	–	.12*** (4.99)	.096*** (5.45)	–	–
Log degree of trade openness	–	−.17*** (−5.19)	−.19*** (−6.71)	−.14*** (−4.56)	−.15*** (−5.21)
Log active labor	–	.19*** (3.14)	.18*** (3.26)	.156** (2.05)	.158** (2.13)
Inflation rate	–	–	−.0014* (−1.94)	−.0014** (−2.60)	−.0015** (−2.51)
Log private sector credit	–	–	–	.040** (2.20)	.046** (2.63)
Log fixed capital formation	–	–	–	–	.031 (1.097)
Sargan test	P = .39	P = .13	P = .19	P = .72	P = .79

Notes: t-statistic in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

The coefficient of government expenses as an index for the evaluation of government size was positive and significant. Since the huge windfall oil revenues of the OPEC countries make up a large portion of the GDP of these countries, it can be said that first of all, due to the large role and interference of governments in developing countries and secondly, due to the extensive support of governments in the different production and service sectors, the economic growth of these countries seems to be large. The extent of changes in economic growth for a 1% change in government expense was .12%. In fact, this can be interpreted as the increased expenditures of government throughout society will be followed by improvement in economic growth in the country. Moreover, thanks to the dynamic nature of the estimation model, an economic growth variable with a lag was used in the estimation as the effective variable and the changes in economic growth in the current year against a 1% change in economic growth in the past year was about .35%. Finally, establishment of fixed capital was input into the model as an effective variable of economic growth and the results indicated a positive but not significant effect of that variable on economic growth. Therefore governments are required to provide updated information and services and to highlight the role of capital in the R&D section in the studied countries. Compared to previous studies conducted in this area, such as the findings of Al-Khouri (2007), Ayadi et al. (2013), Mhadhbi (2014), and Suleiman and Aamer (2007), the extracted results of this study also showed a significant and positive relationship between financial development (FD) and economic growth. In addition, there was a significant and positive relationship between ICT and economic growth, which was consistent with the findings of Andrianaivo and Kpodar (2011), Nour (2002), Papaioannou (2004), and Reuter (2010).

Conclusions

The results obtained indicate that financial development and ICT development have had a significant effect on the economic growth of the OPEC countries for the period studied as during several stages of estimation, the extent of sensitivity of economic growth compared to the explanatory variable of ICT development was .048 percent and the extent of elasticity of economic growth compared to the explanatory variable of financial development was .05 percent. Moreover, the extent of influence of financial development and ICT development on economic growth was relatively weak and this could be attributed to the characteristics of the oil-exporting countries. It can be concluded that upon the development of financial markets and the extensive use of ICT equipment, this group of countries have failed to significantly assist their economies in parallel with progress of their economic growth and development goals.

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