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The nexus between knowledge-based economy and economic growth in North Africa region

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Abstract:

This paper aims to understand the interaction between knowledge-based economy and economic growth in North Africa economies. We apply panel data analysis from the period of 2013-2018, including selected North Africa countries. We use the GMM estimators introduced by Arellano and Bond. The results suggest that human capital and research, institutions, knowledge and technology outputs and creative outputs have significant influence on economic growth in North Africa region.

Key words: Knowledge-based economy, North Africa, Economic growth, GMM model.

JEL Classification Codes: O3, O4, O32.

Introduction

For a range of developing nations, the transformation to a knowledge-based economy is seen as a promising way to develop. Education, training and development of human capital are central to such a growth process as emerging information and communication technologies are increasingly used. Growth is considered an economic phenomenon in endogenous growth theories, based mainly on the human investments of profit-driven agents and investments in physical capital (already established by neoclassical theory in Solow's model) and public capital (Guellec & Ralle, 2003). According to Chen and Dahlman (2005), four pillars are central to an effective transition to the knowledge economy: These pillars which forms the backbone of the World Bank Knowledge Index are: - An economic incentive and institutional regime that offers good economic policies and institutions that allow efficient mobilization and allocation resources, and stimulate innovation in order to create, disseminate and use existing knowledge efficiently. - Educated and skilled workers who can continuously upgrade and adjust skills in order to use information and knowledge efficiently; - An effective innovation system of firms: efficient innovation framework for businesses, research centers, universities, consultants and other organizations that can keep up with the information revolution, draw on and assimilate and adapt the increasing stock of global knowledge to local needs; -a modern and adequate information infrastructure, to promote the efficient communication, distribution and processing of knowledge and information. Following the Arab Spring in 2010/2011, the North Africa countries, namely Algeria, Egypt, Libya, Mauritania, Morocco, and Tunisia, have recovered strongly. Indeed, real GDP growth in 2018 was projected at 4.9%, up from 3.3% in 2016, higher than the African average of 3.6% and second only to East Africa (African Development Bank, 2018). However, this improved performance stems mostly from Libya's higher-than-expected production and export of oil, which, thanks to the improved security situation resulting from joint regional and international assistance to the country, produced strong GDP growth of 55.1%. As we can see, there is a clear connection between the economic growth of this region and oil exports, but oil revenues

cannot systematically increase economic growth. Therefore, the transition of the countries in the area to a knowledge-based economy is becoming critical. A knowledge-based economy, it is believed, will allow this area to rise from its energy dependence and consolidate its economic growth and development. It seems, however, that several requirements must be fulfilled in order to achieve this aim. Therefore, the aim of this paper is to examine empirical policies and investments linked to the transition to a knowledge-based economy in this particular context. Our analyses will focus on four indicators that are likely to facilitate the transition to a knowledge-based economy: the institutional framework, human capital and research, knowledge, and technology outputs, which are related to economic growth in the region.

In this study, the generalized method of moments (GMM) dynamic panel estimators is used. The dynamic panel "Generalized Moments" method was introduced by Holtz-Eakin et al. (1988), Arrelando and Bonde (1991), and Arrelando and Bover (1995). Several specific advantages characterize it. Indeed, the dynamic panel GMM method provides solutions to simultaneity bias, inverse causality, and omitted variables. Thus, with the General Method of Moments' estimation, it is possible to find suitable instruments for the right-hand side variables that are then checked for homogeneity concerning the error term. The model provides evidence that the chosen knowledge-based economy indicators impact economic growth in the North Africa region.

This paper has the following structure: The following section discusses the concept of knowledge-based economy before moving to the theoretical and empirical frameworks of the interaction between economic growth and knowledge-based economy. The empirical model, data, and methods used to estimate the empirical model are covered in the third section. After a presentation of the results, the remaining section includes a discussion and concluding remarks.

1- Theoretical and empirical evidence

The Neoclassical economic literature has confirmed the existence of convergence, which means that developing countries' development takes place faster than compared to wealthy countries. The hypothesis of convergence assumes that countries vary only

in their capital/labor ratio and hypothesize that an economy with a lower per capita income level will also experience a higher rate of growth. There are a variety of studies and publications on the convergence process between countries. The presence of absolute convergence between countries was verified by Mankiw et al. (1992) and Solow (1956), while others confirmed the conditional convergence between countries with similar parameters e.g. Barro and Sala-i-Martin (1995) and Barro (1991). Under this context, human capital and public consumption, physical capital, expenditure to GDP ratio, trade and capacity to absorb technology, human capital efficiency, R&D infrastructure and innovation are generally the variables that affect economic growth. Economic growth is realized through the development of jobs and the rise in the value of labor. The demand for skilled and qualified workers increases with economic growth to begin with (Kamara et al., 2007).

In most developing countries, including Africa, this phenomenon is currently being observed and is a key aspect of emerging knowledge-based economies. In particular, the essence of a knowledge-based economy is characterized by a rising demand for highly skilled labor, with wage premiums that are relatively high and have the potential to boost living standards(Piętak,2014).

The adoption of technology from the international market is essential for developing countries because it may be the only way to increase their growth in productivity and technological development (Romer, 1990). But it is also important to stress that these countries still need to be concerned about their human resources (Nguyen, 2009), which could be the main factor deciding whether a country will take off or fall into poverty trap, given its level of growth. Several studies confirm that there is a positive correlation between knowledge-based economic indicators and economic growth. There is a positive short-term relationship between education quality and economic growth in Africa, as well as on human capital development, which potentially affects productivity and economic growth (Kamara et al. 2007).

Our study aim to identify the relationship between the knowledge-based economy indexes and economic growth, we study the empirical literature relating to

economic growth in three categories: (a) institutions: The political situation, the legislative environment and the market climate; (b) human capital and research: Health, tertiary education and development and research;(c) technologies outputs, and innovative outputs (in other words, the knowledge content of products and especially exports): creation of knowledge, knowledge diffusion, and creativity for innovation. Several studies provide evidence of a correlation between institutional efficiency and economic development. The establishment of efficient and transparent institutions, accompanied by good governance will encourage foreign companies to set up, which will stimulate innovation growth and economic development through creativity. Barro and Sala-i-Martin (1995) found that growth is negatively impacted by political instability. Jalilian et al. (2007) find a positive correlation between regulatory quality and economic performance in developing countries. Havrylyshyn and van Rooden (2003) verified the importance of the institutional structure in transition countries for economic growth. Kaufmann et al. (1999) demonstrated a positive relationship between the quality of governance and GDP per capita. Acemoglu & Johnson (2005) found that institutional efficiency has a greater impact on long-term growth than on short-term growth. Barkhordari (2018) found that for economic development, the efficiency of institutions is critical. For human capital and research, studies have shown that education has a positive impact on economic growth in general. Using data from 1960 to 1985, Romer (1986) studied the impact of human capital on economic growth in 112 countries. The study emerges with a result that confirms the positive relationship between the two variables. Barro (1991) conducted a study for the period from 1960 to 1985, the study included 98 countries. He found a positive relationship between the level of human capital represented by primary and secondary school enrolment rates per capita real GDP. Applying a panel GMM process, Gyimah-Brempong et al. (2006) studied the impact of higher education on economic growth in African countries in the 1960-2000 period. Their study finds that the level of education has a positive impact on economic development. Using the 1980-2012 time data using the ARDL method, Yakisik

and Cetin (2014) used education enrolment rates in Turkey in order to reflect human capital in the sample.

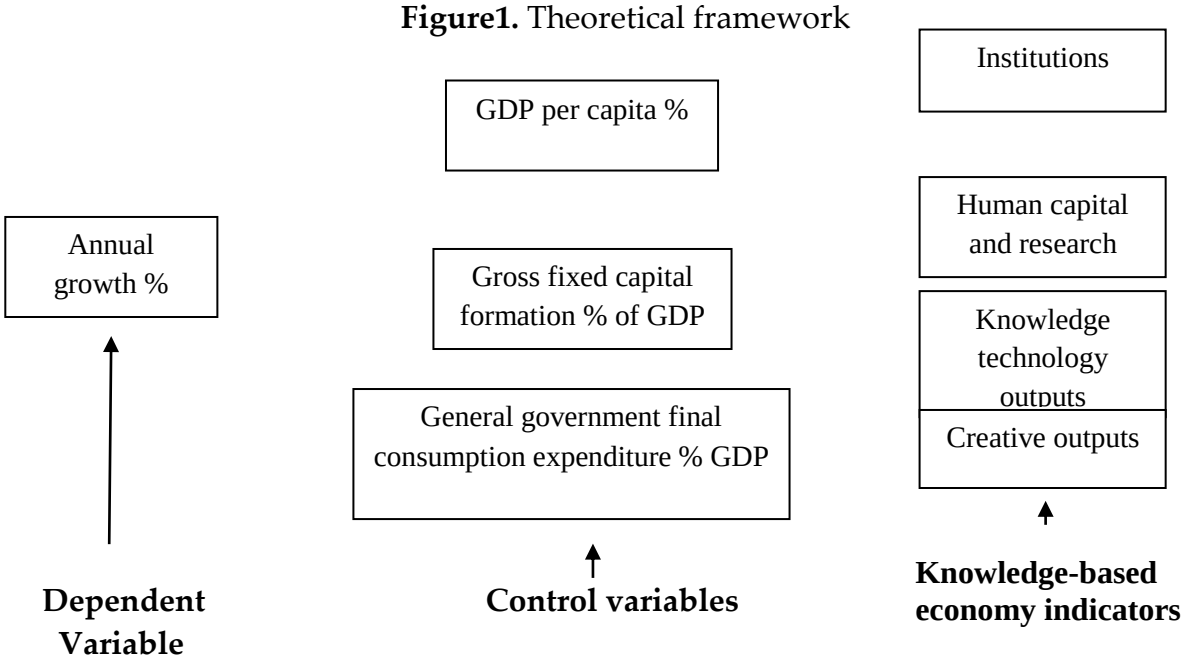
The analysis covered selected developing countries. Their results show that the rate of secondary school enrolment was found to have significant impact on economic growth. Altiner and Toktas (2017) argue that economic growth is strongly impacted by the rise in human capital stocks, for the 2000-2014 periods. For the technology and innovative outputs, innovation within society tends to generate economic growth. Using the GMM method, Nasab and Aghaei (2009) investigates the impact of information and communication technologies on economic growth for the OPEC countries during the period 1990–2007. The authors find a significant positive relationship and stress the importance to implement different policies to promote investment in information and communication technologies to improve economic growth.

The positive relationship between economic development and the export of high or advanced technology has also been argued in previous researches. E.g. Santos et al. (2013) who assessed the influence of export on European Union countries' development. From 1995 to 2010, researchers using data from 23 European nations showed that diversification of exports into items with a high technology content substantially increase the pace of growth. Frolov and Lebedev (2007), also analyzed the effect of high-technology exports on the economic growth. The results showed that, in the short and medium term, the promotion of export play an important role in increasing growth.Cuaresma and Wörz (2005) verified the same findings among the 45 countries from 1981 to 1997.

2- Methodology and empirical study

An empirical model is being developed within the context of the research findings referred to above to evaluate the influence of knowledge-based economic indicators on economic growth in selected North African countries. The theoretical framework is represented in the following figure.

Figure1. Theoretical framework



Source: Author's compilation

Barro and Sala-i-Martin (2004) used three control variables to determine economic growth in North Africa. In this paper, we have used the same variables to answer our overall research question. The variables are: GDP per capita, (GDPper) investment (INVS), and government consumption (GOVC). GDP per capita is included to predict the positive contribution to economic growth. INVS represents the private and public investment. The GOVC variable captures the effectiveness of the state's macroeconomic policies in creating economic growth. (Figure1). The data used is from the World Bank official website. To check the impact of knowledge-based economy indicators on economic growth, we use four variables of the global innovation index that are measured on a 0–100 scored by WIPO; those indicators are institutions (INST), human capital and research (HCR), knowledge technology outputs (KTHO), and creative outputs (CRO). (See table 1).

Table 1. Variables, definition and their sources

Variables	Definition	Source
GDPgro	Annual GDP growth (percentage)	World Bank
GDPper	GDP per capita % of GDP	World Bank
INVS	Gross fixed capital formation % of GDP	World Bank
GOVC	General government final consumption expenditure % GDP	World Bank
INST	Performing and transparent institutions followed by good governance that encourages innovation and economic growth .	WIPO
HCR	Human capital research: The degree and quality of a country's education and research activity are the key determinants of a nation's innovation potential. It's related to knowledge creation, and diffusion.	WIPO
KTHO	Knowledge and technology outputs: related to the fruits of innovation and technological research	WIPO
CRO	Creative outputs: the role of creativity is still undervalued and underestimates. It's related to the use of ICTs in business and organizations.	WIPO

Source: adapted from World Bank and WIPO.

Our dynamic panel model can be written as follows:

$$(Y_{i,t}) - (Y_{i,t-1}) = \alpha\,(Y_{i,t-1}) + Z_{i,t}\,\beta + \eta_i\,þ\,\xi_t + \varepsilon_{i,t} \quad (1)$$

Where yi,t is GDP growth in North Africa courtiers, i= 6, (Algeria- Morocco, Tunisia, Egypt, Libya, and Mauritania), during the period t = (2013-2018).

yi, t − 1 is the GDP growth in country i during period t − 1,

Zi, t is a row vector of control variables in country in during period t,

ηi is a country-specific effect,

ξt is a period-specific effect common to all countries, and

εi, t is the stochastic error term. The log-linear functional form is applied in order to reduce heteroscedasticity.

In this study, the time series is much greater than the cross section. Under such conditions, the GMM estimators introduced by Arellano and Bond (1991) are more suitable. This method allows us to control for the endogenous problems and control for the unobserved effects, by first differencing regressions or instruments, second, on using observations of explanatory and lag of the dependent variable as instruments (Barkhordari, 2018). For this model, equation (1) is transformed by taking the deviation from the mean of the time series of each variable for each country, and then the new equation is estimated by OLS. The equation (1) includes a lagged endogenous component.An alternative estimation technique that addresses the lagged endogenous variable's presence and allows a certain degree of endogeneity in the other explanatory variables is recommended by Arellano and Bond (1991). Arellano and Bond's Difference Equation is:

$$\Delta y_{it} = \alpha \Delta y_{i(t-t)} + \Delta x'_{it}\gamma + \Delta \xi_t + \Delta v_{it} \quad (2)$$

The GMM method estimator suggested by Arellano and Bover (1995) and Blundell and Bon (1998) combine the normal set of moment conditions with lagged levels as instruments in first differences and additional set of moment conditions derived from the level equation. The existence of additional moment conditions depends on the hypothesis that the correlation between x_{it} and the country-specific effect ηi is available. According to Blundell and Bond (1998), it is assumed that the difference of x_{it} is uncorrelated with the personal effects, although x_{it} and η_i are allowed to be correlated (Emiko, 2010).Under the null hypothesis, the Sargan test has a chi-squared distribution ($\chi 2$) with degrees of freedom equal to the number of moment conditions minus the number of parameters to be estimated. (Verbeek, 2008). The Sargan test results show that there is no connection between the residuals and the instruments.

3- Empirical results

We report the results as followed: First, without considering the knowledge-based economy indicators, the influence of the three control variables, including GDPperc, INVS, and GOVC; second, the impact of the three control variables, taking the knowledge-based economy indicators individually into account. The table 2 indicates the correlation matrix, the results show there is a positive but moderate correlation between INST, HCR, KTHO, CRO variables and economic growth (GDPgro). GOVC variable is negatively correlated to GDPgro.

Table 2.Correlation matrix

	GDP gro	GDPper	INVS	GOVC	INST	HCR	KTHO	CRO
GDPgro	1							
GDPper	0.9136	1						
INVS	-0.0948	-0.1388	1					
GOVC	-0.4313	-0.2109	0.7181	1				
INST	0.2082	-0.1015	0.5397	-0.1103	1			
HCR	0.4095	0.0781	-0.4160	-0.8976	0.4045	1		
KTHO	0.2626	-0.0908	0.4438	-0.2203	0.9137	0.5628	1	
CRO	0.2158	-0.0836	0.3833	-0.2317	0.8836	0.5233	0.8763	1

Source: Stata 13 outputs.

Table 3. Impact of GDP per capita, investment and government expenditure on economic growth

	Coefficient	**Std error**	**Probability value**
Constant	1.287786	1.1794661	0.000***
Growth L1	-0.0046188	0.0089013	0.604
GDPper	1.004652	0.0071965	0.000***
GOVC	0.083161	0.0064237	0.000***
INVS	-1.287786	0.0055911	0.137
J-statistic (Sargan test)	1.1034		

***/** significant, respectively at the 1%, and 5% levels

Table 3 indicates the impact of our control variables on economic growth in North Africa region. As we can see, GDP per capita seem to be significant which is consistent with the findings in the theoretical literature. Government expenditure is also positively significant; there is a positive relation between government expenditure and our

dependent variable economic growth. This outcome converges with the Keynesian hypothesis that says economic growth is accelerated by the expansion of government spending. Government spending is thus known to be an exogenous factor that changes aggregate production. The Keynesian school of thought indicates that constructive fiscal policy is an effective tool for governments to improve economic activity and economic growth (Shafuda, 2015). For the INVS variable, surprisingly, it is not significant, which means, investment does not impact economic growth in North Africa. This result could be explained by the low level of investment in the region, but also, and above all, by the fact that investments are characterized by a lack of profitability. Following the example of Algeria's investments, Algeria invests massively in projects without any guaranty of profitability e.g. the great mosque, the east-west highway... etc. Another factor that could possibly explain this result is the high level of corruption in the region, which weakens the positive influence of investments on the region's economies. Table 4 indicated the influence of human capital and research index on economic growth in North Africa. Human capital and research are positively correlated with economic growth and the variable is significant at the 5% threshold. This indicates that human capital and research is essential to generate growth in this region. Investing in human capital could be an alternative to oil exports and will be a source of much-needed economic diversification in this region. This result depends on the empirical studies that state a positive connection between economic growth and education.

Table 4: Impact of human capital and research index on economic growth.

	Coefficient	Std error	Probability value
Constant	0.8941571	0.2611271	0.001***
Growth L1	-0.0102231	0.008552	0.237
GDPper	1.004976	0.0067202	0.000***
GOVC	0.0352103	0.0065376	0.000***
INVS	-0.0033068	0.0059099	0.576
HCR	0.0035472	0.0018047	0.049**
J-statistic (Sargan test)	0,1158		

***/** significant, respectively at the 1%, and 5% levels

Table 5 highlights the relationship between institutions and economic growth. As we can notice, institution (INST) is positively correlated with economic growth, and the results indicate that the variable is significant at 1% threshold. Indeed, to achieve a transition to a knowledge-based economy, it is necessary to have quality institutions, and a stable political environment. Good institutions allow the government to have the ability and the possibility to formulate cohesive and effective policies that promote the development of the public and the private sector.

Table 5 Impact of institution index on economic growth

	Coefficient	Std error	Probability value
Constant	1.451262	0.1937316	0.001***
Growth L1	-0.0002234	0.0030401	0.000***
GDPper	1.0070553	0.0071974	0.000***
GOVC	0.0405167	0.0064602	0.000***
INVS	-0.0079082	0.0056114	0.153
INST	0.0034772	0.0003648	0.000***
J-statistic (Sargan test)	0.1124		

***/** significant, respectively at the 1%, and 5% levels

This result converges with the previous empirical studies. Institutions are singled out as the main factor that causes economic growth. It is difficult to imagine successfully establishing a knowledge-based economy without establishing transparent institutions and effective governance.

Table 6.Impact of knowledge and technology outputs index on economic growth

	Coefficient	Std error	Probability value
Constant	1.432723	0.215364	0.001***
Growth L1	0.0038076	0.0104599	0.716
GDPper	1.009047	0.0082165	0.000***
GOVC	0.0446886	0.0082165	0.000***
INVS	-0.0147953	0.0071573	0.394**
KTHO	0.0020412	0.0011811	0.084*
J-statistic (Sargan test)	0.1462		

***/** significant, respectively at the 1%, and 5% levels.

Table 7. Impact of creative outputs index on economic growth

	Coefficient	Std error	Probability value
Constant	0.8072888	0.2106005	0.000***
Growth L1	0.0310691	0.0100158	0.002***
GDPper	0.981812	0.0082533	0.000***
GOVC	0.229754	0.0072982	0.002***
INVS	0.0102382	0.0069883	0.143
CRO	0.004345	0.0011165	0.000***
J-statistic (Sargan test)	0.4417		

***/** significant, respectively at the 1%, and 5% levels

Table 6 and Table 7 indicates that the variable knowledge and technology outputs (that is outputs with a high knowledge content) is not significant, and the second variable creative outputs is positively significant at 1% level. This fact that the knowledge and technological outputs variable is not significant, can be explained by the fact that the North African region is not really productive in term of technology production. The region is more an importer than an exporter of technology. However, the finding implies that, technology and innovative production matter for economic growth in North Africa. It is important to note that knowledge-based economy requires reinforcing the linkages between universities and firms, investing in R&D, and encouraging inventive and innovative activities.

Conclusion

The purpose of this paper was to analyze the relationship between the knowledge economy and economic growth in the area of North Africa. We use the GMM estimators introduced by Arellano and Bond to estimate the relationship between economic growth and various Knowledge-based economy indicators in the region.

We have chosen control variables following the Barro and Sala-i-Martin model (2004): GDP per capita, investments and government expenditures, and four indicators of knowledge-based economy according to WIPO: Institutions, human capital and research, knowledge and technological outputs, and creative outputs. The results

suggest that, institutions lead to the improvement of economic growth performance. Ensuring an enabling environment, and a stable political environment, is a guarantee of improved economic growth. Effective governance and transparent institutions will enable the authorities to implement its policies in complete serenity; therefore, the first step in the transfer to a knowledge-based economy is to set up quality institutions. The empirical findings suggest that human capital investment and research lead to faster growth performance. So, the sub indicators of the index: education and R&D are important to higher economic growth rate. An increase of innovative outputs leads to enhance economic growth. Then, boosting creativity and innovative ideas generate a creative technology and creative outputs that are likely to be exploited by companies and/or which are likely to be exported. These results can be useful and helpful to move on with success to a knowledge-based economy. North African economies must invest more in human capital; provide quality education, set up transparent institutions with effective governance. Also, in order to ensure technological and creative production that is a vector for wealth creation, authorities must now encourage innovative initiatives and strengthen relations between universities and companies. Switching to the knowledge economy is one of the alternatives recommended to the economies of this region to generate more sustainable growth but above all to succeed in emerging and achieve the much desired economic development. The countries of the North African region should now seriously consider the possibility of changing their economic model based mainly on the exploitation of fossil energy or public expenditure, and move towards the knowledge-based economy, which will be a new engine of growth that will lead to a less dependent and diversified economy.

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