JOEEP

Journal Homepage: http://dergipark.org.tr/joeep

Araştırma Makalesi ● Research Article

Determinants of Economic Complexity in MENA Countries

MENA Ülkelerinde Ekonomik Kompleksitenin Belirleyicileri

Ayşe Yasemin Yalta [a,*] & Talha Yalta [b]

[a] Prof. Dr., Hacettepe Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İktisat Bölümü, 06800, Çankaya/Ankara/Türkiye.
ORCID: 0000-0002-9854-9813
[b] Prof. Dr., TOBB ETÜ, İktisadi ve İdari Bilimler Fakültesi, İktisat Bölümü, 06560, Söğütözü/Ankara/Türkiye.
ORCID: 0000-0003-2660-1480

MAKALE BİLGİSİ

Makale Geçmişi:
Başvuru tarihi: 12 Kasım 2020
Düzeltme tarihi: 18 Aralık 2020
Kabul tarihi: 02 Ocak 2020

Anahtar Kelimeler:
Ekonomik kompleksite
Ekonomik büyüme
MENA
Sistem GMM

ÖZ

Orta Doğu ve Kuzey Afrika (MENA) ülkeleri, ekonomik kompleksite açısından gelişmekte olan ekonomilerin çoğunun gerisinde kalmaktadır. Bu çalışma, 1970-2015 döneminde MENA bölgesi ülkelerinde ekonomik kompleksitenin belirleyicilerini sistem GMM yaklaşımı kullanarak araştırarak literatüre katkı sağlamaktadır. Bulgular, beşeri sermayenin ekonomik kompleksite ile pozitif olarak ilişkili olduğunu göstermektedir. Ancak, doğal kaynak rantının ekonomik kompleksite üzerinde olumsuz bir etkisi vardır. Bu da bu ülke grubu için Hollanda hastalığının varlığını doğrulamaktadır. Sonuçlar ayrıca, doğal kaynak rantlarının ekonomik kompleksite üzerindeki etkisinin beşeri sermaye birikimine bağlı olduğunu göstermektedir.

ARTICLE INFO

Article history:
Received: November 12, 2020
Received in revised form:December 18, 2020
Accepted: January 02, 2020

Keywords:
Economic complexity
Economic growth
MENA
System GMM

ABSTRACT

Middle East and North Africa (MENA) countries lag behind most of the emerging economies in terms of economic complexity. This study contributes to the literature by exploring the determinants of economic complexity in the MENA region for the period between 1970-2015 by employing a system GMM approach. The findings reveal that human capital is positively associated with economic complexity. However, natural resource rent has a negative influence on economic complexity, supporting the existence of Dutch disease for this country group. The results also indicate that the effect of natural resource rents on economic complexity depends on the accumulation of human capital.

1. Introduction

The immense transformations in the world economy in the last several decades have created both opportunities as well as challenges for the developing countries. While some countries have managed to adopt to the changing conditions and exploit the opportunities, others have failed to cope with the changes, finding it increasingly difficult to maintain sustainable growth rates. In today's more complex and globalized economic system, adoption of new ways of production and value creation have become essential to catch up with the rest of the world. Recently, a new literature on so called "economic complexity" has emerged emphasizing the significance of increasing productive

* *Sorumlu yazar/Corresponding author*.
e-posta: *yyalta@hacettepe.edu.tr*

Atıf/Cite as: Yalta, Y. A., & Yalta, T. (2021). Determinants of Economic Complexity in MENA Countries. *Journal of Emerging Economies and Policy*, 6(1), 5-16.
e-ISSN: 2651-5318. © 2021 TÜBİTAK ULAKBİM DergiPark ev sahipliğinde. Her hakkı saklıdır. [Hosting by TUBITAK ULAKBIM JournalPark. All rights reserved.]

capabilities and diversification of products on economic growth. This literature, which was first initiated by Hidalgo and Hausmann (2009) suggests that improving economic complexity can bring about various important benefits to a given country. These include higher economic growth (Hausmann et al., 2014; Ourens, 2012; Zhu and Li, 2017), lower output volatility (Hvidt, 2013; IMF, 2016), and reduced income inequality (Hartmann et al., 2017). Furthermore, various studies show that economic complexity can help countries escape the middle income trap as well (Felipe et al., 2012; Fortunato and Razo, 2014).

The above findings point out the importance of the design and implementation of various policies to stimulate economic complexity. However, currently there are only a few studies empirically examining the determinants of economic complexity. These include Gabrielczak and Serwach (2017), who report that trade integration may promote economic complexity, as well as Javorcik et al. (2017), who conclude that foreign direct investment can contribute to product upgrading. In addition, Nguyen et al. (2020) examine the effects of patents and financial development on economic complexity index and conclude that while patents have a positive effect on economic complexity, the effect of financial development depends on the size of the financial sector. Employing a panel data analysis for 122 countries for the period between 1963-2013, Camargo and Gala (2017) show that when exports concentrate on a specific sector, economic complexity decreases.

Understanding the determinants of economic complexity is especially important for the MENA countries, which face many challanges in keeping up with the rapid transformations in the world economy. Low and volatile growth rates, low productivity and high unemployment are often cited as the main structural obstacles for this country group (Abed and Davoodi, 2003). Therefore, improving economic complexity may be a policy option for this region to cope with these problems.

However, Middle East and North Africa (MENA) countries lag behind most of the emerging economies in terms of economic complexity. A closer look at the economic complexity index reveals that economic complexity in MENA on average is lower than that of Europe, Pacific and Latin America regions. Furthermore, MENA region is currently comprised of countries with some of the lowest levels of economic complexity in general, meaning that their production structure is not sufficiently diversified. This in turn causes various adverse effects such as inefficient allocation of resources as well as increased vulnerability to external shocks. Furthermore, the risks are even more pronounced for oil exporting MENA countries, which have limited motivation towards diversification due to their reliance on natural resources. The policy makers in these countries are aware of the problem that as the oil reserves decline, it will be more and more difficult to maintain stable growth rates and create employment in the future. These goals cannot be reached by producing more of the same product but can only be achieved with a structural transformation toward producing more sophisticated products with higher value added (Yildirim, 2014). Simply put, MENA countries should start thinking about how to make their economies more complex.

In light of the above discussion, it is of crucial importance to understand the main drivers of economic complexity in the MENA region so that relevant policy actions can be taken to achieve a more advanced and diversified economic system that allows sustainable growth. To the best of our knowledge, there is only one study empirically examining the determinants of economic complexity for MENA countries. Sepehrdoust et al. (2019) investigate the determinants of economic complexity on MENA countries for the period between 2002-2017 employing a PVAR analysis, and find that trade liberalization, foreign direct investment and gross fixed capital formation have a positive effect on improving economic complexity. As a result, our objective in this paper is to fill this gap in the literature by analyzing the cross country differences in economic complexity during the period between 1970-2015 for 12 selected MENA countries based on data availability. We employ a dynamic panel data methodology which permits us to account for the potential endogeneity of the explanatory variables. Our study differs from that of Sepehrdoust et al. (2019) in two ways. We employ a system GMM approach and use more variables including institutional quality and natural resource rent to analyze the determinants of economic complexity for MENA countries. Furthermore, we also examine how the effect of natural resource rents changes with human capital.

Our paper is related with the strand of the literature on the determinants of high technology exports and export diversification as well. There is a literature focusing on the determinants of high technology exports. These studies emphasize the role of increasing patent applications (Kabaklarli et. al., 2017), attracting foreign direct investment (Kabaklarli et. al., 2017), encouraging research and development expenditures (Kılıç et al., 2015), human resources and technology (Seyoum, 2004) and increasing value added in the industy (Güneş and Akın, 2019) to achieve high technology exports. Furthermore, a number of studies have emerged to assess the factors behind export diversification. These suggest a range of variables as possible determinants of export diversification such as human capital accumulation (Agosin et al., 2011), GDP per capita (Elhiraika and Mbate, 2014), investment (Bebczuk and Berrettoni, 2016) and foreign direct investment (Iwamoto and Nabeshima, 2012). As a result, we also build on this literature by evaluating whether these factors can determine economic complexity as well.

The outline of the study is as follows: Section 2 reviews the definition and the measurement of economic complexity. This is followed by Section 3, which discusses possible determinants of economic complexity. Section 4 explains

the methodology and describes the data, while Section 5 presents the empirical results. Finally, Section 6 concludes with a discussion of the policy implications.

2. Economic Complexity

In recent years, the concepts of high technology exports, export diversification and economic complexity have received considerable attention in the literature. High technology exports refers to products with high research and development intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery (World Bank, 2020). Although all of these concepts have proven to be significant for growth and development, there are substantial differences in terms of their definition and measurement. Export diversification refers in general to various policies implemented to alter the shares of commodities in the export bundle (Esanov, 2012). This is mostly assessed by so called concentration indices such as Herfindahl-Hirschman index, Theil's index, Gini-Hirchman Index as well as Shannon entropy. However, it is argued that these measures fail to capture the differences in productive capabilities across different countries (Hartmann et al., 2017). Recently, Hidalgo and Hausmann (2009) have analyzed these capabilities and productive knowledge among countries also introducing the concept of economic complexity to explain the complex structure of an economy.

Economic complexity measures the degree of productive knowledge and capability for an economy. Naturally, it is not easy to quantify these intangible elements. Hence, Hausmann and Hidalgo (2013) propose a method based on the assumption that productive knowledge is reflected in the composition of the products that a country makes. By using data on international trade, they construct economic complexity index (ECI). The ECI measures a country's productive structure by using the concepts of both diversity and ubiquity. While diversity indicates the number of products a country exports, ubiquity refers to the number of the countries that export the same product (Hidalgo and Hausmann, 2009). Based on this definition, sophisticated economies are the ones having a higher diversity but also lower ubiquity. Therefore, a country exporting goods that are exported by many other countries is considered to be less complex. To be more complex, a country must export different kinds of products and at the same time it must export the goods produced only by a small number of countries.

Hausmann et al. (2011) calculate economic complexity index for a large set of countries. Based on this index, it becomes possible to evaluate the changes in economic complexity in a country over time as well as the cross country comparisons.

Table 1 presents the top 20 economies in terms of economic complexity in both 1970 and 2015. According to the table; Japan, Switzerland, Germany and Sweden had the highest ECI in 2015 meaning that these countries produce relatively more differentiated goods and export these to more countries. One striking observation in the table is the remarkable performance of South Korea and Singapore. These countries which were not even in the top 20 in 1970, have managed to climb to the top places in 2015. On the other hand, Italy and Belgium seem to have lagged behind some other European countries in terms of economic complexity over the last decades.

Table 1. 20 Countries with the Highest ECI in 1970 and 2015

The countries with the highest ECI in 1970		The countries with the highest ECI in 2015	
Germany	2.309	Japan	2.297
Switzerland	2.135	Switzerland	2.158
United Kingdom	2.057	Germany	2.098
Austria	1.991	Sweden	1.924
Sweden	1.987	United States	1.816
Japan	1.970	Finland	1.770
Italy	1.847	Singapore	1.746
United States	1.759	Austria	1.683
France	1.730	Czech Republic	1.670
Belgium	1.464	South Korea	1.654
Finland	1.424	United Kingdom	1.642
Denmark	1.388	Slovenia	1.424
Norway	1.310	France	1.418
Hong Kong	1.286	Hungary	1.354
Netherlands	1.287	Ireland	1.352
Zimbabwe	1.152	Slovakia	1.319
Belgium	1.220	Netherlands	1.315
Italy	1.214	Israel	1.237
Israel	1.186	Denmark	1.131

Source: OEC [The Observatory of Economic Complexity] (2020)

The economic complexity index in the MENA country group in 1970 and 2015 are presented in Table 2. Here we see that economic complexity is higher in Saudi Arabia, Qatar and Kuwait in 2015, reflecting that these countries' product space are relatively more diversified. In 2015, Saudi Arabia, Qatar and Kuwait were ranked in the 26th, 44th and 47th place respectively among a total of 117 countries. It is also evident in the table that ECI is the lowest for Algeria and Sudan. Sudan ranked as the 115th country in the world while Algeria ranked 99th country in 2015.

It must be noted that improving economic complexity has started to gain attention in the policy spheres of MENA region. Consequently, several projects have been undertaken to boost complexity in different countries. Turkey and Saudi Arabia were able to increase economic complexity over time. UAE and Kuwait also succeeded in improving their economic complexity. The UAE has promoted the development of industrial zones and Kuwait has launched some large infrastructure projects financed by private partnership, which in turn helped increase complexity (Manama, 2016).

Table 2. MENA Countries with the Highest ECI in 1970 and 2015

ECI Country Rankings in MENA Region in 1970		Ranking in the World (In 96 countries)	ECI Country Rankings in MENA Region in 2015*		Ranking in the World (in 117 countries)
Lebanon	0.648	24	Saudi Arabia	0.870	26
Jordan	0.598	28	Qatar	0.322	44
Qatar	-0.078	46	Kuwait	0.259	47
Tunisia	-0.134	47	Turkey	0.133	52
Egypt	-0.136	48	UAE	0.124	53
Morocco	-0.315	54	Lebanon	0.116	54
Algeria	-0.493	58	Jordan	-0.054	62
Turkey	-0.546	61	Oman	-0.297	67
UAE	-0.735	69	Tunisia	-0.323	68
Iran*	-0.828	74	Egypt	-0.376	69
Saudi Arabia	-0.880	75	Morocco	-0.877	92
Kuwait	-0.917	77	Algeria	-1.011	99
Oman	-1.149	88	Sudan	-1.537	115
Sudan	-1.307	95			

Source: OEC (2020)

*Economic complexity value was not available for Iran for 2015.

3. Determinants of Economic Complexity

The existing literature reveals that economic complexity is positively related with the accumulation of productive capabilites. Nonetheless, increasing the capabilities and skills necessary to produce sophisticated products usually takes time. According to Hidalgo and Hausmann (2009), the diversification is achieved gradually by first moving into those products that use similar capabilities with the existing ones. Only after this, a country can move on to producing more sophisticated products. This process depends on several factors and the speed of diversification can vary from one country to another. This section briefly reviews the possible factors for improving economic complexity. Although a therotecial model regarding the determinants of economic complexity has not yet been developed in the literature, the various studies on the determinants of high technology exports, economic diversification and export diversification can be used to identify the possible drivers of economic complexity. This literature suggests a range of factors including macroeconomic variables, human capital and institutional quality. Below we discuss the factors considered also in this study.

One of the most cited determinants of economic diversification is GDP per capita, which is used as a proxy for the country's degree of development. It is argued that increases in GDP per capita can lead to a change in the consumer preferences towards more diversified products (Elhiraika and Mbate, 2014). In an influential study, Imbs and Wacziarg (2003) find that GDP size can significantly affect economic complexity. Thus, the subsequent studies use GDP per capita as an additional control variable as well (See Alaya, 2012; Agosin et al.,2012; Longmore et al., 2014).

Investment plays an important role on high technology exports and economic complexity by increasing the amount of capital stock in the economy. In this regard, the influence of public investment is not negligible. The private sector can sometimes hesitate to undertake new investment projects, especially when the return on these projects is uncertain. Thus, governments should design policies that provide incentives for the firms to produce more sophisticated products (Turnovsky, 1996). It is also documented in the literature that public investment can cause an improvement in economic diversity if the government invests in infrastructural projects such as education, energy, airports and highways (Argimon et.al.1997; Ramirez and Nazmi, 2003). Furthermore, government expenditure on infrastructure or human capital can help improve the business environment as well. Therefore, as a whole total investment is expected to affect economic complexity positively.

Investment in human capital is identified as another key factor in determining high technology exports and economic complexity. Tebaldi (2011) argues that human capital is one of the most important determinants of high technology exports. New growth theory argues that human capital increases economic growth rates by improving people's knowledge, capacity and productivity (Romer, 1990). Human capital can be proxied by education, through which the labor force can be embedied with skills and knowledge required for stimulating innovation. It is argued that the effect of education on economy is not uniform in the sense that the different stages of education may have varying impacts on the economy (Krueger and Lindahl, 2001; Vandenbussche et al., 2006; Grossman and Helpman, 1991). While the primary and secondary education provide individuals with basic skills important for technology adoption and imitation, the higher levels of education are essential for technology creation (Papageorgiou, 2003). However, it is also likely that the effects of the composition of the human capital may vary with different levels of development. The literature has identified that while primary and secondary education are more important for least developed countries (Gemmell, 1996), higher education contributes more to growth in developed countries (Petrakis and Stamatakis, 2002; Bayraktar-Sağlam, 2016). The recent studies also attempt to link the composition of human capital with the distance to technology frontier. Vandenbussche et al. (2006) propose a model and argue that higher levels of education will have a stronger effect on the

economy when a country becomes closer to the technological frontier. For the countries which are distant from the frontier, less skilled human capital becomes more important. Some studies provide empirical evidence on this view. Loening (2005) argues that primary and secondary education is more important for economic growth in Guatemela. Pereira and Aubyn (2009) show that improving tertiary education does not have a positive effect on growth in Portugal. One should be careful when using education as a proxy for the human capital. Most of the studies in the literature use either the average number of years of formal schooling attained or the expenditure on education. However, recent discussions point out that these indicators fail to measure the quality of the education received by students. Instead, some qualitative measures based on standardized international exams, such as the OECD Programme for International Student Assessment (PISA) scores can be more informative to assess the role of cognitive skills. Hidalgo and Hausmann (2009) argue that the quality of education is more important for economic complexity because the diversity of knowledge can lead to an increase in the productive capacity of the society. Despite this, most of the studies continue to use data on number of years of schooling because of data limitations.

Foreign direct investment has also been recognized as one of the important drivers of high technology exports as well as economic diversification (Seyoum, 2004; Iwamoto and Nabeshima, 2012; Javorcik et al. 2017; Kabaklarlı et al., 2017). The research shows that multinational enterprises spend more on research and development activities (UNCTAD, 2003) and have a greater tendency to develop new products than the domestic firms (Brambilla, 2009). Therefore, by facilitating technology transfer, know-how and working practices, FDI may promote economic complexity. Nevertheless, the effect of FDI may change based on the country characteristics, and the composition of the FDI. An examination of the FDI flows into MENA region reveals that oil, gas and nontradables sectors have been attracting the great bulk of FDI in most of the MENA countries as natural resource endowments attract resource seeking FDI. The rest of FDI flows is mostly in nontradeables sectors such as tourism and construction (UNCTAD, 2011). Interestingly, the FDI in high tech services is almost zero in this region (Gourdon, 2010). Therefore, especially oil exporting countries may not actually benefit from positive spillovers associated with FDI. Moreover, FDI inflows to oil exporting countries is very low compared to other developing countries. The governments in this region do not have incentives to encourage FDI because the energy reserves are under the control of government entities and the revenues obtained from energy exports can be invested locally by government (Rogmans and Ebbers, 2013).

Terms of trade has also been considered as one of the factors associated with complexity. Terms of trade can have two different effects on economic complexity. On the one hand, an increase in terms of trade may increase profitability and encourage more diversification (Agosin et al.,2011). On the other hand, positive terms of trade shocks can discourage export diversification because of the increases in export earnings. The second effect is more evident for resource rich countries.

It has also been proved that institutional environment encourages the successful implementation of more complicated production processes in the economy (Costinot, 2009). By helping private enterprises to operate in a transparent environment, a sound institutional framework may provide incentives for both domestic and foreign investments. In most of the middle east countries, however, the level of corruption and political instability raises the cost of doing business and risks of investment (Strauss, 2015).

As for the effects of natural resource rents on diversification and complexity, the so called “Dutch disease hypothesis” is mainly used in the literature. This hypothesis suggests that economic development of natural resource sector may lead to a decline in the other sectors and eventually may be harmful for economic growth. It is argued that high resource rents usually affect economies negatively for a number of reasons. First, natural resource rents can cause entrepreneurs to focus more on rent-seeking activities rather than productive tasks. Sachs and Warner (1999) suggest that resource abundance can decrease a country’s motivation for physical and human capital accumulation causing the country to be constrained with low technology industries. Similarly, Leamer et al. (1999) argue that the abundance of natural resources has an adverse effect on technology upgrading. In a recent study, Camargo and Gala (2017) find that Dutch disease leads to less economic complexity. The literature has also documented that the marginal return of natural resources may also depend on the level of education and institutional quality in the country. It may be difficult for the countries without enough human capital accumulation to change the production structure in favor of more complex products (Maier and Wood, 1998). On the other hand, the countries that can efficiently use their human capital can produce more sophisticated products. Besides education, the role played by institutions on escaping the resource curse has also been heavily discussed. It is argued that resource dependent countries with weak institutions usually have difficulty in diversifying their production and exports (Mehlum et al., 2006).

Within this framework, we now turn to empirically analyze if the abovementioned variables play a significant role in improving economic complexity.

4. Data and Empirical Methodology

The choice of the methodology to analyze the determinants of economic complexity requires special attention due to a number of considerations. First of all, the dynamic nature of the data must be taken into account because the economic complexity may be persistent, meaning that the past values of economic complexity may have an effect on the current economic complexity. However, the use of the lagged

dependent variable can cause auto correlation problem and the method chosen should be able to tackle with this issue. Secondly, there might be a bi-directional relation between economic complexity and some of the explanatory variables causing endogeniety bias. Using OLS estimates or fixed effect model may lead to biased and inconsistent estimates in these circumstances. As a result, to control for country-specific effects, to deal with the autocorrelation problem and to account for the potential endogeneity of the explanatory variables, we employ a dynamic panel data analysis. Specifically, we employ system Generalized Method of Moments (GMM) proposed by Arellano and Bover (1995). In calculation of system estimator, while variables in differences are instrumented with lags of their own levels, variables in levels are instrumented with lags of their own differences (Bond et al., 2001). It is argued that by allowing the use of more instruments, this estimator improves efficiency. Arellano and Bond (1991) suggest two tests to evaluate the strength of the instruments. The first test is the Sargan test for over-identifying restrictions, in which the null hypothesis is that the instruments are valid. The second test applied is the tests of serial correlations for the error terms, where the null hypothesis is that there is no second order serial correlation. The rejection of null hypothesis in both tests raises concerns regarding the validity of the instruments.

The empirical model is specified by the following equation:

$$EC_{it} = \beta + \gamma\, ECi_{(t-1)} + \theta\, X_{it} + \varepsilon_{it} \quad (1)$$

where EC_{it} is economic complexity index that varies across countries and over time, X_{it} is the vector of explanatory variables and ε_{it} is the random error term. Economic complexity index is taken from the Observatory of Economic Complexity. After normalizing the economic complexity index, logistic transformation is applied. The lag of economic complexity index is also included in the analysis to take into account the persistence of economic complexity. The control variables are selected in line with the previous empirical literature on the determinants of economic diversification and complexity. The variables we consider are per capita gross domestic product, investment, human capital, terms of trade, natural resources rent, FDI and institutional quality indicators. Investment data is calculated by the sum of public and private investment obtained from IMF Investment and Capital Stock Database. IMF (2015) compiles data on both public and private investment. Human capital is proxied by education. We use average years of schooling in the population over 15 years, compiled by Barro and Lee (2013). This data is broken down into three categories as primary, secondary and tertiary education to analyze the importance of different stages of education. Considering the effect of education on a disagregated basis provides helpful insights regarding the policies to be implemented to increase the positive effect of education. Based on the growing literature on the effect of the composition of human capital, we expect that all of these types of education may affect economic complexity differently. Data on terms of trade, foreign direct investment, GDP per capita and natural resource rent are also retrieved from World Development Indicators (2018). To analyze the effect of institutional quality, data on democracy obtained from Polity IV database is also used (Marshall, and Jaggers, 2007). This indicator considers different dimensions of institutionalized democracy such as the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive (Marshall and Jaggers, 2007).

The data consists of a panel of 12 countries over the period from 1970-2015. The list of the countries included in the study as well as the definition and data sources of the variables are provided in Table A1 and Table A2 in the appendix. We use five year averages of the data for two purposes: First, taking averages allows us to analyze the determinants of economic complexity in the long run. Second, the use of five year averages help minimize the effect of correlations due to business cycle fluctuations and mitigate endogeneity problems (Chin and Ito, 2002).

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Economic Complexity	126	-.368992	.5809255	-1.967916	1.040862
GDP Per Capita	81	29446.9	34032.26	1743.446	123579.7
FDI	119	1.664115	2.439917	-1.580623	13.6494
Terms of Trade	86	134.3459	85.70364	64.12003	732.7973
Natural Resource Rent	123	15.06082	14.81058	.0003306	53.91554
Average Years of Total Schooling	108	5.398889	2.168398	.96	10.32
Average Years of Primary Schooling	108	3.173056	1.174242	.71	5.64
Average Years of Secondary Schooling	108	1.965556	1.001444	.23	4.27
Average Years of Tertiary Schooling	108	.2601852	.1590684	.02	.81
Democracy	118	-4.030508	16.56048	-77	9
Investment	126	3.172309	1.337562	-.225766	5.949772

In Table 3, descriptive statistics of these variables have been reported. It is observed that economic complexity has an average level of -0.368 in MENA countries. The table presents that there is significant variation across countries in terms of the variables under consideration. The minimum value of economic complexity index is -1.9679, while the maximum value is 1.04086.

5. Empirical Results

Following equation (1), the first regression attempts to examine possible determinants of economic complexity. More specifically, the analysis tries to identify the association between various stages of human capital accumulation and economic complexity. The results are presented in Table 4. The coefficients of lagged value of economic complexity, human capital and natural resource rent are significant. While human capital affects economic complexity positively, natural resources rent has a negative impact on complexity. One interesting finding is that tertiary education does not play a significant role on economic complexity, while primary and secondary education matters for economic complexity. This is in line with some of the earlier studies in the literature, which has identified that primary and secondary education are more important for developing countries. It is also known that although MENA countries have taken several steps to improve the education system in recent years, there are still certain structural problems in the education system, which make it more difficult to enhance the education capacity at higher levels. This finding is also related with the findings in the literature linking the effect of education with the distance to technology frontier. Because these countries are far away from the technological frontier, the effect of primary and secondary education seems to be higher. Overall, these results are similar to that of Jetter and Hassan (2012) who find that natural resource rents have a negative effect and primary enrollment rate have a positive effect on export diversification. Another interesting observation from the results is that natural resources rent tend to reduce economic complexity, indicating that reliance on natural resources actually reduces the incentive for more diversification. This finding confirms the "resource curse hypothesis" in the literature.

Table 4. The effects of different types of education on economic complexity

	(1)	(2)	(3)	(4)
Variables	Economic Complexity	Economic Complexity	Economic Complexity	Economic Complexity
Economic Complexity (lagged)	0.506*	0.530*	0.503*	0.237
	(0.182)	(0.189)	(0.173)	(0.435
Terms of Trade	-0.001	-0.001*	-0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Investment	0.028	-0.008	0.062	0.109
	(0.126)	(0.141)	(0.114)	(0.201)
Natural Resource Rent	-0.058*	-0.055*	-0.057*	-0.118*
	(0.025)	(0.027)	(0.024)	(0.064)
GDP Per Capita	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
FDI	-0.014	-0.024	-0.006	0.005
	(0.017)	(0.021)	(0.015)	(0.026)
Average Years of Schooling (total)	0.134			
	(0.055)			
Average Years of Schooling (Primary)		0.313*		
		(0.132)		
Average Years of Schooling (Secondary)			0.243*	
			(0.097)	
Average Years of Schooling (Tertiary)				3.763
				(3.085)
Constant	-0.900*	-1.065*	-0.759*	-1.239*
	(0.363)	(0.412)	(0.329)	(0.725)
Number of Observations	60	60	60	60
Number of Countries	12	12	12	12
Number of Instruments	10	10	10	10
Sargan p. value	0.60	0.74	0.41	0.86
1st Order Serial Correlation (p-value)	0.93	0.98	0.95	0.17
2nd Order Serial Correlation (p-value)	0.41	0.35	0.46	0.84

Notes: (i) Regressions are estimated by using the system GMM estimator. (ii) The standard errors are reported in parantheses. (***), (**), (*) indicate significance at the 1, 5, 10 per cent level respectively.

With regard to the role of FDI, we cannot find a significant effect of FDI indicating that MENA region cannot benefit from FDI. This is not surprising for this country group because FDI inflows to this region is very low and most of the FDI is directed towards natural resources and nontradables goods sector.

Table 5. The effects of human capital and democracy on economic complexity

	(1)	(2)	(3)
Variables	Economic Complexity	Economic Complexity	Economic Complexity
Economic Complexity (lagged)	0.574***	0.731***	0.717***
	(0.149)	(0.187)	(0.189)
Total Schooling Years	-0.049	0.076	0.102*
	(0.075)	(0.062)	(0.060)
Terms of Trade	-0.002*	0.000	0.000
	(0.001)	(0.001)	(0.001)
Investment	0.138	-0.019	-0.081
	(0.112)	(0.090)	(0.092)
Natural Resource Rent	-0.050*	-0.047*	-0.012*
	(0.024)	(0.022)	(0.007)
GDP per capita	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)
FDI	-0.002	-0.015	-0.033*
	(0.015)	(0.021)	(0.019)
Democracy		0.006	-0.004
		(0.072)	(0.086)
FDI*Democracy		0.011*	
		(0.006)	
Natural Resource rent*total years of schooling	0.006*		
	(0.004)		
Natural resource rent*democracy			0.010
			(0.007)
Constant	-0.147	-0.485	-0.422
	(0.185)	(0.355)	(0.388)
Number of Observations	60	55	55
Number of Countries	12	11	11
Sargan p-value	0.17	0.74	0.29
1st Order Serial Correlation (p-value)	0.30	0.99	0.21
2nd Order Serial Correlation (p-value)	0.88	0.35	0.61

Notes: (i) Regressions are estimated by using the system GMM estimator. (ii) The standard errors are reported in parenthesis. (***), (**), (*) indicate significance at the 1, 5, 10 per cent level respectively.

In Table 5, we investigate interaction effects. The main question we ask is whether the effect of natural resources on economic complexity changes with human capital and democracy. In column (1), an interaction term is introduced by multplying the natural resource rent with average total school years. It is seen that this interaction term is significant indicating that the marginal effect of natural resources depend on the level of education. Provided that the country is embeddied with enough human capital, the natural resources rent can also influence economic complexity positively. In columns (2) and (3), we turn to the effect of institutional structure. In column (2), we evaluate if the marginal effect of FDI depends on democracy by interacting FDI with democracy. It is evident from the table that FDI actually increases economic complexity in relatively more democratic countries. Finally, in column (3) we interact the natural resources rent with democracy. The interaction variable turns out not to be significant indicating that the marginal effect of natural resource rent does not depend on institutional quality for these countries. Table 4 shows that even after including new variables, human capital and natural resources appear to be significant.

Since GMM estimation relies on the validity of the instruments used, the Sargan test as well as tests of auto correlation are also presented for each specification. The results imply that we cannot reject the null hypothesis that the instruments are valid and there is no second order correlation.

6. Conclusion

In today's rapidly evolving global economy, maintaining a productive base of complex, differentiated and high value added products has increasingly become a main factor of sustainable growth and long-term economic prosperity. On the other hand, the MENA region is currently comprised of countries with some of the lowest levels of economic complexity in general. Unless these countries achieve a rapid and major transformation of their economies, they surely will fall further behind the rest of the world in terms of development. Therefore, it is essential to understand the factors for improving economic complexity in these countries. In this study, we explore the determinants of economic complexity by adopting a dynamic panel data

methodology using data on 12 MENA countries for the period between 1970-2015.

We find robust evidence across various specifications indicating that primary and secondary education enhance economic complexity, while tertiary education does not seem to play a significant role. Another important finding is the large negative effect of natural resources rent on economic complexity, which seems to be a major factor preventing MENA countries from exploring the possible product diversification opportunities. The empirical results also indicate that FDI and terms of trade do not provide substantial contribution to economic complexity, although the former seems to foster economic complexity in relatively more democratic regimes.

The evidence obtained in this study has significant implications for improving productive capabilities and product diversification in the MENA region. First, the results reveal that human capital is positively associated with economic complexity, underlying the importance of providing adequate funding for education. Because the results do not show a significant effect of tertiary education for the MENA region, MENA countries should first focus on the more realistic task of rising their standards in the lower levels of education. This in turn may help countries move from producing primary products to higher technology products.

Regarding the effect of foreign direct investment on economic complexity, our baseline estimates show a significant relation which works in tandem with the existence of democracy. As a result, MENA countries should also take steps towards a more pluralistic society while also strengthening their institutional capacity, which is conducive for both private and public sector development.

Last but not least, the findings of the study support the "resource curse" hypothesis. Moreover, it is seen that the marginal effect of natural resource rents also depends on the accumulation of human capital. This confirms that it is crucial for the oil exporting countries in this region to concentrate efforts towards better managing their natural resources. More importantly, however, the countries should implement policies for using the revenues generated from natural resources to improve the education system in order to improve their economic complexity.

Our study shows that improved democratic standards as well as a better educational system are the two main ingredients that can increase the level of productive knowledge and capability of MENA countries and help achieve the necessary transformation to avoid increased economic and social problems as the oil reserves continue to decline in the future.

Acknowledgments

This work was sponsored by the Economic Research Forum (ERF) and has benefited from both financial and intellectual support. The contents and recommendations do not necessarily reflect the ERF's views. The authors would also like to thank the anonymous reviewers for extremely useful comments and suggestions.

References

Abed G. T., & Davoodi, H. R. (2003). *Challenges of growth and globalization in the Middle East and North Africa*. Washington DC: International Monetary Fund.

Agosin, M., R. Alvarez, R., & C. Baravo-Ortega (2011). Determinants of export diversification around the world: 1962-2000. *The World Economy*, 35(3), 295-315.

Alaya, M. (2012). The determinants of MENA export diversification: An emprical analysis. *ERF Working Paper Series*.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies* 58(2), 277-97.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29-51.

Argimon, I., González-Páramo, J. M., Roldan J. M. (1997). Evidence of public spending crowding-out from a panel of OECD countries. *Journal of Applied Economics*, 29(8), 1001-1010.

Barro, R. & Lee, J-W. (2013). A new data set of educational attainment in the world, 1950-2010. *Journal of Development Economics*, 104, 184-198.

Bayraktar-Sağlam, B. (2016). The stages of human capital and economic growth: Does the direction of causality matter for the rich and the poor?. *Social Indicators Research*, 127, 243-302.

Bebczuk, R., & Berrettoni, D. (2006). Explaining export diversification: An empirical analysis. CAF Research Program on Development Issues, Department of Economics, Universidad Nacional de La Plata.

Bond, S., Hoeffler, A., & Temple, J. (2001). GMM Estimation of empirical growth models. *Centre for Economics Policy Research*, 3048.

Brambilla, I. (2009). Multinationals, technology, and the introduction of varieties of goods. *Journal of International Economics*, 79(1), 89–101.

Camargo, J. S. M. & Gala, P. (2017). The resource curse reloaded: revisiting the Dutch disease with economic complexity analysis. (Erişim: 13.01.2020). https://bibliotecadigital.fgv.br/dspace/handle/10438/18037.

Costinot, A. (2009). On the origins of comparative advantage. *Journal of International Economic*s, 77(2), 255–264.

Elhiraika, A. B. & Mbate, M. (2014). Assessing the determinants of export diversification in Africa. *Journal of Applied Econometrics and International Development*, 14(1), 147-162.

Esanov, A. (2012). Economic diversification: Dynamics, determinants and policy implications. *Revenue Watch Institute*, 1–26.

Felipe, J., Abdon, A., & Kumar, U. (2012). Tracking the middle-income trap: What is it, who is in it, and why?. *Working Paper 715*, Levy Economics Institute of Bard College.

Fortunato, P., & Carlos, R. (2014). Export sophistication, growth and the middle-income trap. In José M. Salazar-Xirinachs, Irmgard Nübler & Richard Kozul-Wright (Ed.), *Transforming Economies: Making Industrial Policy Work for Growth, Jobs and Development*. Geneva: International Labour Office.

Gabrielczak, P., & Serwach, T. (2017). Does the Euro increase the complexity of exported goods? The case of Estonia, *Lods Economics Working Papers*.

Gemmell, N. (1996). Evaluating the impacts of human capital stock and accumulation on economic growth: Some evidence. *Oxford Bulletin Economics Statistics* 58(1), 9-28.

Gourdon, J. (2010). FDI flows and export diversification: Looking at extensive and intensive margins. In: Lopez-C ´ alix, J. R., Walkenhorst, P., & Diop, N. (Ed.), *Trade Competitiveness of the Middle East and North Africa* (pp 13–44). World Bank Publications.

Grossman, G. M., & Helpman, E. (1991). Innovation and growth in the global economy. Cambridge: MIT Press.

Güneş, S., & Akın, T. (2019). Yüksek teknolojili ürün ihracatı: Lider ülkeler ve Türkiye analizi. *Sosyoekonomi*, 27(40), 11-29. doi:10.17233/sosyoekonomi.2019.02.01

Hartmann, D., Guevara, M., Jara-Figueroa, C., Aristarán, M. & Hidalgo, C. (2017). Linking economic complexity, institutions and income inequality. *World Development*, 93, 75-93.

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, 12, 1-25

Hausmann, R., Hidalgo, C., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes, A., & Yıldırım, M. (2011). The atlas of economic complexity. *Puritan Press*.

Hausmann, R., & Hidalgo, C. (2013). How will the Netherlands earn its income 20 years from now? The hague: WRR, *Webpublications*, 74.

Hausmann, R., Cunningham, B., Matovu, J., Osire, R., & Wyett, K. (2014). How should Uganda grow? Harvard Kennedy School, *Faculty Research Working Paper Series*, 235.

Hidalgo, C., & Hausmann, R. (2009). The building blocks of economic complexity. *Proceedings of the national academy of sciences*, 106(26), 10570-10575.

Hvidt, M. (2013). Economic diversification in GCC countries: Past record and future trends. Research Paper, Kuwait Programme on Development, Governance and Globalisation in the Gulf States.

Imbs, J., & Wacziarg, R. (2003). Stages of diversification. *American Economic Review*, 93(1), 63-86.

IMF (2015). Investment and Capital Stock Database.

IMF (2016). Economic diversification in oil-exporting Arab countries. Manama: Annual Meeting of Arab Ministers of Finance.

Iwamoto, M., & Nabeshima, K. (2012). Can FDI promote export diversification and sophistication in host countries? Dynamic panel system GMM analysis. *Institute of Developing Economies*.

Javorcik, B., Lo Turco, A., & Maggioni, D. (2017). New and improved: Does FDI boost production complexity in host countries?. *The Economic Journal*, 128(614), 2507-2537.

Jetter, M., & Hassan, A. R. (2012). The roots of export diversification. *Documentos de Trabajo CIEF*, 010600, Universidad Eafit.

Kabaklarlı, E., Duran, M., & Üçler, Y. (2017). The determinants of high-technology exports: A panel data approach for selected OECD countries. *DIEM*, 1-13, 888-900.

Khan, M. S., & Kumar, M. S. (1997). Public and private investment and the growth process in developing countries. *Oxford Bulletin of Economics and Statistics*, 59(1), 69-88.

Kılıç, C., Bayar, Y., & Özekicioğlu, H. (2015). Araştırma geliştirme harcamalarının yüksek teknoloji ürün ihracatı üzerindeki etkisi: G-8 ülkeleri için bir panel veri analizi. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, (44), 115-130. doi:10.18070/euiibfd.62317

Krueger A. B., & Lindahl, M. (2001). Education for growth: Why and for whom?. *Journal of Economic Literature*, 39(4), 1101–1136.

Leamer, E., Maul, H., Rodriguez, S., & Schott, P.K. (1999). Does natural resource abundance increase Latin American income inequality?. *Journal of Development Economics*, 59, 3–42.

Loening, J. (2005). Effects of primary, secondary, and tertiary education on economic growth: Evidence from Guatemala. *Policy Research Working Paper* 3610, Washington DC: World Bank.

Longmore, R., Jaupart, P., & Cazorla, M.R. (2014). Toward economic diversification in Trinidad and Tobago. *Policy Research Working Paper* 6840.

Maier, J., & Wood, A. (1998). Africa's export structure in a comparative perspective. *UNCTAD*, 4, Geneva: UN.

Marshall, M. & Jaggers, K. (2007). POLITY IV PROJECT, Data Set Users Manual, Center for Systemic Peace.

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *Economic Journal*, 116(508), 1-20.

Nguyen, C. P., Christophe S., & Su, T. D. (2020). The drivers of economic complexity: International evidence from financial development and patents. *International Economics*, 164, 140-150. ISSN 2110-7017, doi: https://doi.org/10.1016/j.inteco.2020.09.004.

OEC [The Observatory of Economic Complexity] (2020). Economic Complexity Legacy Rankings (ECI). (Accessed on 13.01.2020), https://oec.world/en/rankings/country/eci/

Ourens, G. (2012). Can the method of reflections help predict future growth?. Documento de Trabajo/FCS-DE; 17/12, Université catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES).

Papageorgiou, C. (2003). Distinguishing between the effects of primary and post-primary education on economic growth. *Review of Development Economics*, 7(4), 622-635.

Pereira, J., & Aubyn, M. St. (2009). What level of education matters most for growth? Evidence from Portugal. *Economics of Education Review*, 28(1), 67-73.

Petrakis, P. E., & Stamakis, D. (2002). Growth and education levels: A comparative analysis. *Economics of Education Review*, 2, 513-521.

Ramirez, M., & Nazmi, D. N. (2003). Public investment and economic growth in Latin America: An empirical test. *Review of Development Economics*, 7(1), 115-126.

Rogmans, T., & Ebbers, H. (2013). The determinants of foreign direct investment in the Middle East North Africa region. I*nternational Journal of Emerging* Markets, 8(3), 240-257.

Romer, P. M. (1990). Endogenous technical change. *Journal of Political Economy*, 98, 71-102.

Sachs, J. D. & Warner, A. M. (1999). The big push, natural resource booms and growth. J*ournal of Development Economics*, 59(1), 43-76.

Sepehrdoust, H., Davarikish, R., & Setarehie, M. (2019). The knowledge-based products and economic complexity in developing countries. *Heliyon*, (5)12, 2405-8440. doi: https://doi.org/10.1016/j.heliyon.2019.e02979.

Seyoum, B. (2004). The role of factor conditions in high-technology exports: An empirical examination. *The Journal of High Technology Management Research*, 15, 145–162.

Strauss, J. (2015). Economic challenges in the MENA region in Middle Eastern business environment. *Cognella Academic Publishing*.

Tebaldi, E. (2011). The determinants of high-technology exports: A panel data analysis. *Atlantic Economic Journal*, 39(4), 343-353.

Turnovsky, S. J. (1996). Optimal tax, debt and expenditures policies in growing economy. *Journal of Public Economy*, 60, 21-44.

UNCTAD (2003). World investment report. *FDI Policies for Development: National and International Perspectives*. New York, NY: United Nations.

UNCTAD (2011). *United nations conference on trade and development database*. URL: www.unctad.org/Templates.

Vandenbussche, J., Aghion, P., & Meghir, C. (2006). Growth, distance to frontier and composition of human capital. *Journal of Economic Growth*, 11(2), 97-127.

World Bank (2020). URL: https://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS

World Development Indicators (2018). Washington D.C. World Bank.

Yildirim, M. (2014). Diversifying growth in light of economic complexity. *Brookings Blum Roundtable*.

Zhu, S., & Li, R. (2017). Economic complexity, human capital and economic growth: Empirical research based on cross-country panel data. *Applied Economics*, 49(38), 3815-3828.

Appendices

Table A1. Country List

Algeria	Sudan
Egypt	Tunisia
Jordan	Turkey
Kuwait	United Arab Emirates
Saudi Arabia	Qatar
Morocco	Iran

Table A2. Description of Variables and Data Sources

Variable	Description	Source
Economic Complexity	Economic Complexity Index (ECI) measures the complexity of a country's export basket.	Observatory of Economic Complexity, https://oec.world/en/
Per Capita GDP	GDP per capita based on purchasing power parity (PPP). Data are in constant 2011 international dollars.	World Development Indicators, 2018.
Investment	The total of public and private investment.	The data is obtained from International Monetary Fund, Investment and Capital Stock Dataset, 1960-2015.
Human Capital	Average years of schooling in the population over 15 years. This data is broken into primary, secondary and tertiary education.	Barro, Robert and Jong-Wha Lee (2013). http://www.barrolee.com/
Terms of Trade	Net barter terms of trade index is calculated as the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000.	World Development Indicators, 2018. http://databank.worldbank.org/source/world-development-indicators
Natural Resource Rent	Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	World Development Indicators, 2018. https://databank.worldbank.org/source/world-development-indicators
Foreign Direct Investment	Foreign direct investment are the net inflows of investment to acquire a lasting management interest in an enterprise operating in an economy other than that of the investor.	World Development Indicators, 2018. https://databank.worldbank.org/source/world-development-indicators
Democracy	This indicator considers different dimensions of institutionalized democracy such as the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive.	http://www.systemicpeace.org/polity/polity4.htm