Efficiency for Sustainable Growth: Evidence from the North African Countries

Ekrem Erdem, Can Tansel Tugcu

Abstract—Improved resource efficiency of production is a key requirement for sustainable growth, worldwide. In this regards, by considering the energy and tourism as the extra inputs to the classical Coub-Douglas production function, this study aims at investigating the efficiency changes in the North African countries. To this end, the study uses panel data for the period 1995-2010 and adopts the Malmquist index based on the data envelopment analysis. Results show that tourism increases technical and scale efficiencies, while it decreases technological and total factor productivity changes. On the other hand, when the production function is augmented by the energy input; technical efficiency change decreases, while the technological change, scale efficiency change and total factor productivity change increase. Thus, in order to satisfy the needs for sustainable growth, North African governments should take some measures for increasing the contribution that the tourism makes to economic growth and some others for efficient use of resources in the energy sector.

Keywords—Data envelopment analysis, Economic efficiency, North African countries, Sustainable growth.

I. INTRODUCTION

ASSUMING all the other factors fixed, necessary condition for raising income and welfare is to achieve a sustainable growth performance. To this end, theories of economic growth (e.g. [1]-[7]) have investigated the factors that determine macroeconomic growth. Although there is a consensus on the determinants of economic growth, a few of the countries have attained an expected income level and achieved to sustain it. Because reaching an expected level and sustaining it depends on the efficient use of the resources and it is not an easy task. Reference [8] suggests that, improved resource efficiency of production is a key requirement for sustainable growth, worldwide. In this regards, by considering the energy and tourism as the extra inputs to the classical Coub-Douglas production function, this study aims at investigating the efficiency changes in the North African countries. To this end, the study uses panel data for the period 1995-2010 and adopts the Malmquist index based on the data envelopment analysis. By employing the Malmquist index, we had a chance to decompose the efficiency change into the technical efficiency change, technological change, scale efficiency change and total factor productivity change.

North Africa or Northern Africa is the northernmost region

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of Africa. Geopolitically, the United Nations definition of North Africa includes eight countries or territories; Algeria, Egypt, Libya, Mali, Mauritania, Morocco, Sudan and Tunisia. Algeria, Morocco, Tunisia, Libya and often Mauritania and Western Sahara are the Maghreb, while Egypt and Sudan comprise the Nile Valley. Egypt is a transcontinental country because of the Sinai Peninsula, which geographically lies in West Asia. North Africa also includes a number of Spanish possessions (Ceuta and Melilla and tiny Spanish islets off the coast of Morocco). The Canary Islands and the Portuguese Madeira Islands, in the North Atlantic Ocean northwest of the African mainland, are sometimes included in considerations of the region. Due to lack of balanced panel data, this study considers Egypt, Libya, Tunisia, Algeria and Morocco as the North Africa sample. Table I illustrates some macroeconomic statistics about these countries.

The economies of Algeria and Libya were transformed by the discovery of oil and natural gas reserves in the deserts. Libyan oil is especially prized because of its low sulphur content, which means it produces much less pollution than other fuel oils. Morocco's major exports are phosphates and agricultural produce, and as in Egypt and Tunisia, the tourist industry is essential to the economy. Egypt has the most varied industrial base, importing technology to develop electronics and engineering industries, and maintaining the reputation of its high-quality cotton textiles.

Egypt's economy depends mainly on agriculture, media, petroleum imports, natural gas, and tourism; there are also more than three million Egyptians working abroad, mainly in Saudi Arabia, the Persian Gulf and Europe. Egypt has a developed energy market based on coal, oil, natural gas, and hydro power. Substantial coal deposits in the northeast Sinai are mined at the rate of about 600,000 tons (590,000 long tons; 660,000 short tons) per year. Oil and gas are produced in the western desert regions, the Gulf of Suez, and the Nile Delta. Egypt has huge reserves of gas, estimated at 1,940 cubic kilometers (470 cu mi), and LNG up to 2012 exported to many countries. Egypt produces its own energy, but has been a net oil importer since 2008 and is rapidly becoming a net importer of natural gas.

The Libyan economy depends primarily upon revenues from the oil sector, which accounts for 80% of GDP and 97% of total exports. Libya holds the largest proven oil reserves in Africa and the country is an important contributor to the global supply of light, sweet crude. Apart from petroleum, the other natural resources are natural gas and gypsum. The International Monetary Fund estimated Libya's real GDP growth at 122% in 2012 and 16.7% in 2013, after a 60%

plunge in 2011. The World Bank defines Libya as an upper middle income economy. Substantial revenues from the energy sector, coupled with a small population, give Libya one of the highest per capita GDPs in Africa. This allowed the Libyan Arab Jamahiriya state to provide an extensive level of social security, particularly in the fields of housing and education.

TABLE I
MACROECONOMIC STATISTICS

Egypt	1995	2000	2005	2010
GDP	60.16	99.84	89.69	218.89
POP	61.17	66.14	71.78	78.08
GDPPC	984	1510	1249	2803
IMPORTS	16.66	22.78	29.25	57.20
EXPORTS	13.57	16.17	27.21	46.73
INFLATION	15,74	2,68	4,87	11,27
TOURISM RCPT	2.95	4.66	7.21	13.63
ENERGY PRO.	59808	53090	77981	88397
Libya				
GDP	25.54	33.90	44.00	74.76
POP	4.75	5.18	5.59	6.04
GDPPC	5380	6549	7865	12375
IMPORTS	5.73	5.25	12.45	N.A.
EXPORTS	7.45	12.08	29.23	N.A.
INFLATION	7,24	-2,90	2,65	2,80
TOURISM RCPT	0.004	0.08	0.30	0.17
ENERGY PRO.	77239	75931	97768	93837
Tunisia				
GDP	18.03	21.47	32.28	44.43
POP	8.96	9.56	10.03	10.55
GDPPC	2013	2245	3219	4211
IMPORTS	8.80	9.21	14.63	24.35
EXPORTS	8.10	8.49	14.51	22.24
INFLATION	6,24	2,96	2,02	4,42
TOURISM RCPT	1.84	1.98	2.80	3.48
ENERGY PRO.	5330	6634	6681	8121
Algeria				
GDP	41.76	54.79	103.20	161.21
POP	29.32	31.72	33.96	37.06
GDPPC	1425	1727	3039	4350
IMPORTS	12.11	11.70	24.84	50.65
EXPORTS	10.94	22.56	48.72	61.98
INFLATION	29,78	0,34	1,38	3,91
TOURISM RCPT	0.03	0.10	0.48	0.32
ENERGY PRO.	106718	142222	166662	150525
Morocco				
GDP	37.18	37.02	59.52	90.77
POP	26.83	28.71	30.13	31.64
GDPPC	1373	1276	1948	2823
IMPORTS	11.17	12.35	22.57	39.09
EXPORTS	8.84	10.36	19.23	30.17
INFLATION	6,12	1,89	0,98	0,99
TOURISM RCPT	1.47	2.28	5.43	8.18
ENERGY PRO.	831	571	610	879

[a]GDP, IMPORTS, EXPORTS and TOURISM RECEIPTS are in billion US. dollars in current prices. GDPPC is in current US. dollars. INFLATION is measured as the growth rate of consumer price index. ENERGY PRODUCTION is measured as kt of oil equivalent.

Tunisia now finds itself as an export-oriented country in the process of liberalizing and privatizing an economy that, while averaging 5% GDP growth since the early 1990s, has suffered from corruption benefiting politically connected elites. The agricultural sector stands for 11.6% of the GDP, industry 25.7%, and services 62.8%. The industrial sector is mainly made up of clothing and footwear manufacturing, production of car parts, and electric machinery. Although Tunisia managed an average 5% growth over the last decade it continues to suffer from a high unemployment especially among youth. Tunisia was in 2009 ranked the most competitive economy in Africa and the 40th in the world by the World Economic Forum. Tunisia is one of the European Union's most established trading partners in the Mediterranean region and ranks as the EU's 30th largest trading partner. Tunisia was the first Mediterranean country to sign an Association Agreement with the European Union, in July 1995, although even before the date of entry came into force.

Algeria is classified as an upper middle income country by the World Bank. The economy remains dominated by the state, a legacy of the country's socialist post-independence development model. In recent years, the Algerian government has halted the privatization of state-owned industries and imposed restrictions on imports of goods and services and foreign involvement in its economy. Algeria has struggled to develop industries outside hydrocarbons in part because of high costs and an inert state bureaucracy. The government's efforts to diversify the economy by attracting foreign and domestic investment outside the energy sector have done little to reduce high youth unemployment rates or to address housing shortages. The country is facing a number of short-term and medium-term problems, including the need to diversify the economy, strengthen political, economic and financial reforms, improve the business climate and reduce inequalities amongst regions. A wave of economic protests in February and March 2011 prompted the Algerian government to offer more than $23 billion in public grants and retroactive salary and benefit increases. Public spending has increased by 27% annually during the past 5 years. The 2010–14 public-investment programs will cost US$286 billion, 40% of which will go to human development.

Morocco's economy is considered a relatively liberal economy governed by the law of supply and demand. Since 1993, the country has followed a policy of privatization of certain economic sectors which used to be in the hands of the government. Morocco has become a major player in the African economic affairs, and is the 5th African economy by GDP (PPP). Tourism is one of the most important sectors in Moroccan economy; it is well developed with a strong tourist industry focused on the country's coast, culture, and history. Morocco attracted more than 10 million tourists in 2013. Tourism is the second largest foreign exchange earner in Morocco after the phosphate industry. The Moroccan government is heavily investing in tourism development, in 2010 the government launched its Vision 2020 which plans to make Morocco one of the top 20 tourist destinations in the world and to double the annual number of international arrivals to 20 million by 2020, with the hope that tourism will

then have risen to 20% of GDP. A large government sponsored marketing campaigns to attract tourists advertised Morocco as a cheap and exotic, yet safe, place for tourists, most of the visitors to Morocco continue to be European, with French nationals making up almost 20% of all visitors. Tourism is increasingly focused on Morocco's culture, such as its ancient cities. The modern tourist industry capitalizes on Morocco's ancient Roman and Islamic sites, and on its landscape and cultural history. 60% of Morocco's tourists visit for its culture and heritage.

The distinction between North Africa and much of Sub-Saharan Africa is historically and ecologically significant because of the effective barrier created by the Sahara Desert for much of modern history. From 3500 BCE, following the abrupt desertification of the Sahara due to gradual changes in the Earth's orbit, this barrier has culturally separated the North from the rest of the continent. As the seafaring civilizations of the Phoenicians, Greeks, Romans, Muslims and others facilitated communication and migration across the Mediterranean Sea, the cultures of North Africa became much more closely tied to Southwestern Asia and Europe than Sub-Saharan Africa. The Islamic influence in the area is also significant, and North Africa is a major part of the Islamic world.

Rest of the paper is organized as follows: Section II describes the methodology and data set. Section III presents findings. Finally, Section IV concludes.

II. METHODOLOGY AND THE DATA

In order to estimate efficiency changes, this study employs output-based Malmquist TFP index which is generated by [9]. This methodology provides an opportunity to calculate TFP growth by using basic production factors (i.e. capital and labor) and decompose it into the technical efficiency change (TEC), technological change (TC), scale efficiency change (SEC) and total factor productivity change (TFPC). The output-oriented Malmquist TFP index estimated in the study can be shown as [10]:

$$m_0(y_{t+1}, x_{t+1}, y_t, x_t) = \left[\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} \times \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t)} \right]^{1/2} \quad (1)$$

where y represents the GDP that is proxied by gross domestic product in current prices and x is the vector of explanatory variables (i.e. capital that is proxied by gross fixed capital formation in current prices, labor that is proxied by total labor force and other variables related to tourism and energy sectors). Equation (1) represents the productivity of the production point (xt+1, yt+1) relative to the production point (xt, yt). This index is the geometric mean of two output-based Malmquist TFP indices. One index uses period t technology and the other period t+1 technology.

Rest of the data set covers international tourism receipts in current prices and energy production that is measured as kt of oil equivalent. All of the data were attained from the online data base of World Bank. The name of the data base is "World Development Indicators". The study covers annual balanced panel data from 1995 to 2010.

III. RESULTS

The estimation of (1) was conducted by using data envelopment analysis (DEA) on DEAP 2.1 software created by [10] and findings were reported in Table II.

Results show the first that tourism increases technical and scale efficiencies, while it decreases technological and total factor productivity changes. Besides, in the case of tourism, Egypt and Algeria seem the most efficient countries, whereas Morocco is the most inefficient one. Second, when the production function is augmented by the energy input, technical efficiency change decreases, while the technological change, scale efficiency change and total factor productivity change increase. In the case of energy input, Algeria, Morocco and Egypt appear at the top three in efficiency ranking, whereas Libya is the most inefficient one.

TABLE II
ESTIMATED EFFICIENCY SCORES

Basic Model	Egypt	Libya	Tunisia	Algeria	Morocco	Panel Mean
TEC	1.006	0.982	1.013	1.000	0.990	0.998
TC	1.013	0.995	0.998	1.041	0.998	1.009
SEC	1.006	0.982	0.987	1.000	0.999	0.995
TFPC	1.019	0.978	1.011	1.041	0.988	1.007
Tourism Model						
TEC	1.006	1.000	1.013	1.000	0.990	1.002
TC	1.013	0.942	0.988	1.002	0.998	0.990
SEC	1.006	1.000	0.987	1.000	0.999	0.998
TFPC	1.019	0.942	1.011	1.002	0.988	0.992
Energy Model						
TEC	1.000	0.982	0.995	1.000	1.000	0.996
TC	1.014	0.997	1.009	1.049	1.023	1.018
SEC	1.000	0.982	0.995	1.000	1.000	0.996
TFPC	1.014	0.980	1.004	1.049	1.023	1.014

IV. CONCLUSION

By considering the energy and tourism as the extra inputs to the classical Coub-Douglas production function, this study aimed at investigating the efficiency changes in the North African countries under the context of sustainable growth. For this purpose, the study used panel data for the period 1995-2010 and adopted the Malmquist index based on the data envelopment analysis.

Findings implied a policy that promotes tourism will, in turn, cause the efficient use of resources, although it does not spur the growth rate. On the other hand, subsidizing energy production will, in turn, boost growth rates of the North African countries, although the resources are not consumed efficiently. Thus, in order to satisfy the needs for sustainable growth, governments should take some measures for increasing the contribution that the tourism makes to economic growth and some others for efficient use of resources in the energy sector.

Finally, this study has an important restriction. Since there is no available data related to agriculture, manufacturing and

services in Libya, the classical Coub-Douglas production function has augmented by adding only two variables. If this problem is solved, it can be a good potential for the future researches.

REFERENCES

[1] E. D. Domar, "Capital expansion, rate of growth, and employment," Econometrica, vol. 14, no. 2, pp. 137-147, 1946.
[2] R. F. Harrod, Towards a Dynamic Economics. McMillan, UK, 1948.
[3] R. M. Solow, "A contribution to the theory of economic growth," Quarterly Journal of Economics, vol. 70, pp. 65-95, 1956.
[4] P. M. Romer, "Increasing returns and long run growth," Journal of Political Economy, vol. 94, no. 5, pp. 1002-1037, 1986.
[5] R. E. Lucas, "On the mechanics of economic development," Journal of Monetary Economics, vol. 22, pp. 3-42, 1988.
[6] P. M. Romer, "Endogenous technological change," Journal of Political Economy, vol. 98, no. 5, pp. 71-102, 1990.
[7] R. J. Barro, "Government spending in a simple model of endogenous growth," Journal of Political Economy, vol. 98, no. 5, pp. 103-125, 1990.
[8] S. Giljum and C. Polzin, Resource efficiency for sustainable growth: global trends and European policy scenarios. SERI Working Paper, Vienna, Austria, 2009.
[9] R. Fare, S. Grosskoph, M. Norris and Z. Zhang, "Productivity growth, technical progress, and efficiency changes in industrialised countries," American Economic Review, vol. 84, pp. 66-83, 1994.
[10] T. Coelli, A Guide to DEAP Version 2.1: A Data Envelopment Analysis (computer) Program. CEPA Working Papers, No 8, 1996.