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Sources of economic growth in MENA countries: a Harrod-neutral technological progress identification framework

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Abstract
This study answers the question: What are the results of assuming the nature of technological progress as Harrod-neutral in growth accounting for the Middle East and North African (MENA) countries? Accordingly, this study contributes to the debate over whether the sources of economic growth stem from technological progress, capital or human capital accumulation. The study finds evidence that economic growth stems from capital accumulation rather than total factor productivity for the MENA countries, except Israel and Saudi Arabia. The authors concluded that assuming the nature of technological progress as Harrod-neutral in growth accounting for the MENA countries does not have a critical impact on the results.

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Keywords Sources of economic growth; growth accounting; human capital; bounds testing; ARDL; MENA

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1. Introduction

Economic growth, which is discerned as an escalation in the economic production capacity may be increased by raising production factors such as labor and capital, or by raising the technological level. According to the supply-side view of economic growth studies, capital accumulation (both physical and human capitals) and technological progress are expected to be the primary sources for economic growth. Literature studying the factors that contribute to the economic growth attempts to compute the contributions of the growth factors and technological progress to the output growth rate.

Related literature begins with the seminal work of Solow (1957). In his study, Robert Solow made use of a production function connecting the output to capital and labor (in physical units), and referred to all alterations regarding production function as "technical change". In Solow's study (1957), U.S. economics data obtained from the period between 1909 and 1949 were used. Many additional studies were conducted on the topic basing on his study. For example, the sources of economic growth in the Japanese economy from 1955 to 1971 were analyzed in Nishimizu and Hulten (1978) with the assumption of Hicks-neutral technological progress for each sector. The results of their study showed that main sources for sectorial economic growth are intermediate goods and production-capital factors outcome instead of productivity. In the study conducted by Collins and Bosworth (1996) data obtained for the period between 1960 and 1994 regarding East and South Asian, sub-Saharan and North African, Middle Eastern and Latin American countries and industrially developed countries were analyzed. According to the results of this study, in East Asian countries, emphasis was on capital accumulation instead of productivity. Klenow and Rodríguez-Clare (1997) defined a production function following Mankiw, Romer and Weil (1992). The authors documented that the productivity majorly contributes to the growth in Hong Kong, Taiwan, and the Republic of Korea. This result were also generalized to a sample of 98 countries and stated that differences in productivity growth contributes to as much as

90% of the country differences in output growth per worker. More recently, in the study conducted by Madsen (2010), data from the period between 1870 and 2006 that depend on the empirical indications of the model by Abel-Blanchard for 16 industrially developed countries were used. This study found evidence that conventional studies accounting for growth give higher significance to factor accumulation and tend to emphasize factor accumulation induced by TFP. Making use of the data for the period between 1960 and 2007 regarding 18 countries from Latin America from among 83 countries which are either developed or developing, Ferreira et al. (2013) proved that the primary source of growth was not total factor productivity until the end of the 1970s. However, this study concluded that physical and human capital accumulation as the primary source for low level output per worker. Further, researchers stated that after the late 1970s, total factor productivity decreased and that a stagnation occurred in the sample economies.

Most relevant literature regarding sources of economic growth aims at addressing whether it is progress in technology, or accumulation of physical or the human capital that is a primary source of economic growth sources (Ben Ali et al., 2016). A well-known and simple question has been argued: What is the cause for rapid growth in some countries while said growth cannot be achieved in other countries? This question can be replaced with the following: What is the cause for rapid growth in some regions, such as East Asia, while other regions cannot achieve such rapid growth as a whole?

As an economically diverse region, MENA countries deserve attention be given to their growth process as it consists of countries which are rich in oil and as well as countries which lack resources. The real gross domestic product (GDP) per capita ranges from $2,500 to $60,000 among the oil-rich countries of Qatar, Kuwait, Saudi Arabia, Iraq and Bahrain. The countries with a real GDP per capita of less than $15,000 include Sudan, Egypt, Iraq, Morocco, Jordan, Iran, Tunisia and Turkey, among which Sudan is the poorest. The Penn World Table data for the period between 1970 and 2011 show that the long-run growth rates, per worker, of output, physical capital stock and human capital of majority of the MENA countries (Turkey,, Iran, Malta, Syria, Morocco, Jordan, Sudan, Tunisia and Egypt) are positive, with Egypt and Malta having the highest average output growth rates in the region (3.8 and 3.5%, respectively). Conversely, the oil-rich countries of the region have negative long-term output growth rates per worker. The physical capital accumulation per worker data indicates that the highest growth rates (5.5% and 4.2%, respectively) on average among the MENA countries is observed for Turkey and Egypt. The country in the region that has the real GDP per capita, on average, has a positive physical capital accumulation growth rate per worker. Although the oil-rich MENA countries have recorded positive capital accumulation growth rates per worker, their average growth rates are lower compared to other countries in the region. The human capital per worker index, as a combination of years of schooling and return on education, shows that Egypt and Turkey have growth rates that are the highest in the analysis period. The human capital index per worker has an upward trend for Egypt, Jordan, Malta and Morocco while there is a decreasing trend in human capital per worker in Bahrain, Israel, Kuwait, Syria, Tunisia and Turkey. The index data show that Iran, Iraq, Qatar and Sudan exhibit an inert pattern after the 1990s.

It is implied by the difference between these countries with regard to variables of the sources of growth analysis that some countries in the region grow faster than others and that this more rapid growth does not depend on whether the country is oil-rich or has a higher real GDP per capita. In this paper, we examine whether economic growth stems from technological progress or accumulation of capital for the MENA countries. As it is emphasized in Acikgoz and Mert (2014 and 2015), Harrod-neutral technological progress should be assumed to harmonize econometric methodology and economic theory if time series analysis methods related to the long run are used.[1] Therefore this study is aimed at determining the outcomes of considering the character of technological progress to be Harrod-neutral with respect to growth accounting for MENA countries.

With the exception of Nehru and Dhareshwar 1993; Senhadji 2000; and Abu-Bader and Abu-Qarn 2007, studies concerning Middle East and North Africa are not copious. Thus, we attempt to overcome the main shortcoming of the labor-augmenting (Harrod-neutral) technical change neglected in the literature. Most of the studies that are empirically based use the production function without assuming that a technical change of labor-augmentation may yield results with the consequence being underestimation of total factor productivity growth. For example, Abu Bader and Abu Qarn (2007) investigated sources of growth for ten MENA countries for the period between 1960 and 1998 using growth accounting analysis. It was found that there is a negligible contribution of productivity gains towards the growth, therefore concluding that the factor leading to economic growth in MENA economies is factor accumulation. However, this study is based on the work of Collins and Bosworth (1996), which does not assume Harrod-neutral identification. Collins and Bosworth (1996) used the production function without assuming labor-augmenting (Harrod-neutral) technological change. Dani Rodrik states that this approach may yield results with the consequence of underestimation of total factor productivity growth (see Comments Section of Appendix A in Collins and Bosworth, 1996). Our study therefore assumes labor-augmenting technological change, specifically Harrod-neutral technological change, and analyzes sources of economic growth that employ this identification.

[1] As highlighted Clive W. Granger, “if macro theories are about equilibria, econometric techniques are not, it becomes difficult for these theorems to be tested on actual data”. In other words, it is not useful to assume that the nature of technological progress as Hicks-neutral since it does not have a steady-state if one analysis relations between output and production factors in the long-run.

It is found in our study that for the countries in MENA except Saudi Arabia and Israel, economic growth arises from accumulation of capital instead of total factor productivity.[2] Thus, with regard to MENA countries, considering technological progress as Harrod-neutral with respect to growth accounting does not affect the results critically. However, this does not imply the compatibility of Hicks-neutral technological progress with the methods in time series that are based on the long-run relationships between the variables of the sources of growth analysis.

This paper has four sections: Section 2 gives details about the model, the data set and the methodology employed in this work. Section 3 includes the model estimation results and discusses the findings. The paper ends with conclusion section.

2. Model, Data and Methodology

2.1. Model

The production function under Harrod-neutral technological progress assumption is given below (See Mankiw, Romer and Weil (1992)):

$$Y_t = K_t^{\alpha} H_t^{\beta} \left(A_t L_t\right)^{1-\alpha-\beta}$$

This production function can be written by per labor:

$$\frac{Y_t}{L_t} = A_t^{1-\alpha-\beta} \left(\frac{K_t}{L_t}\right)^{\alpha} \left(\frac{H_t}{L_t}\right)^{\beta}$$

The growth accounting calculation is then based on the following equations:

$$\ln\left(\frac{Y_t}{L_t}\right) = (1-\alpha-\beta)\ln A_t + \alpha \ln\left(\frac{K_t}{L_t}\right) + \beta \ln\left(\frac{H_t}{L_t}\right)$$

Thus, the estimation equation is as follows:

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[2] The estimated long-run coefficients for seven countries are not economically meaningful, and therefore, we are not able to provide sources of growth analysis results for Bahrain, Iraq, Jordan, Kuwait, Malta, Syria or Tunisia.

$$\ln\left(\frac{Y_t}{L_t}\right) = C_t + \alpha \ln\left(\frac{K_t}{L_t}\right) + \beta \ln\left(\frac{H_t}{L_t}\right) + u_t \tag{1}$$

where the constant term (C_t) is equal to $(1-\alpha-\beta)\ln A_t$ and u_t is the error-term.

After we estimate the parameters (α and β) and constant term (C_t), we calculate capital per labor growth and human capital per labor growth contribution to output per labor growth based on the following equation:

$$r_{Y/L} = (1-\alpha-\beta) r_A + \alpha\, r_{K/L} + \beta\, r_{H/L} \tag{2}$$

where r represents the growth rate of the variable.

2.2. Data

Following the definition of the World Bank and depending on the data availability, the sample used in this paper includes the following fifteen MENA countries: Turkey, Egypt, Bahrain, Israel, Iraq, Iran, Jordan, Malta, Saudi Arabia, Morocco, Kuwait, Qatar, Syria, and Tunisia. The data set covers the period 1970 to 2011 for each of the 15 cited countries.

The Penn World Table (PWT 8.0) data is used in the estimations. The dependent variable of the model is the real gross domestic product (GDP) per labor (*YL*). The real GDP (code *rgdpna* in PWT 8.0), capital stock (code *rkna* in PWT 8.0),the index of human capital (code *hc*in PWT 8.0) all of which are scaled to the number of persons engaged (code *emp* in PWT 8.0). This index of PWT is constructed by using the number of years of schooling data of Barro and Lee (2012) and return on education data of Psacharopoulos (1994).[3] Hereafter, we use the physical capital stock, real GDP, and human capital per worker rather than per labor. Finally, gross domestic product and capital stock data are in national currencies (computed using 2005 prices). All the data were converted into logarithmic values before they were used in the estimations.

[3] The original index is based on per person. We multiplied this index by population, and then we scaled it to the number of persons engaged.

2.3. Methodology

Since the technological progress identification assuming Harrod-neutral is in compliance with the econometric analysis based on the long term, the long-run relationships among the variables in Equation (1) were examined with the ARDL approach that is also referred to bounds testing to cointegration.[4]

Pesaran (1997), Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001) established an alternative method to standard cointegration analysis. Unlike the standard cointegration analysis, this method circumvents the pretesting issues in identifying the integration orders of the variables. Therefore, regardless of whether the variables in the model are purely I(0), purely I(1) or mutually cointegrated, the bounds testing can be applied. Another advantage of ARDL approach is that it is relatively more efficient in small samples compared to the Johansen cointegration approach requiring large data samples. Finally, as some authors explain, with ARDL, the problems of endogeneity that might be experienced when physical capital stock and human capital per labor are employed in the real GDP per labor equation can be dealt with (Lewis and MacDonald 2002).

The ARDL bounds testing approach proceeds in two stages. The first stage pertains to estimation of an unrestricted error-correction model (UECM), as given in Equation (3).

$$\begin{aligned}\Delta \ln YL_t &= \gamma_1 + \gamma_2 t + \delta D_t + \beta_1 \ln YL_{t-1} + \beta_2 \ln KL_{t-1} + \beta_3 \ln HL_{t-1} + \sum_{i=1}^{p} \gamma_{1i} \Delta \ln YL_{t-i} \\ &\quad + \sum_{i=0}^{p} \gamma_{2i} \Delta \ln KL_{t-i} + \sum_{i=0}^{p} \gamma_{3i} \Delta \ln HL_{t-i} + \varepsilon_t \end{aligned} \tag{3}$$

[4] MENA region shows economic diversity and includes both countries that are rich in oil and countries that lack resources. In this paper, each country was investigated separately instead of combining the countries in a panel data set since the region does not create a homogenous country group. Besides the data set used in this paper has showed that they are generally different from each other in terms of per worker real GDP and capital stock.

where D_t denotes a structural change dummies vector; Δ denotes the first-difference operator; and t denotes the deterministic time trend. ln*YL* is the log of the real GDP per worker; ln*KL* is the log of physical capital stock per worker; and ln*HL* is the log of human capital per worker.

In the event that long-run relationship is established in the first stage, a conditional ARDL (p_1,q_1,q_2) long-run model for the dependent variable (in our case, ln*YL*) is estimated as follows:

$$\ln YL_t = c_0 + c_1 t + \psi D_t + \sum_{j=1}^{p_1} \lambda_j \ln YL_{t-j} + \sum_{j=0}^{q_1} \theta_{1j} \ln KL_{t-j} + \sum_{j=0}^{q_2} \theta_{2j} \ln HL_{t-j} + \varepsilon_t \quad (4)$$

Where the lag lengths p_1,q_1,q_2 relating to three variables in the model are selected by using information criteria while rest of the variables are defined above.

The long-run parameters of the sources of growth equation are acquired by OLS, and the estimates stated in the conditional ARDL model of Equation (4) are used to obtain the long-run level estimates of Equation (1) as follows:

$$\hat{C}_t = \frac{\hat{c}_0}{1 - \sum_{k=1}^{p} \hat{\alpha}_k} \text{ and } \hat{\alpha} \text{ or } \hat{\beta} = \frac{\sum_{j=0}^{q_j} \hat{\theta}_{ij}}{1 - \sum_{k=1}^{p} \hat{\lambda}_k} \quad (5)$$

After establishing a long-run relationship among the variables, the related short-run dynamic error-correction model (not reported in this paper) that is based on ARDL approach is performed.

3. Results and Discussion

3.1. Lag Lengths and Estimation of the Long-Run Parameters

We first tested the existence of a long-run level relationship between the related variables. We then made an estimation regarding the long-run parameters of the sources of growth equation, and finally, we reported the results of the sources of growth for eight MENA countries.

For half of the MENA countries, there is a steady increase in the real GDP per worker series over time. At least at the beginning, this suggests a linear trend for the real GDP per worker equation. Therefore, the test regressions for each country given in Equation (3) were estimated by OLS with and without a linear time trend. The specification given in Equation (3) depends on the assumption that the error terms u_t are serially uncorrelated. Therefore, appropriate selection of the lag length p of the test regressions is of importance. The appropriate lag length for the test regression with or without a linear deterministic trend were selected using Akaike and Shwarz Information Criteria (AIC and SBC) while controlling the residual serial correlation against the first to fourth orders. We report the test statistics for the first and fourth orders in Table 1.

We calculated three different F-statistics to test the validity of the restrictions ($\beta_1 = \beta_2 = \beta_3 = 0$) in Equation (3) under several conditions that have the following restrictions on the model parameters for first, second and third F-statistics respectively:

i. unrestricted intercept and no trend (F-iii),
ii. unrestricted intercept and a restricted trend (F-iv), and
iii. unrestricted intercept, and an unrestricted trend (F-v).

Small sample problem with regard to the bounds testing approach was investigated by Narayan (2004 and 2005) and the critical values for the F-statistics which are also applicable for small sample sizes were generated. As we have 42 observations for each country, critical values were taken from Narayan (2005). The bounds testing results are summarized in Table 2.

Although the bounds testing for cointegration is not dependent on pretesting the integration order, the augmented Dickey and Fuller (1979) ADF test and generalized least squares detrended Dickey-Fuller defined by Elliot et al. (1996) DF-GLS test were utilized in order to determine the integration order of the series. In order to control how unit root test results are affected by the structural changes, we also made use of the tests developed by Zivot and Adrews (1992) and Lee and Strazicich (2003). The tests show that all series in the model are either I(1) or I(0) but not I(2). In view of this, we started testing for a long-run level relationship by making use of the bounds tests. For the sake of brevity, the unit root test results were not reported but can be provided upon request. We used a long-run level relationship instead of cointegration as in Pesaran, Shin and Smith (2001) because we have the mixed series in terms of their integration order.

Time plots of the series show that there are noteworthy breaks in the level and, as expected, in the growth rates of the series of each MENA country. Zivot and Andrews (1992) and Lee and Strazicich (2003) unit root tests results were used to determine the break dates. If both tests produced statistically significant break dates, dummy variables were specified for each country. For almost all countries, the number of specified dummy variables is greater than one. Thus, the test regression for the bounds testing procedure given in Equation (3) was repeated with these dummy variables. Statistically significant dummy variable(s) were retained in the test regressions. Taking into account the resulting endogenously determined structural breaks, we also employed dummy variables in the ARDL procedure to correctly specify the long-run elasticities of the real GDP per worker equations for the selected MENA countries.[5]

In order to check the ARDL estimates in terms of robustness we also estimated the long-run parameters by making use of the fully modified OLS (FM-OLS) method presented by Phillips and Hansen (1990). This method modifies OLS in order to correct serial correlation in the error term and to solve the endogeneity in the regressors.

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[5] Dummy variables found to be significant for Bahrain are *D*81 and *DT*81. *D*81 takes a value of 1 for the year 1981, and 0 otherwise; DT81 takes a value of 1 for the period 1981-2011, and 0 otherwise. For Egypt, *D*75 takes a value of 1 for the period 1970-1975, and 0 otherwise. A dummy variable that takes a value of 1 in 1990 and 1991 to control the effect of the break in the Iraq-Kuwait years as Iraq was kept in the estimations. Both the output per worker and capital stock per worker series of Kuwait have a marked decline during the Iraq-Kuwait War period. A dummy variable that takes a value of 1 in 1990 and 1991 was retained in the test regressions of Kuwait. To catch up for the effect of the level shift in the real GDP series of Saudi Arabia, we defined a dummy variable that takes a value of 1 in the period 1985-2011.

We also investigated the stability of the estimated long-run model by applying the parameter non-constancy tests produced by Hansen (1992). Hansen (1992) proposed three tests – Sup*F*, Mean*F*, and L_C – having the same null hypothesis. However, these tests vary in accordance with the alternative hypothesis they utilize.

The Sup*F* test is based on the ideas that form the basis for the classical Chow *F*-tests. The alternative hypothesis amounts to calculating the Chow *F*-statistic due to a sudden regime shift at an unknown point in time.. To perform the Sup*F* test, a truncated sample size *T* is used. We used the subset [0.15*T*, 0.85*T*]. When the question under investigation is whether the specified model captures a stable relationship, use of Mean*F* test is suitable. If the likelihood of the variation of parameter is relatively constant throughout the sample, the L_C statistic is recommended. In the L_C statistic, the null of cointegration is also tested against the alternative of no cointegration. Test results for stability are provided in Table 3 with the long-run parameter estimates.

Lag Length Selection and Bounds Testing

Lag lengths and the LM test statistics with their *p*-values reported in Table 1 show that both AIC and SBC selected the same lag lengths for the test regressions on Egypt, Iran, Iraq, and Malta. For several countries – Israel, Malta, Qatar and Tunisia – we were not able to reject the null of no first and/or fourth order serial correlation at the lags selected by AIC and SBC. In such cases, we also calculated *F*-statistics at the lags when there is no such problem in the error terms of the test regression. For these countries, *F*-statistics calculated at different lags than those calculated at the lags selected by AIC and SBC confirmed the bound testing results provided in Table 2.

Table 1. Statistics for Selecting Lag Length of the Real GDP per worker Equations

Country	Information Criteria	with Constant			with Constant and Trend		
		p_c	$\chi^2(1)$	$\chi^2(4)$	p_t	$\chi^2(1)$	$\chi^2(4)$
Bahrain	**AIC**	4	0.144 (0.705)	15.193 (0.004)	4	0.002 (0.964)	17.334 (0.002)
	SBC	2	1.376 (0.241)	17.026 (0.002)	2	2.713 (0.100)	17.010 (0.002)
Egypt	**AIC/SBC**	1	4.865 (0.027)	7.264 (0.123)	1	4.676 (0.031)	7.369 (0.118)
Iran	**AIC/SBC**	1	0.526 (0.468)	2.903 (0.574)	1	0.144 (0.704)	3.991 (0.407)
Iraq	**AIC/SBC**	1	1.675 (0.196)	5.018 (0.285)	1	1.698 (0.193)	5.119 (0.275)
Israel	**AIC**	4	0.490 (0.484)	11.265 (0.024)	4	2.651 (0.104)	11.274 (0.024)
	SBC	1	2.172 (0.141)	3.652 (0.455)	1	0.017 (0.895)	3.168 (0.530)
Jordan	**AIC**	3	0.016 (0.900)	11.524 (0.021)	3	0.019 (0.892)	11.874 (0.018)
	SBC	1	1.570 (0.210)	3.711 (0.447)	1	0.203 (0.652)	8.613 (0.072)
Kuwait	**AIC**	4	4.038 (0.045)	10.100 (0.039)	4	4.485 (0.034)	11.838 (0.019)
	SBC	1	3.105 (0.078)	4.293 (0.368(	1	3.859 (0.050)	5.796 (0.215)
Malta	**AIC/SBC**	4	0.818 (0.366)	7.714 (0.103)	4	0.998 (0.318)	9.725 (0.045)
Morocco	**AIC**	2	1.965 0.161	6.305 0.178	1	0.726 (0.394)	9.343 (0.053)
	SBC	1	2.185 (0.139)	8.044 (0.090)	1	0.726 (0.394)	9.343 (0.053)
Qatar	**AIC**	4	4.535 (0.033)	20.716 (0.000)	4	4.498 (0.034)	22.007 (0.000)
	SBC	1	0.093 (0.761)	10.606 (0.031)	1	0.114 (0.736)	11.538 (0.021)
Saudi Arabia	**AIC**	2	0.490 (0.484)	6.031 (0.197)	4	9.380 (0.002)	28.273 (0.000)
	SBC	1	3.851 (0.050)	10.796 (0.029)	2	2.641 (0.104)	14.422 (0.006)
Sudan	**AIC**	4	0.000 (1.000)	1.036 (0.904	4	1.541 (0.214)	7.841 (0.098)
	SBC	2	0.764 (0.382)	15.329 (0.004)	2	0.778 (0.378)	12.491 (0.014)
Syria	**AIC**	2	0.545 (0.460)	6.673 (0.154)	3	0.003 (0.958)	9.066 (0.060)
	SBC	1	0.414 (0.520)	4.403 (0.354)	1	0.676 (0.411)	2.445 (0.655)

Table 1. Statistics for Selecting Lag Length of the Real GDP per worker Equation (continued)

Country	Information Criteria	with Constant			with Constant and Trend		
		p_c	$\chi^2(1)$	$\chi^2(4)$	p_t	$\chi^2(1)$	$\chi^2(4)$
Tunisia	**AIC**	4	2.157 (0.142)	15.497 (0.004)	4	0.010 (0.919)	14.494 (0.006)
	SBC	3	4.262 (0.039)	11.240 (0.024)	4	0.010 (0.919)	14.494 (0.006)
Turkey	**AIC**	2	0.277 (0.599)	3.797 (0.434)	4	5.388 (0.020)	11.522 (0.021)
	SBC	1	4.660 (0.031)	6.287 (0.179)	2	3.196 (0.074)	12.838 (0.012)

Notes: p_c and p_t are the lag orders chosen according to AIC and SBC with and without linear deterministic trend, respectively. $\chi^2(1)$ and $\chi^2(4)$ are LM statistics for testing no residual serial correlation against order 1 and 4, respectively. *p*-values of $\chi2$ statistics are given in parenthesis below the estimates of LM statistics.

For Equation (3), the calculated three *F*-statistics for Bahrain, Iran, Iraq, Kuwait and Malta are higher than the upper bound critical values at the 1% and 5% levels. Thus, the null hypothesis of no long-run level relationship cannot be accepted for the real GDP per worker model of these four MENA countries.

With respect to Israel, the three *F*-statistics which are calculated at the lags selected by SBC show that the null hypothesis of no long-run level relationship may be strongly rejected at all traditional significance levels. the *F*-iii and *F*-iv statistics for Jordan show that there is a long-run level relationship at the 5 % level for the real GDP per worker equation. These results indicate the presence of evidence of a long-run level relationship among said three variables with or without a linear time trend. With respect to Morocco, Qatar and Sudan, the *F*-iii, *F*-iv and *F*-v statistics calculated at the lag lengths of 1, 4 and 4, respectively, indicate that there is a long-run level relationship for ln*YL* equation at the 1% and 5% significance levels.

Table 2. F-statistics for Testing the Existence of levels the Real GDP per Worker Equation

Country	Information Criteria	p_c	with constant	p_t	with constant and Trend	
			***F*-iii**		***F*-iv**	***F*-v**
Bahrain	**AIC**	4	12.499***	4	10.698***	8.815***
	SBC	2	12.508***	2	10.228***	13.224***
Egypt	**AIC/SBC**	1	4.846*	1	3.632	4.218
Iran	**AIC/SBC**	1	29.976***	1	24.118***	29.323***
Iraq	**AIC/SBC**	1	10.850***	1	7.907***	8.182***
Israel	**AIC**	4	2.925	4	5.057*	6.640**
	SBC	1	10.547***	1	11.789***	15.701***
Jordan	**AIC**	3	7.466***	3	5.393**	3.492
	SBC	1	5.797**	1	5.420**	1.237
Kuwait	**AIC**	4	10.908***	4	8.001***	10.019***
	SBC	1	5.372**	1	7.526***	9.909***
Malta	**AIC/SBC**	4	9.698***	4	7.015***	8.742***
Morocco	**AIC**	2	3.101	1	10.023***	13.287***
	SBC	1	9.293***	1	10.023***	13.287***
Qatar	**AIC**	4	8.043***	4	5.788**	6.583**
	SBC	1	2.024	1	1.493	1.811
Saudi Arabia	**AIC**	2	4.987*	4	3.804	5.067
	SBC	1	7.662***	2	6.041**	8.025**
Sudan	**AIC**	4	7.278***	4	10.444***	11.799***
	SBC	2	3.551	2	3.687	4.864
Syria	**AIC**	2	5.780**	3	3.299	4.366
	SBC	1	5.780**	1	5.665**	6.765**
Tunisia	**AIC**	4	3.587	4	4.278	5.688*
	SBC	3	10.608***	4	9.731***	12.929***
Turkey	**AIC**	2	2.392	4	9.368***	12.229***
	SBC	1	8.386***	2	6.306**	8.120**

Notes: p_c and p_t are as in Table 1. Maximum lag length was taken as 4. The critical values with two explanatory variables and 42 observations are extracted from Narayan (2005). ***, ** and * indicate the null of there is no long-run levels relationship can be rejected at the 1%, 5% and 10% levels, respectively.

F-iii is the *F*- statistics for testing $\beta_1 = \beta_2 = \beta_3 = 0$ in Equation (3) under the constraint of unrestricted intercept and no trend. *F*-iv is the *F*-statistics for testing $\beta_1 = \beta_2 = \beta_3 = 0$ in Equation (3) under the constraint of unrestricted intercept and restricted trend. *F*-v is the *F*-statistics for testing $\beta_1 = \beta_2 = \beta_3 = 0$ in Equation (3) under the constraint of unrestricted intercept and unrestricted trend.

Regarding Saudi Arabia, the number of lags for the test regressions selected by AIC is 2 without a linear deterministic trend and 4 with a linear deterministic trend. SBC selected the lags 1 and 2 (see Table 1). The LM test results regarding residual serial correlation provided in Table 1 suggest that the residuals of the test regression without a linear deterministic trend are not serially correlated at lag 2.

The residuals of the test regression with a linear deterministic trend have a fourth order serial correlation at the 1% level at lags 2 and 4. Under this assumption violation, we trust the results of the *F*-iii statistics given in Table 2 for this country. The calculated *F*-iii statistics are greater than the upper bound critical value at the 10% level for the 1960 to 2011 period. This can be accepted as weak evidence for the existing real GDP per worker equation for Saudi Arabia.

According to the bounds testing results for Syria, all three *F*-statistics calculated at the lag length of 1 imply that a long-run level of the real GDP per worker equation exists at the 5% level. The bounds test results reported in Table 2 for Turkey show that three *F*-statistics with the selected lag lengths by AIC and SBC indicate the presence of a long-run level relationship among the physical capital stock per worker, real GDP per worker, and human capital per worker.

Because of serially correlated residuals at the selected lags, we are cautious as we read the results by *F*-statistics for the existence of the real GDP equation for Tunisia. The *F*-v statistic shows that there is a long-run relationship among the variables.. However, at the lower lags (e.g., $p = 1$) that were not reported herein, the residuals of the test regression with/without a linear trend are not serially correlated. Furthermore, at lag 1, all three *F*-statistics are greater than the upper bounds at the 1%, 5% and 10 % levels. Following this evidence for the long-run level relations, we estimated the long-run parameters of the sources of the growth model for Tunisia.

Table 3. Long-Run Estimates of the Real GDP per Worker Equation with ARDL and FM-OLS

Dep. Var.: ln*YL*	Without Deterministic Trend			With Deterministic Trend		
	AIC[a]	SBC[b]	FM-OLS	AIC[a]	SBC[b]	FM-OLS
	BAHRAIN					
Coefficient on ln*KL*	0.427 (0.871)	1.023 (4.229)***	1.657 (2.231)	0.202 (1.017)	0.202 (1.017)	1.533 (2.075)
Coefficient on ln*HL*	1.028 (2.913)***	0.510 (2.879)***	-1.548 (-1.770)	1.553 (5.655)***	1.553 (5.655)***	-1.433 (-1.647)
Constant	4.419 (0.792)	-2.126 (-0.770)	-6.942 (-0.873)	6.336 (3.024)***	6.336 (3.024)***	-5.594 (-0.707)
Stability Tests of Hansen (1992)						
Sup*F*	860.770			839.694		
Mean*F*	194.223			189.789		
L_C	1.662			1.639		
	EGYPT					
Coefficient on ln*KL*	0.370 (7.307)***	0.370 (7.307)***	0.317 (6.348)***	0.336 (3.271)***	0.336 (3.271)***	0.317 (6.331)***
Coefficient on ln*HL*	0.895 (5.136)***	0.895 (5.136)***	1.161 (7.612)***	0.915 (5.042)***	0.915 (5.042)***	1.162 (7.588)***
Constant	4.105 (19.288)	4.105 (19.288)	4.089 (19.288)***	4.352 (6.239)***	4.352 (6.239)***	4.086 (19.197)***
Stability Tests of Hansen (1992)						
Sup*F*	7.801♣			8.998♣		
Mean*F*	5.451♣			5.010♣		
L_C	0.305♣			0.282♣		
	IRAN					
Coefficient on ln*KL*	0.433 (3.608)***	0.433 (3.608)***	-0.033 (-0.267)	0.276 (2.481)**	0.442 (3.689)***	-0.060 (-0.471)
Coefficient on ln*HL*	0.396 (2.784)***	0.396 (2.784)***	-0.579 (-3.684)***	0.489 (4.544)***	0.418 (2.870)***	-0.499 (-3.123)***
Constant	4.536 (3.687)***	4.536 (3.687)***	11.947 (9.371)***	6.187 (5.320)***	4.405 (3.567)***	12.080 (9.308)***
Stability Tests of Hansen (1992)						
Sup*F*	207.074			176.198		
Mean*F*	27.672			24.082		
L_C	0.621♣			0.607♣		
	IRAQ					
Coefficient on ln*KL*	-0.432 (-0.944)	-0.432 (-0.944)	0.117 (0.424)	-0.417 (-0.414)	-0.611 (-0.371)	0.140 (0.495)
Coefficient on ln*HL*	0.836 (1.127)	0.836 (1.127)	0.067 (0.139)	0.784 (0.235)	2.840 (0.513)	0.141 (0.282)
Constant	12.243 (2.851)***	12.243 (2.851)***	8.219 (2.773)***	12.181 (2.082)**	11.378 (1.228)	7.577 (2.546)**
Stability Tests of Hansen (1992)						
Sup*F*	84.442			16.067		
Mean*F*	15.688			5.173		
L_C	0.098♣			0.074♣		

Table 3. Long-Run Estimates of the Real GDP per Worker Equation with ARDL and FM-OLS (*continued*)

Dep. Var.: ln*YL*	**Without Deterministic Trend**			**With Deterministic Trend**		
	AIC[a]	**SBC[b]**	**FM-OLS**	**AIC[a]**	**SBC[b]**	**FM-OLS**
				ISRAEL		
Coefficient on ln*KL*	0.685 (8.639)***	0.641 (17.860)***	0.499 (13.845)***	*0.193* *(1.947)**	0.224 (1.710)*	0.548 (19.484)***
Coefficient on ln*HL*	0.181 (0.570)	-0.033 (-0.256)	-0.890 (-4.853)***	*0.025* *(7.187)****	0.205 (1.537)	-0.657 (-4.596)***
Constant	2.301 (1.481)	3.270 (4.989)***	6.772 (9.662)***	*7.754* *(7.187)****	7.511 (5.311)***	5.721 (10.463)***
Stability Tests of Hansen (1992)						
Sup*F*	40.205			61.573		
Mean*F*	11.249			17.551		
L_C	0.441♣			0.454♣		
				JORDAN		
Coefficient on ln*KL*	0.559 (1.674)	0.559 (1.674)	0.049 (0.063)	0.751 (1.985)*	0.751 (1.985)*	0.480 (0.842)
Coefficient on ln*HL*	1.344 (1.425)	1.344 (1.425)	0.440 (0.197)	0.564 (0.464)	0.564 (0.464)	0.013 (0.08)
Constant	0.162 (0.069)	0.162 (0.069)	8.066 (1.893)*	-0.455 (-0.190)	-0.455 (-0.190)	4.223 (1.354)
Stability Tests of Hansen (1992)						
Sup*F*	507.931			301.158		
Mean*F*	208.464			122.309		
L_C	0.738♣			0.514♣		
				KUWAIT		
Coefficient on ln*KL*	0.070 (0.177)	0.070 (0.177)	-0.359 (-0.239)	0.202 (0.420)	0.202 (0.420)	0.931 (0.630)
Coefficient on ln*HL*	0.264 (0.523)	0.264 (0.523)	2.690 (1.111)	-0.007 (-0.009)	-0.007 (-0.009)	3.381 (1.419)
Constant	10.276 (1.862)*	10.276 (1.862)*	11.932 (0.549)	9.258 (1.600)	9.258 (1.600)	-4.952 (0.231)
Stability Tests of Hansen (1992)						
Sup*F*	136.075			72.808		
Mean*F*	50.651			21.662		
L_C	0.442♣			0.212♣		
				MALTA		
Coefficient on ln*KL*	-0.798 (-1.077)	-0.578 (-0.834)	0.169 (0.473)	0.877 (0.495)	3.143 (1.428)	0.696 (1.449)
Coefficient on ln*HL*	6.126 (2.635)**	5.548 (2.507)**	4.442 (3.560)***	4.711 (1.703)*	2.280 (0.808)	2.081 (1.245)
Constant	8.324 (1.962)*	6.924 (1.766)*	-0.133 (-0.072)	-7.171 (-0.440)	-27.277 (-1.262)	-1.592 (-0.639)
Stability Tests of Hansen (1992)						
Sup*F*	2347.826			171.237		
Mean*F*	530.525			37.863		
L_C	1.364			0.369♣		

Table 3. Long-Run Estimates of the Real GDP per Worker Equation with ARDL and FM-OLS (*continued*)

Dep. Var.: ln*YL*	Without Deterministic Trend			With Deterministic Trend		
	AIC[a]	SBC[b]	FM-OLS	AIC[a]	SBC[b]	FM-OLS
	MOROCCO					
Coefficient on ln*KL*	*0.372 (5.203)****	*0.329 (3.227)****	0.520 (9.101)***	0.431 (6.673)***	0.492 (8.888)***	0.489 (10.216)***
Coefficient on ln*HL*	*0.733 (3.621)****	*0.933 (3.059)****	0.441 (2.643)**	1.255 (3.626)***	1.019 (5.070)***	0.480 (3.433)***
Constant	*3.987 (8.953)****	*4.123 (6.797)****	2.991 (8.417)***	2.711 (3.951)***	2.351 (3.948)***	3.242 (10.880)***
Stability Tests of Hansen (1992)						
Sup*F*	124.215			79.159		
Mean*F*	31.281			25.402		
L_C	1.174			1.229		
	QATAR					
Coefficient on ln*KL*	*0.909 (37.955)****	0.887 (13.849)***	0.940 (17.482)***	0.892 (15.711)***	0.839 (8.245)***	0.947 (17.605)***
Coefficient on ln*HL*	*0.803 (7.817)****	0.683 (3.130)***	0.913 (5.361)***	0.837 (5.888)***	0.726 (2.908)***	0.909 (5.328)***
Constant	*-0.832 (-3.208)****	-0.378 (-0.538)	-1.377 (-2.234)***	-0.631 (-0.989)	0.232 (0.191)	-1.472 (-2.386)***
Stability Tests of Hansen (1992)						
Sup*F*	66.099			78.093		
Mean*F*	19.886			23.518		
L_C	0.201$^{\clubsuit}$			0.218$^{\clubsuit}$		
	SAUDI ARABIA					
Coefficient on ln*KL*	-16.499 (-0.496)	-1.398 (-1.074)	3.827 (3.262)***	-0.247 (-0.564)	-1.368 (-1.718)*	*0.587 (2.136)**
Coefficient on ln*HL*	4.303 (0.500)	1.076 (0.999)	-4.539 (-3.539)***	1.453 (5.134)***	1.353 (2.327)**	*0.958 (2.323)***
Constant	205.993 (0.524)	26.868 (1.855)*	-26.861 (-1.968)*	12.224 (2.414)**	26.868 (2.854)***	*2.876 (0.945)*
Stability Tests of Hansen (1992)						
Sup*F*	1675.873			585.645		
Mean*F*	226.306			67.761		
L_C	1.044			0.525$^{\clubsuit}$		
	SUDAN					
Coefficient on ln*KL*	*0.299 (14.849)****	0.299 (14.849)***	0.316 (5.810)***	0.538 (2.893)***	0.527 (2.749)***	0.308(5.781)***
Coefficient on ln*HL*	*0.453 (4.915)****	0.453 (4.915)***	0.676 (3.068)***	1.828 (1.754)*	1.159 (1.361)	0.723 (3.358)***
Constant	*5.488 (28.699)****	5.488 (28.699)***	4.960 (11.634)***	1.899 (0.690)	3.602 (1.585)	4.950 (11.888)***
Stability Tests of Hansen (1992)						
Sup*F*	50.696			15.707		
Mean*F*	26.682			2.981		
L_C	0.059$^{\clubsuit}$			0.054$^{\clubsuit}$		

Table 3. Long-Run Estimates of the Real GDP per Worker Equation with ARDL and FM-OLS (*continued*)

Dep. Var.: ln*YL*	Without Deterministic Trend			With Deterministic Trend		
	AIC[a]	SBC[b]	FM-OLS	AIC[a]	SBC[b]	FM-OLS
				SYRIA		
Coefficient on ln*KL*	1.425 (4.916)***	0.954 (3.085)***	1.658 (3.750)***	-0.364 (-1.063)	-0.241 (-0.770)	1.539 (4.834)***
Coefficient on ln*HL*	-1.585 (-2.385)**	-0.406 (-0.624)	-1.721 (3.068)***	0.662 (1.519)	0.567 (1.402)	-1.532 (-2.233)***
Constant	-2.816 (-1.400)***	-0.001 (-0.002)	-5.042 (-1.806)*	11.694 (4.100)***	10.563 (4.037)***	-4.097 (-1.839)*
Stability Tests of Hansen (1992)						
Sup*F*	29.01			26.588		
Mean*F*	16.031			14.972		
L_C	0.716♣			0.921♣		
				TUNISIA		
Coefficient on ln*KL*	-0.618 (-1.815)*	-0.892 (-1.450)	-0.524 (-2.752)***	-0.229 (-1.095)	-0.299 (-1.910)*	0.370 (3.262)***
Coefficient on ln*HL*	3.950 (6.777)***	4.343 (4.196)***	3.592 (9.583)***	0.892 (1.010)	1.658 (2.397)**	-1.874 (-2.954)***
Constant	9.210 (3.356)***	11.516 (2.321)**	8.824 (5.830)***	10.022 (5.177)***	9.524 (7.838)***	8.160 (7.874)***
Stability Tests of Hansen (1992)						
Sup*F*	76.005			2765.266		
Mean*F*	25.368			202.289		
L_C	0.931♣			0.695♣		
				TURKEY		
Coefficient on ln*KL*	0.514 (3.965)***	*0.448 (3.323)****	0.455 (5.144)***	0.880 (19.339)***	0.885 (10.149)***	0.417 (4.238)***
Coefficient on ln*HL*	0.408 (1.477)	*0.552 (1.924)**	0.474 (2.504)**	0.746 (11.119)***	0.785 (6.374)***	0.561 (2.664)***
Constant	3.893 (4.293)***	*4.392 (4.725)****	4.493 (7.367)***	0.080 (0.181)	-0.053 (-0.060)	4.730 (6.968)***
Stability Tests of Hansen (1992)						
Sup*F*	71.901			11.532♣		
Mean*F*	10.906♣			4.957♣		
L_C	0.465♣			0.410♣		

Notes: The standard errors of the long-run parameter estimates obtained with ARDL are computed using the Delta-method. For stability tests, the null hypothesis is that "the estimated long-run parameters are stable". The Bartlett kernel is used for bandwidth to estimate the elements of covariance matrix. Critical values for the stability tests were obtained from Hansen (1992: 327-328). Trimming region is taken as [0.15 and 0.85] for Sup*F* and Mean*F* statistics. The symbols ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. ♣ shows that the estimated long-run parameters are stable at the 1% or 5% or 10% levels. Because of space problem, we did not report the selected lags of ARDL(p, q_1,q_2) by AIC and SBC. The long-run elasticities that are used in growth accounting are in *italic*.

3.2. Long-run Elasticities

Having found a long-run level relationship among the variables of the sources of growth analysis for all MENA countries, ARDL(p,q_1,q_1) given in Equation (4) was estimated with and without linear time trend. We presented the long-run elasticities obtained with ARDL approach (from Equation (4) by using the formula given in Equation (5)), FM-OLS method as well as stability tests of the long-run parameters in Table 3. The lag lengths of ARDL(p,q_1,q_2) model were selected by both AIC and SBC.

The long-run elasticities estimated by the ARDL approach and FM-OLS are different for some countries, meaning the results are not robust and are subject to the estimation methods used in this paper. Although all MENA countries have a long-level relationship between lnYL, lnKL and lnHL, the signs (negative coefficients) and the magnitudes (coefficients less than zero or greater than one) of the long-run coefficients for seven of the MENA countries were not appropriate either economically or econometrically (see Table 3). The positive parameters greater than one imply increasing returns concerning the factors. In other words, if the elasticity parameter is equal to 1.2 and if there is a 10% increase in per worker capital, then output per worker will increase by 12%. However, decreasing returns should be assumed as such an assumption guarantees moving towards equilibrium. As a consequence, if the estimated long-run elasticities are greater than one, we cannot interpret the parameters as there will be, theoretically, an expected disequilibrium. Furthermore, we cannot interpret the negative elasticities and elasticities higher than 1 because they are not economically meaningful, and therefore, we are not able to provide sources of growth analysis results for Bahrain, Iraq, Jordan, Kuwait, Malta, Syria or Tunisia.

The ARDL and FM-OLS estimates for Egypt match closely with the coefficient of lnKL. FM-OLS found the coefficient of lnHL to be greater than 1. However, the Sup$F$ and Mean$F$ statistics show that the long-run parameters of the real GDP per worker equation are stable. As previously noted herein in the previous section, the L_C test statistic also serves as a test of the null of cointegration against no cointegration. Although we have no strong evidence regarding the bounds testing for Egypt, the L_C test statistic strongly rejects that there is no long-run level relationship among the variables.

With respect to Iran, the long-run elasticities of the lnYL with respect to lnKL and lnHL obtained using ARDL and FM-OLS are completely different. For example, the FM-OLS estimates do not have the correct signs. The signs and magnitudes of the coefficients obtained by the ARDL are as expected. The L_C statistic indicates stability of parameters over time and confirms presence of a long-run level relationship among related variables.

Regarding Israel, the ARDL and FM-OLS produced different coefficient estimates in the long run. Obtained results also differ when the lags of the conditional ARDL model are selected by AIC and SBC. Only statistically significant long-run elasticities are obtained when the lag length is selected by SBC and when a linear time trend is present in the ARDL model. Moreover, the L_C statistics indicate stability of the long-run parameters.

Using the formula given in Equation (5), the level estimates for Morocco were calculated and are reported in Table 3. The estimates of all levels are highly significant and indicate expected signs. When human capital per worker holds constant, a 1% increase in physical capital stock per worker leads to an increase of approximately 0.32 to 0.37 in the real GDP per worker in Morocco. Similarly, the elasticity of the real GDP per worker with respect to human capital per worker is estimated to be between 0.73 and 0.93 using ARDL approach when the lag lengths were determined by the AIC. As with other countries, the long-run relationships were also estimated by using the FM-OLS technique. Levels estimates obtained with the FM-OLS method are significant and have the expected signs and magnitudes. The values of Sup$F$ and Mean$F$ are relatively high, thus rejecting the null hypothesis that the long-run parameters are stable over time. The calculated L_C values are slightly greater than the critical value at the 1% level. Nonetheless, we calculated the sources of economic growth even though there is weak evidence for parameter stability for Morocco.

The estimates of all levels (long-run estimates) for Qatar are significant and indicate expected signs. The magnitudes of the long-run elasticities vary between 0 and 1, which is compatible with the theory. These levels estimates were used to determine the sources of growth for the economy of Qatar. For Qatar, there is more than one option for obtaining the sources of growth calculations. The ARDL models selected by the AIC produces a long-run elasticity coefficient, as specified by SBC. We prefer to use the level estimates specified by AIC without a linear trend because it strongly rejects the null hypothesis that the long-run coefficients are not different from zero.

The long-run relationship was estimated using four different conditional ARDL(p,q_1,q_1) specifications and two FM-OLS specifications. The four conditional ARDL models produced quite different results. The FM-OLS estimates are also different with and without a linear trend. Only the FM-OLS with a linear trend produced the estimates that have correct signs wherein the magnitudes of the elasticities are between 0 and 1. FM-OLS estimates with a linear deterministic trend were used to calculate sources for economic growth in the economy of Saudi Arabia.

AIC and SBC select slightly different conditional ARDL models when a linear trend term was included in the model for Sudan, and the FM-OLS estimates of the coefficient of the ln*HL* variable are greater than those of ARDL estimates (see Table 3). When we add a linear deterministic trend to the ARDL model, this coefficient is found to be greater than one, a finding that does not make sense theoretically. Therefore, we use the level estimates obtained by the ARDL approach when there is no linear trend term (first two columns of Table 3). The calculated L_C values given in Table 3 are greater than the critical value at the 1 % level.

The estimated orders of an ARDL(p,q_1,q_2) model in the three variables (lnYL, lnKL, lnHL) for a country are selected by searching across 64 ARDL models, spanned by p = 0, 1, …, 4 (with/without trend) and using both AIC and SBC. One of the selected ARDL models is the ARDL (1,2,2) specification. The estimates given in the second column of Table 3 are obtained by using this ARDL model. All level estimates are highly significant and indicate expected signs. The magnitudes are also found to be less than one. The results show that there is a positive effect of capital stock per worker and human capital per worker on the real GDP per worker for Turkey. The Sup F, Mean F and L_C test statistics strongly accept stability of long-run parameters over the sample period.

3.3. Growth Accounting

We analyzed sources of economic growth for Turkey, Sudan, Saudi Arabia, Qatar, Morocco, Israel, Iran and Egypt. Various empirical studies have been conducted with regards to the sources of economic growth in countries which are developed and developing. Nonetheless, the number of studies related to the sources of economic growth for MENA countries are limited. Economic growth may be caused by alternate sources. In this paper, we tried to investigate the sources of economic growth in MENA.

Table 4. Growth Accounting Results (percentages)

Country	**Average growth rate of output per labor (%) (1)**	**Contribution of capital stock per labor (2)**	**Contribution of human capital stock per labor (3)**	**Contribution of technological progress (4) = (1) – (2) – (3)**
Egypt	0,0355	**57,5860**	39,5131	2,9008
Iran	0,0046	**175,4500**	83,3137	-158,7637
Israel	0,0131	32,1674	-0,3003	**68,1329**
Morocco	0,0154	**58,2939**	27,6266	14,0795
Qatar	-0,0184	**91,8789**	23,5584	-15,4373
Saudi Arabia	-0,0084	-7,4409	-23,4345	**130,8755**
Sudan	0,0187	**59,7692**	21,2485	18,9823
Turkey	0,0290	**64,1659**	33,5705	2,2636

Source: Author’s calculations.

Table 4 summarizes sources of growth calculations for eight countries with percentages. As presented in this table, we found that for Turkey, Sudan, Morocco and Egypt, the primary source of growth is accumulation of physical capital with contribution ranging from 57 to 64%. For these countries, human capital stock contribution is also of importance as it has a contribution ranging from 21% to 39%. The contribution of technological progress in Turkey and Egypt is minimal at 2.90% and 2.26% respectively. However, the contributions in technological progress for Morocco and Sudan are considerably higher, at 13.27% and 18.98%, respectively. Surprisingly, while Iran and Qatar exhibit negative contribution with regards to progress in technology, the contribution of physical capital stock in Iran is 175.45% and the contribution of human capital is 83.31%, both of which are significantly high when compared to the other 15 countries. The contribution of capital accumulation and human capital per worker to the output growth are 91.9% and 23.6% respectively in Qatar. Nonetheless, Iran's and Qatar's technological progress contribution is negative at −158.76% and −15.4%.[6] Unlike the other countries, technological progress is the main source of economic growth for Israel and Saudi Arabia, at 68.13% and 130.8 %, respectively.

Accordingly, the results of our study support the argument that for MENA countries, the primary source of economic growth is accumulation of physical capital with the exception of Israel and Saudi Arabia, both of whom depend on their technological progress as the main source of their economic growth[7]. Physical capital accumulation suggests the need for policies to increase savings and thereby

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[6] Negative contributions might be possible. It means that a factor apart from the physical and human capital accumulation slows down economic growth in Iran and Qatar. Since contribution of factor productivity is calculated as a residual, the reason for that negative contribution might be all other possible effects apart from the physical and human capital accumulation. If we knew the exact reasons of this negative contribution, it would be explanation of endogenous growth. Negative contribution results were also obtained in Maddison (1970) and Crafts (2000).

[7] On the other hand, our study can be criticized as follows. Because sources of growth analysis is a short-run analysis, one should use the short-run information that is econometrically obtained from long-run information when applying growth accounting. Although we are able to obtain econometrically significant parameter estimates for eight MENA countries in

achieve fast growth. Therefore, for most of the MENA countries, increasing savings and capital accumulation is important. However, it is also noted that MENA countries' most significant problem is their large fiscal and external deficits. From this perspective, the main challenge for these countries is to implement policies intended to raise domestic savings. However, we emphasize that, while our results point to capital accumulation, these results are valid for past data. In other words, the policy recommendations above are valid only if we assume that the future data will yield the same information as the past data. However, if we do not assume the future data will yield the same information as the past data, one might interpret the results as follows. MENA countries' large fiscal and external deficit problems are accompanied by the need for physical capital accumulation to achieve fast growth. This then creates a bottleneck effect. However, if the MENA countries' efforts are focused on policies to improve productivity rather than capital accumulation, it may be possible to escape this problem. In other words, as large fiscal and external deficits prevent increasing domestic savings and capital accumulation, it then becomes an important agenda for MENA countries to focus on policies to improve productivity.

4. Conclusion

In this study, sources of economic growth for MENA countries under Harrod-neutral assumption for the nature of technological progress in growth accounting were analyzed. Our study showed that the evidence stating that economic growth arises from accumulation of capital instead of total factor productivity, with the exception of Saudi Arabia and Israel is provided. Therefore, the nature of technological progress when assumed to be Harrod-neutral has no impact on the outcomes for MENA countries.

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the long-run, short-run estimates of $\Delta\ln KL$ and/or $\Delta\ln HL$ for $\Delta\ln YL$ were negative. Therefore, we used long-run estimates for sources of growth for these MENA countries. From this perspective, the results should be interpreted carefully.

Consider that, the primary source is accumulation of capital for the economies that are growing faster included in our sample (Turkey and Egypt), and therefore, technological progress contribution is insignificant. Sudan and Morocco may be subjected to similar interpretations. Therefore, with regard to said countries, increasing savings and accumulation of capital is important. Nonetheless, the large fiscal and external deficit problems of the MENA countries may seriously prevent those policies from raising savings and capital accumulation. With respect to Iran, contrary to the very high capital stock contributions, the rate of growth of output per labor is low. In a similar manner, Qatar has a negative growth despite the high contributions of capital stock. These findings emphasize policies focusing on technological progress instead of accumulation of capital for Qatar and Iran. Contrarily, Saudi Arabia has a negative growth despite higher technological progress contribution. This result suggests how policies are important on accumulation of capital instead of progress in technology with respect to Saudi Arabia.

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