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MEASURING AGRICULTURAL PRODUCTIVITY GROWTH IN MENA COUNTRIES

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Abstract

This paper investigates the patterns of agricultural productivity growth in Middle East and North Africa (MENA) countries during the period 1970–2000. We use a nonparametric, output-based Malmquist index to examine whether our estimates confirm or invalidate the results of previous studies indicating the decline of agricultural productivity in developing countries. We will show that, on average, agricultural productivity growth has increased at an annual rate of 1 percent during the whole period. Our estimations show that technical change is the main source for this growth. Those results generally weaken the finding of the other studies. Nonetheless, we find a reduction in agriculture productivity mainly in developing countries suffering from political conflicts and wars.

ملخص

تبحث هذه الورقة نماذج نمو الإنتاجية الزراعية في دول الشرق الأوسط وشمال أفريقيا خلال الفترة من عام 1970 إلى عام 2000. حيث تستخدم مؤشر مالمكويست غير المعلمي اعتماداً على المخرجات لاختبار هل تؤكد تقديراتنا الدراسات السابقة التي تشير إلى انخفاض الإنتاجية الزراعية في الدول النامية أم تدحضها وسوف نبين أن معدل النمو الإنتاجية قد زاد في المتوسط، بمعدل 1% سنوياً خلال تلك الفترة من عام 1970 إلى 2000. تشير تقديراتنا إلى أن تغير التقنية هو السبب الرئيسي لذلك النمو، وتضعف تلك النتائج بشكل عام غيرها من نتائج الدراسات الأخرى. ومع ذلك نجد أن هناك انخفاضا في الإنتاجية الزراعية لاسيما في الدول النامية التي تعاني من النزاعات السياسية والحروب.

1. Introduction

Agriculture productivity growth in an economy is important because it is an essential source of overall growth. That is why productivity differences among countries, and mainly between developed and underdeveloped ones, has emerged as a central issue of development economics. Aggregate productivity can be defined as the amount of output that can be obtained from given levels of inputs in a sector or an economy. Therefore, increases in productivity occur when output from a given level of inputs increases. This phenomenon is mainly attributable to improvements in the technical efficiency with which the inputs are used and innovations in technology that allow more output to be produced[1]. Our analysis will examine changes in agricultural productivity in the MENA region.[2] MENA countries continue to be extremely vulnerable to weather and commodity price shocks due to their limited economic resource base. They are prone to high volatility in economic activity, and therefore it is crucial to identify their sources of growth.

The MENA region, which is one of the largest producers and importers of food and feed grains in the world, is a major global market for agricultural and food products. Indeed this region includes Egypt, the largest wheat importer in the world, and Turkey, one of the largest wheat producers. As illustrated in Table 1, the region’s share of agriculture in GDP is decreasing in the majority of MENA countries as well as in the region with 12.61% in 1970 vs. 11.12% in 2000. Sudan had the highest share in 1970 and in 2000, with 43.61% and 41.15%, respectively.

This region is also characterized by rapidly growing populations, rising real incomes, and changing diets as consumers reduce their intake of grains and add more vegetables and livestock products. While the overall population is growing, the region is experiencing declining farm populations and declining land in farms, and increased urbanization has reduced the availability of water for agriculture. The combination of increasing demand for food, decreasing resources for agriculture, reduced yet still considerable government intervention and rising competition from continuing trade liberalization, has undermined the region’s capacity to meet its consumption needs.

Agricultural productivity growth has been studied intensively during the last five decades. Development and agricultural economists have examined the sources of productivity growth over time and space (productivity differences among countries and regions). Agricultural productivity growth is crucial for securing food and raw materials demand arising from a steady population growth. During the 1970s and 1980s a number of major analyses of cross-country differences in agricultural productivity used cross-sectional data. The majority of these studies focused generally on the estimation of the production elasticities and investigating the contributions of farm scale, education and research in explaining cross-country labor productivity differentials (see for example, Lau and Yotopoulos (1989), Kawagoe et al. (1985), Kawagoe and Hayami (1983, 1985), and Hayami and Ruttan (1970)).

The recent expansion of the number of papers investigating cross-country differences in agricultural productivity levels and growth rates is most likely driven by three factors. First, the availability of some new panel data sets, such as that produced by the FAO. Second, the development of new empirical techniques to analyze this type of data, such as the Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) techniques. Third, the desire to assess the degree to which the green revolution and other programs have improved

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[1] TFP indices can also capture the effects of improved infrastructure such as irrigation, roads and electricity, as well as technology in the form of research and development.

[2] The countries considered in this study are Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Qatar, Saudia Arabia, Sudan, Syria, Tunisia, Turkey, United Arab Emirates and Yemen.

agricultural productivity in developing countries.[3] *"One of the recurring themes in the reported results in many of these studies is that less developed countries exhibit technological regression while the developed countries show technological progress"* (Fulginiti and Perrin (1993, 1997, 1998, 1999), Arnade (1998), Trueblood (1996), Kawagoe et al. (1985), Kawagoe and Hayami (1985), Lau and Yotopoulos (1989)).

Those studies show that agriculture growth in developing countries over the last half century is the product of resource increase instead of improved technical efficiency of the resource and the adoptions of new techniques or human capital development. This result is quite distressing, given the incredible advances that have been made in agriculture over the past 40 years. For example, the "Green Revolution" of the late 1960s was characterized by spectacular improvements in the yields of many major food crops, and throughout the past four decades huge advances have been made in irrigation systems, fertilizer use and genetic engineering. Why then, would agricultural productivity in developing countries be declining?

The principal aim of our study is to provide up to date information on agricultural total factor productivity (TFP) growth over the past three decades (1970-2000) for MENA countries. A focus on a more homogeneous geographical area, such as MENA region, will help us to identify characteristics of this evolution specific to geographical, social, or political circumstances of these countries. Our analysis will be based on the DEA technique to calculate Malmquist TFP index numbers. Higher TFP would imply a shift in the production possibilities frontier of the agricultural sector away from the origin, leading to higher output from the application of technology and better utilization of resources.

The rest of this paper is organized as follow. Section 2 provides a more detailed review of literature. We present the DEA and Malmquist TFP index methods in section 3. We describe the data used and discuss our results in section 4, and finally we try to suggest appropriate policy implications and conclude in section 5.

2. Literature Review

Agriculture productivity analyses performed to date show that most developing countries are experiencing relatively negative productivity growth with technical change being the main source of this regression. Kawagoe et al. (1985) showed regressive agricultural productivity in 22 LDCs, but an increase in productivity in the 21 developed countries included in the sample. Kawagoe and Hayami (1985) found similar results for the same data set, using an indirect production function approach that is similar to the indexing approach except that input shares are estimated by using marginal productivities from an aggregate production function instead of prices. Analyses by Lau and Yotopoulos (1989) also found declining agricultural productivity for LDCs in the 1970s but an increase in the 1960s, although they used different functional form (translog functional form and country effects).

Trueblood (1996) estimated a traditional Cobb–Douglas production function and also used the deterministic nonparametric methodology to estimate a Malmquist index. The models were estimated with quality-adjusted inputs using panel data covering 117 countries and 31 years. The study also found negative productivity growth in a significant number of developing countries. Fulginiti and Perrin (1997, 1998, 1999) used an output-based Malmquist index to estimate agricultural productivity. They identified negative productivity growth in a set of 18 developing countries over the period 1961–1985. In their results, at least half of the 18 countries, including Argentina, Brazil, Korea and the Philippines, exhibited negative productivity growth. *"They also found for those countries that tax agriculture most heavily had the most negative rates of productivity change."* Their results lend support to the

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[3] Coelli and Rao (2003) listed 17 studies that have been conducted in the nineties.

results obtained earlier by Kawagoe et al. (1985), Kawagoe and Hayami (1985) and Lau and Yotopoulos (1989), using econometric approaches.

Trying to explain measured productivity decline in developing countries, Fulginiti and Perrin (1993, 1998) related poor productivity performance with economic policy. They found that those countries that tax agriculture most heavily had the most negative rates of productivity change. They suggested that price policies or other interferences with the agricultural sector might stifle potential productivity gains. Fulginiti and Perrin also suggested, as an alternative explanation, that methods and data used in these studies may have inaccurately measured technical regression.

Arnade (1998) estimated agricultural efficiency change indices, technical change indices and productivity indices using nonparametric Malmquist indices for 70 developed and developing countries over the period 1961-1993. Thirty-six of the 47 developing countries included in this sample showed negative rates of technical change, whereas most of the developed country indices rose or followed mixed paths. More recently, Suhariyanto et al. (2001) found negative agricultural productivity growth rates in Asia during 1965-1980 and in Africa from 1971 to 1981. They also showed the rates in both regions improving in subsequent years.

In contrast, recent studies of agricultural productivity growth in developing countries have found positive and rapid growth. Coelli and Rao (2003) examined the growth in agricultural productivity in 93 countries over the period 1980 to 2000. Their results showed an annual growth in total factor productivity growth of 2.1 percent, with efficiency change contributing by 0.9 percent per year and technical change providing the other 1.2 percent. There is little evidence of technological regression found in the earlier studies. They explained the earlier results as a consequence of the use of a different sample period and an expanded group of countries.

Pfeiffer (2003) analyzed agricultural productivity growth in a more homogeneous geographical area, the Andean Community (Bolivia, Colombia, Ecuador, Peru, and Venezuela) over the period 1972-2000. Production and input time-series data were used to estimate a parametric translog production function, a stochastic frontier production function, and a nonparametric Malmquist productivity index to obtain the rate of total factor productivity growth. The results are consistent across methods and indicate that in contrast to previous studies, productivity growth in the Andean Community is positive and increasing over time. Furthermore, the TFP growth rates estimated are comparable to those of developed countries. Land quality, war and violence, and political freedom are important in understanding behavioral differences across countries.

In order to test the methodologies and the results of these studies, Pfeiffer (2003) suggested looking at more homogenous sets of developing countries sharing geographical, economic, and social characteristics.

Nin et al. (2003) re-examined the nonparametric procedure for estimating the Malmquist productivity index. They argued that the technical regression observed is principally the consequence of biased technical change together with the definition of technology used to estimate the Malmquist index. They eliminated this effect by applying a broader cumulative definition of technology than is normally used to estimate the Malmquist index. Their results using this new approach reversed the previous findings and showed that most countries in their sample of 20 developing countries experienced positive productivity growth with technical change being the main source of this growth.

3. Methodology

One of the most popular approaches to measuring productivity changes is based on the calculation of Malmquist Productivity Index, which was introduced by Caves et al. (1982) and based on distance functions. The innovation of Färe et al. (1994), showing that this index can be estimated using a nonparametric approach, has extensively induced its use for measuring and analyzing productivity. This approach allows for the decomposition of productivity growth into two mutually exclusive and exhaustive components :

improvement in technical efficiency with which the inputs are used (catching up), and

the innovation in technology (technical change).

TFP is measured in our study by the Malmquist index methods described in Färe et al. (1994) and Coelli et al. (1998. Ch. 10)[4]. We use the Malmquist Productivity index (MPI) as a measure of productivity change over time. The MPI is based on distance functions, which allow one to describe a multi-input, multi-output production technology without the need to specify a behavioral objective. We consider here an output distance function. A production technology may be defined using the output set, P(x), which represents the set of all output vector, y, which can be produced using the input vector, x.

That is, $P(x) = \{y : x \text{ can produce } y\}$ (1)

The output distance function is defined on the output set, P(x), as:

$d(x,y) = \min\{\delta : (y/\delta) \in P(x)\}.$ (2)

The distance function, d(x,y), will take a value which is less than or equal to one if the output vector y is an element of the feasible production set P(x). Furthermore, the distance function will take a value of unity if y is located on the outer boundary of the feasible production set, and will take a value greater than one if y is located outside the feasible production set. The distance functions are measured by using DEA methods.[5] As we consider the output distance function, the DEA method in this case seeks the maximum proportional increase in output production, with input levels held fixed.

The MPI needs are defined with respect to a reference period technology, therefore the MPI with respect to technology in any period *t* is:

$$M_t = \frac{d_t(x_{t+1}, y_{t+1})}{d_t(x_t, y_t)} \tag{3}$$

An analogous output orientated MPI with period t+1 technology as the benchmark is:

$$M_{t+1} = \frac{d_{t+1}(x_{t+1}, y_{t+1})}{d_{t+1}(x_t, y_t)} \tag{4}$$

As it is difficult to choose between periods t and t+1 for the reference or benchmark period, we define an output orientated MPI as the geometric mean of (3) and (4), (Färe et al. 1994):

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[4] The Malmquist approach is less dependent on the parametric specification of the model.

[5] DEA is a linear-programming methodology, which uses data on the input and output quantities of a group of countries to construct a piece-wise linear surface over the data points. This frontier surface is constructed by the solution of a sequence of linear programming problems – one for each country in the sample. The degree of technical inefficiency of each country (the distance between the observed data point and the frontier) is produced as a by-product of the frontier construction method.

$$M_{t,t+1}(x_t, x_{t+1}, y_t, y_{t+1}) = \left(\frac{d_t(x_{t+1}, y_{t+1})}{d_t(x_t, y_t)} \frac{d_{t+1}(x_{t+1}, y_{t+1})}{d_{t+1}(x_t, y_t)} \right)^{1/2} \tag{5}$$

This can be decomposed into technical efficiency change $(\Delta TE_{t,t+1})$ and technical change $(\Delta TC_{t,t+1})$ as follows:

$$M_{t,t+1}(x_t, x_{t+1}, y_t, y_{t+1}) = \frac{d_{t+1}(x_{t+1}, y_{t+1})}{d_t(x_t, y_t)} \left(\frac{d_t(x_{t+1}, y_{t+1})}{d_{t+1}(x_{t+1}, y_{t+1})} \frac{d_t(x_t, y_t)}{d_{t+1}(x_t, y_t)} \right)^{1/2} \tag{6}$$

This provides further insights into productivity changes, since the first component, $\Delta TE_{t,t+1} = \frac{d_{t+1}(x_{t+1}, y_{t+1})}{d_t(x_t, y_t)}$, measures the change in technical efficiency over the two periods and the second component, $\Delta TC_{t,t+1} = \left(\frac{d_t(x_{t+1}, y_{t+1})}{d_{t+1}(x_{t+1}, y_{t+1})} \frac{d_t(x_t, y_t)}{d_{t+1}(x_t, y_t)} \right)^{1/2}$, measures the change in technology over the two time periods. Greater than unity values for either of these components suggest improvement, while less than 1 values suggest the opposite. Here, the efficiency change component refers to the improved ability of a country to adopt the global technology available at different points of time whereas technical change measures the effect of shift in the production frontier resulting from technological advances on agricultural output.

Following Färe et al. (1994), and given that suitable panel data are available, we can calculate the required distance measures for the Malmquist TFP index using DEA-like linear programs. For the ith country, we must calculate four distance functions to measure the TFP change between two periods, t and t+1. This requires the solving of four linear programming (LP) problems assuming constant returns to scale (CRS) technology:

$$(d_t(y_t, x_t))^{-1} = \max\ \theta$$

Subject to:

$$\begin{aligned} & Y_t \lambda \geq \theta y_{it} \\ & x_{it} \geq X_t \lambda \\ & \lambda \geq 0\,; \end{aligned} \tag{7}$$

$$(d_{t+1}(y_{t+1}, x_{t+1}))^{-1} = \max\ \theta$$

Subject to:

$$\begin{aligned} & Y_{t+1} \lambda \geq \theta y_{it+1} \\ & x_{it+1} \geq X_{t+1} \lambda \\ & \lambda \geq 0 \quad ; \end{aligned} \tag{8}$$

$$(d_t(y_{t+1}, x_{t+1}))^{-1} = \max\ \theta$$

Subject to:

$$Y_t \lambda \geq \theta y_{it+1} \tag{9}$$

$$x_{it+1} \geq X_t \lambda$$

$$\lambda \geq 0 \quad ; \text{and}$$

$$\left(d_{t+1}(y_t, x_t)\right)^{-1} = \max \ \theta$$

Subject to:

$$Y_{t+1} \lambda \geq \theta y_{it} \tag{10}$$

$$x_{it} \geq X_{t+1} \lambda$$

$$\lambda \geq 0 \, ;$$

where

y_{it} and y_{it+1} are M ×1 vectors of output quantities for the i^{th} country in period t and in period t+1, respectively;

x_{it} and x_{it+1} are K ×1 vectors of input quantities for the i^{th} country in period t and in period t+1, respectively;

Y_t and Y_{t+1} are N ×M matrixes of output quantities for all N countries in period t and in period t+1, respectively;

X_t and X_{t+1} are N ×K matrixes of input quantities for all N countries in period t and in period t+1, respectively;

λ is a N ×1 vector of weights; and θ is a scalar indicating the technical efficiency score.

Note that in LPs 9 and 10, where production points are compared to technologies from different time periods, the θ parameter need not be greater than or equal to one, as it must be when calculating standard output-orientated technical efficiencies. The data point could lie above the production frontier. This will most likely occur in LP 10 where a production point from period t+1 is compared to technology in an earlier period, t. If technical progress has occurred, then a value of θ <1 is possible. Note that it could also possibly occur in LP 9 if technical regress has occurred, but this is less likely.

4. Data and Results

The present study is based on data drawn from the AGROSTAT system of FAO Statistics Division (FAO, 2006)[6] and from the World Bank Indicators (WBI, 2004). They consist of two outputs (crops and livestock production) and five inputs (land, animal stock, labor, fertilizer consumption and agricultural machinery (number of tractors)). Output indices (1989-91=100) for crops and livestock obtained from the (WBI, 2004) are used for the outputs. Land is total agricultural area. The number of cattle measured in livestock units is used as a proxy for animal stock. Total economically active population in agriculture is used as the labor variable. Land, animal stock and labor were obtained from the AGROSTAT system of FAO Statistics Division (FAO, 2006). Fertilizers and agricultural machinery are obtained from the (WBI, 2004). For harmonization, we calculate all input indices (1989-91=100). Agricultural TFP indices are estimated for the 21 MENA countries over the period

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[6] The authors are grateful to the FAO for offering valuable data series freely on the internet.

1970-2000. The Malmquist indices are the product of efficiency change and technical change and are computed under the assumption of constant returns to scale.[7]

The results of our DEA and TFP calculations are summarized in this section. Given that we have 31 annual observations on 21 countries, we have a lot of computer output to describe. Especially, we have measures of efficiency change, technical change and TFP change for each country in each pair of adjacent years. We have hence decided to be selective in the choice of the results presented in this paper. We provide information on the means of the measures of efficiency change, technical change and TFP change for each country (over the 31 year sample period) and the mean changes between each pair of adjacent years (over the 21 MENA countries).

Technical efficiency scores and their averages in 1970, 1980, 1990 and 2000 are reported in Table 2 for the full sample. Kuwait is the only country found technically efficient in the four years. Algeria, Egypt, Israel, Morocco, Syria and Tunisia were not found to be frontier countries in any of the four years. Note that the average technical efficiency score of 0.875 in 2000 implies that MENA countries are, on average, producing 87.5 percent of the output that could be potentially produced using the observed input quantities. We observe that MENA region achieved the largest increases in mean technical efficiency over the period 1980-1990 and the largest decreases in mean technical efficiency over the period 1990-2000. The average technical efficiency was the highest during the year 1990.

This average technical efficiency change gives us information only on the “catch-up” part of the productivity story. In fact a country will have a positive efficiency change over time if it is catching up. The degree of catching up or the efficiency change can be related to institutional factors, domestic and trade policies of specific countries. TFP change can also appear in the form of technical change (or frontier-shift). Tables 3 and 4 summarize the means of the measures of efficiency change, technical change and TFP change for each country over the 31-year sample period (1970-2000), and the sub periods (1970-1980, 1981-1990 and 1991-2000).

The mean efficiency change, technical change and TFP change for the 21 MENA countries over the period 1970 to 2000 are illustrated by Figure 1 and Table 3. The average (across all countries) growth in TFP is 1 percent, which is due to 1 percent growth in technical change. Fourteen countries in our sample are experiencing significant productivity growth and seven exhibit substantial productivity regress. This table shows Jordan, Qatar, Lebanon, Libya and Tunisia as the five countries with maximum TFP growth. Jordan shows a 4.9 percent average growth in TFP, which is due to 2.9 percent growth in efficiency change, and 2 percent growth in technical change. Qatar, Lebanon, Libya and Tunisia respectively exhibit TFP growth rates of 3.8, 3.6, 3.4 and 3.4 percent. Turkey, which has the highest share in total agriculture added value (see Table 1), exhibits a TFP growth rate of 0.4 percent.

Even with the majority of countries experiencing significant productivity growth, the measure of weighted annual average technical efficiency change, technical change and TFP change, where each country change is weighted by the country’s share in total agricultural added value, will give higher changes in TFP change and in its components.

The countries which exhibit TFP regression are Bahrain, Iran, Iraq, Kuwait, Mauritania, Oman and Saudi Arabia[8]. In the case of Bahrain, the annual average productivity growth rate

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[7] TFP index may not correctly measure TFP changes when variable returns to scale is assumed for the technology. Hence it is important that CRS be imposed upon any technology that is used to estimate distance functions for the calculation of a Malmquist TFP index. Otherwise the resulting measures may not properly reflect the TFP gains or losses resulting from scale effects.

[8] Iran, Iraq and Kuwait experienced wars during the period studied.

is -2.3%. The results for Iran and Iraq are less dramatic with -1.9% and -1.2% annual average productivity growth rates, respectively. In the case of Iraq, negative productivity value is explained only by technical efficiency regression (a negative rate of technical efficiency change). Agriculture productivity in Bahrain and Iran is declining due to regression of technology and technical efficiency together. From these countries, only Iran and Saudi Arabia have an important share in total agriculture added value. Their shares are respectively 16.88 % and 10.32 % in 2000. Almost all of these countries are oil countries. There is a significant body of literature, which addresses the means by which natural resource abundance may hinder overall development. In this case we posit that both government and private resources are simply diverted towards oil production. Furthermore, oil revenues provide a means of financing food imports rather than relying on domestic production, perhaps relieving the need to use agricultural inputs more efficiently (see Sachs and Warner 1995, for example).

Table 4 compares the TFP index estimates for the period 1970-2000. We note that the estimates of the same index are made for three sub periods: 1970-1980, 1981-90 and 1991-2000. MENA countries are characterized on average by negative productivity rates until the 1990s and positive rates from 1991. Fortunately the positive increase largely offsets the earlier losses. The highest average growth in TFP, in the order of 4.1 %, is recorded during the period 1991-2000.

Table 5 shows the annual averages (over the 21 countries) of efficiency change, technical change and TFP change. We can see that over the whole period there has been no technological regression, though for some individual years there has been some evidence of technological regression. Another interesting feature is the absence of efficiency change (or "catch-up") as a source of TFP growth.

Once the traditional quantitative inputs into agriculture are taken into account, any productivity growth (or change) has to be explained using other factors: either the quality of inputs or unmeasured inputs (such as infrastructure). The data on these factors are missing in the majority of countries in the region. Thus we have tried to explicitly test the linkages between TFP growth in agriculture and various aspects of development such as international trade (openness variable which is defined as the ratio of total exports and imports to GDP), the percentage of rural population of total population, GDP and foreign direct investment over GDP. Unfortunately we have found that all these variables are not significant in both fixed-effect model and random-effect model.

5. Conclusions and Policy Recommendations

This paper analyses agricultural productivity growth in MENA countries over the period 1970-2000 using a nonparametric Malmquist index. Our findings weaken the previous results indicating the decline of agricultural productivity in developing countries. Our estimations show that measured agricultural productivity in MENA countries is generally increasing, especially during 1991-2000, with technical change being the main source for this growth. However this result is not uniform across the entire MENA region. Indeed fourteen countries are characterized by productivity gains while seven others exhibit productivity losses. Declining productivity seems to affect countries, suffering from wars such as Iran, Iraq and Kuwait. The performance of the global region is better during the 1990s than in the previous two decades.

This result may also mean that any stagnation in innovations or technical progress, perhaps due to political, economic or social conditions, would cause a decline in total factor productivity growth in agriculture in the region. The three phenomena – low levels of technology, high population growth and high levels of rural poverty – are interrelated. Low levels of technology in conjunction with high population growth induce low levels of food supply. This in turn may adversely affect both the rural and urban sector. On the one hand, the rural sector may receive higher prices, but the reduction in output will more than likely offset this and lead to lower real income. The urban sector more unambiguously faces higher food prices and lower real income. Thus the importance of introducing technological innovations and greater efficiency in developing countries can hardly be overstated, particularly in terms of poverty reduction (Thirtle et al. (2002)).

Sustained growth in agricultural productivity will induce several positive feedbacks. First, the release of valuable resources for other sectors thereby generating further economic growth. Second, higher levels of agricultural productivity would reduce food prices and therefore increase consumers’ welfare. And finally, in the context of an open economy, productivity growth would improve the competitive position of a country’s agricultural sector. TFP growth in MENA region during the period 1970-2000 is mainly attributed to changes in technical component. But agricultural productivity also critically depends on the efficiency of farmers.

One of the main objectives of this study is to help policy-makers design optimal policies enhancing agricultural productivity and food security. Such policies will be based on the improvement of the infrastructure (such as irrigation, roads and electricity) and training to improve farmer’s technical efficiency, as well as technology in the form of research and development. Higher TFP would imply a shift in the production possibilities frontier of the agricultural sector away from the origin, leading to higher output from the application of technology and better utilization of resources. Ultimately, higher TFP would reduce the levels of poverty in the rural sector and migration.

Thus, on the basis of our findings, we suggest to policy makers to complement the technical changes, which explain the productivities growth in the MENA region, with technologies likely to promote the efficient use of the different inputs – mainly labor per unit areas.

We would like to point out that the negative productivity trends indicated by previous studies are not the product of the used methods but rather the result of the inappropriate sample of countries included in their empirical investigations. Indeed our findings are the result of our choice of a homogeneous region, made up of countries sharing the same geographical, economic, and social characteristics.

In terms of future research, our analysis has focused entirely on nonparametric productivity measurement. Though the results are quite plausible and meaningful, we are quite conscious of the data limitations and the need for further work in this area. Future work should include: (i) an investigation of the effects of other factors such as land quality, irrigation and rainfall; and (ii) the utilization of parametric or semi parametric distance functions to study the robustness of the findings to the choice of methodology.

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Figure 1: Annual Mean Efficiency Change, Technical Change and TFP Change

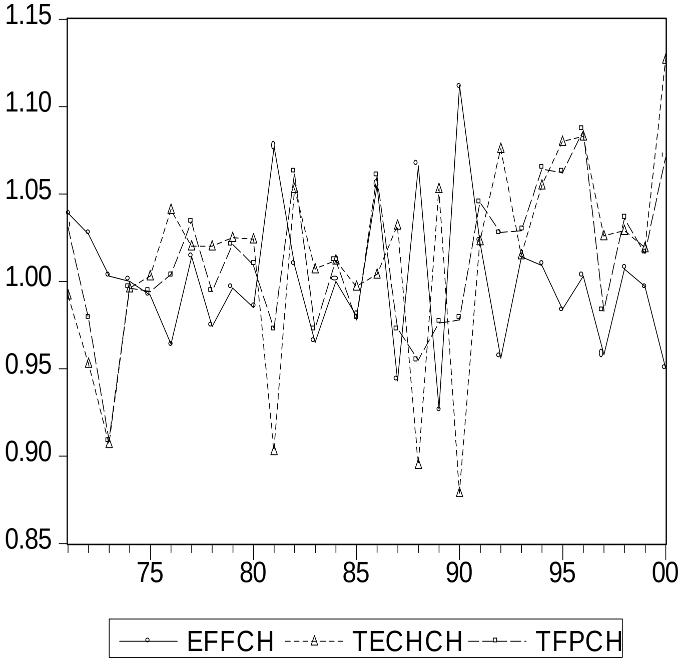

Table 1: Some Indicators of Agriculture for MENA Countries

Country	Share of Agr. in GDP (%)		Country's share in total agriculture added value	
	1970	2000	1970	2000
Algeria	9.21	8.77	4.01	4.87
Bahrain	0.98[a]	0.86[b]	-	-
Egypt	29.42	16.70	16.52	17.15
Iran	11.90[c]	15.11	-	16.88
Iraq	-	-	-	-
Israel	-	-	-	-
Jordan	11.64	2.26	0.58	0.18
Kuwait	0.28	0.43[b]	0.06	-
Lebanon	-	11.92	-	1.99
Libya	2.39	5.04[d]	0.78	-
Mauritania	29.27	21.94	0.49	0.20
Morocco	19.93	13.83	6.71	5.09
Oman	15.54	3.31[e]	0.33	-
Qatar	-	-	-	-
Saudi Arabia	4.54	4.94	1.93	10.32
Sudan	43.61	41.15	6.82	5.01
Syria	20.16	22.65	3.67	4.52
Tunisia	17.03	12.35	2.08	2.66
Turkey	39.54	15.36	55.95	29.29
UAE	0.83[f]	2.09[e]	-	-
Yemen	-	14.07	-	1.46
Mean	12.61	11.12	-	-

[a] The value corresponds to the year 1980

[b] The value corresponds to the year 1995

[c] The value corresponds to the year 1974

- = not available

[d] The value corresponds to the year 1987

[e] The value corresponds to the year 1992

[f] The value corresponds to the year 1975

Source: WDI (2004) database.

Table 2: Technical Efficiency under Constant Returns-to-Scale in Selected Years, by Country.

Country	**1970**	**1980**	**1990**	**2000**
Algeria	0.835	0.590	0.956	0.778
Bahrain	1.000	1.000	0.914	0.925
Egypt	0.890	0.802	0.981	0.842
Iran	1.000	0.874	0.941	0.930
Iraq	0.915	0.890	1.000	0.439
Israel	0.874	0.889	0.996	0.784
Jordan	0.402	0.639	1.000	0.942
Kuwait	1.000	1.000	1.000	1.000
Lebanon	0.695	1.000	0.940	1.000
Libya	0.996	0.852	0.932	1.000
Mauritania	1.000	1.000	0.983	0.788
Morocco	0.736	0.620	0.928	0.810
Oman	1.000	1.000	1.000	0.862
Qatar	0.706	0.741	0.929	1.000
Saudi Arabia	0.985	1.000	0.967	0.908
Sudan	1.000	1.000	0.945	0.982
Syria	0.924	0.954	0.954	0.814
Tunisia	0.515	0.663	0.947	0.892
Turkey	1.000	0.817	0.936	0.709
United Arab Emir.	1.000	1.000	0.952	1.000
Yemen	1.000	0.791	0.912	0.966
Mean	0.880	0.863	0.958	0.875

Table 3: Productivity Index and Components, 1970-2000

Country	Efficiency change (EFFCH)	Technical change (TECHCH)	TFP change (TFPCH)
Algeria	0.998	1.028	1.025
Bahrain	0.997	0.979	0.977
Egypt	0.998	1.022	1.020
Iran	0.998	0.983	0.981
Iraq	0.976	1.012	0.988
Israel	0.996	1.025	1.021
Jordan	1.029	1.020	1.049
Kuwait	1.000	0.988	0.988
Lebanon	1.012	1.023	1.036
Libya	1.000	1.034	1.034
Mauritania	0.992	0.994	0.986
Morocco	1.003	1.020	1.023
Oman	0.995	0.993	0.988
Qatar	1.012	1.026	1.038
Saudi Arabia	0.997	0.997	0.994
Sudan	0.999	1.015	1.015
Syria	0.996	1.012	1.007
Tunisia	1.018	1.015	1.034
Turkey	0.989	1.016	1.004
United Arab Emir.	1.000	1.001	1.001
Yemen. Rep.	0.999	1.011	1.009
Mean	1.000	1.010	1.010

Table 4: Productivity Index for 1970-2000 and Sub-periods

Country	1970-2000	1970-1980	1981-1990	1991-2000
Algeria	1.025	1.002	1.033	1.036
Bahrain	0.977	0.990	0.939	1.071
Egypt	1.020	1.012	1.015	1.037
Iran	0.981	0.934	0.978	1.028
Iraq	0.988	0.986	1.022	0.961
Israel	1.021	1.027	1.009	1.025
Jordan	1.049	1.061	1.045	1.039
Kuwait	0.988	0.959	0.977	1.036
Lebanon	1.036	1.068	0.991	1.051
Libya	1.034	1.018	1.006	1.082
Mauritania	0.986	0.983	0.949	1.013
Morocco	1.023	0.994	1.036	1.034
Oman	0.988	0.974	0.960	1.040
Qatar	1.038	1.026	0.962	1.107
Saudi Arabia	0.994	0.941	1.023	1.043
Sudan	1.015	1.012	0.980	1.043
Syria	1.007	1.023	0.968	1.034
Tunisia	1.034	1.031	1.039	1.029
Turkey	1.004	0.980	1.016	1.007
United Arab Emir.	1.001	0.953	0.946	1.117
Yemen	1.009	0.966	1.023	1.043
Mean	1.010	0.996	0.996	1.041

Table 5: Annual Mean Efficiency Change, Technical Change and TFP Change, 1970-2000

Year	Efficiency change	Technical change	TFP change
1971*	1.039	0.992	1.031
1972	1.027	0.953	0.979
1973	1.003	0.907	0.909
1974	1.000	0.996	0.996
1975	0.992	1.003	0.994
1976	0.964	1.041	1.004
1977	1.014	1.020	1.034
1978	0.974	1.020	0.994
1979	0.996	1.025	1.021
1980	0.985	1.024	1.009
1981	1.077	0.903	0.973
1982	1.009	1.053	1.062
1983	0.965	1.007	0.973
1984	1.000	1.012	1.012
1985	0.980	0.997	0.978
1986	1.055	1.004	1.060
1987	0.943	1.032	0.973
1988	1.066	0.895	0.955
1989	0.927	1.053	0.976
1990	1.112	0.879	0.978
1991	1.022	1.023	1.045
1992	0.956	1.076	1.028
1993	1.014	1.015	1.029
1994	1.009	1.055	1.064
1995	0.984	1.080	1.062
1996	1.003	1.083	1.086
1997	0.958	1.026	0.983
1998	1.007	1.029	1.036
1999	0.997	1.019	1.016
2000	0.950	1.127	1.071
Mean	1.000	1.010	1.010

* Note that 1971 refers to the change between 1970 and 1971.