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# Impact of Total Factor Productivity and Employment on Economic Growth: A Case Study of Saudi Arabia

Imad Eldin E. Abdel Karim Yousif[1*] and Kamaleldin Ali Bashir[1]

[1]Department of Agricultural Economics, College of Food and Agricultural Sciences, King Saud University, Saudi Arabia

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***Corresponding author:** Imad Yousif

## Abstract

The objective of this paper is to analyze the impact of total factor productivity and employment level on economic growth of Saudi Arabia. The data used in the analysis is a time series data covering the period 2005-2019, and a semi-log regression model was estimated. The results showed that real GDP growth is fluctuating during the study period depending on oil price level. The total factor productivity in Saudi Arabia lagged behind that of many emerging economies. The model results revealed that the total factor productivity is more important for economic growth than increasing the size of the labor force. The paper recommends policymakers seeking to foster economic growth in Saudi Arabia, to put more emphasis on improving productivity of capital inputs and labor through adoption of proper technologies, training, and research and development.

**Keywords**: Economic growth, total factor productivity, employment, Saudi Arabia.



## INTRODUCTION

Economic growth is a major objective for countries all over the world. Factor productivity and quantity of inputs (labor and capital) employed in the production process are arguably the main drivers of economic growth. If the number of employed people increases, more goods and services would be produced. Over time, due to a rise in population, labor employed increases and, due to accumulation, capital also increases in an economy. A rise in productivity enables an economy to grow faster with the same set of labor and capital being employed (Alejandro, 2017). Rising productivity is related to increased profitability, lower costs, and sustained competitiveness.

The concept of total factor productivity (TFP) defined as the ratio between real product and real factor inputs was first discussed by Tinbergen (1942) and Stigler (1947). Later on, Solow (1957) [[1]] developed an empirical method for decomposing economic growth based on the contribution of the primary factors of production (capital and labor) and the efficiency with which they are used (see Chen (2002) for an illustration of the econometric approach). Solow (1957) concluded that for most nations economic growth was attributable to technical change, or total factor productivity growth, which he proposed measuring as a residual, based on a production function approach. Therefore, Productivity is the cornerstone of economic growth.

The change in (TFP) is an important concept in economics because it measures the ability of firms, industries, and national economies to increase the aggregate volume of output produced relative to the aggregate volume of inputs used. Derived as a ratio of total production and weighted average of inputs such as labor and capital, TFP provides a measure for growth in real output. The TFP represents the relationship between the quantity of factors employed and the output in an economy. A higher TFP implies higher growth with the same set of labor and capital employed.

Rodrigo (2006) decomposed the sources of growth into a "perspiration" component, corresponding to factor accumulation, and an "inspiration" component, corresponding to productivity gains. Inspiration can lead to sustained higher GDP growth indicating the

[1] Other authors, however, have defined and measured TFP; see Griliches (1996) for an interesting historical treatise on empirical development in TFP.

importance of productivity growth measurement. Productivity growth slowdown and ageing of population are considered two factors affecting Euro area economic growth since 2008; both of these shocks generate demand and supply-side effects leading to a substantial decline in GDP growth, a sizeable fall in inflation, and a drop-in interest rate (Romanos, 2016). Prochniak (2016) showed that changes in productivity played an important role in Poland's economic growth and helped improve the relative competitive position of the Polish economy with regard to other Central and Eastern European countries.

Human capital, in the form of level of education has an important effect on TFP because of its role as a determinant of an economy's capacity to carry out technological innovations and for developing countries in particular, to adopt foreign technology (Romer, 1990 cited by Heshmati *et al.* 2016). Primary and higher education affect TFP in different ways. The former is important for learning-capacity and using information, while the latter is necessary for technological innovations (Isaksson, 2007 cited by Heshmati *et al.* 2016).

Taking Saudi Arabia as a case study, the main question of this paper is whether to concentrate on improvement of TFP through development of human capital and research or to increase the level of employment in the economy to drive economic growth in the future. The main objective of the paper, therefore, is to analyze the impact of TFP and employment rate on economic growth. Achieving this objective is important for policymakers in Saudi Arabia to make a balance between improving productivity and increasing labor force in the economy. This is particularly relevant as Saudi Arabia is adopting plans targeting employment of its youth population through training, increasing women participation in its labor force, and Saudization schemes.

The Saudi economy is the largest in Arab world and one of the top 20 economies in the world. Saudi Arabia's economy is highly dependent on the oil sector as a major source of income. In 2016 the country started a reform process to diversify its economy through Saudi Vision 2030. The economic goals under the Vision aim at increasing the share of non-oil exports to 50% of government revenues, growing the share of the private sector in the domestic economy from 40% to 65%, and ensuring that small and medium enterprises constitute a significant amount of this increase by accounting for 35% of private entities, all by the target date of 2030 (Saudi Vision 30). Implementation of Saudi Vision 2030 so far made progress on economic diversification, particularly regarding labor force participation of women, mobilization of non-oil revenues, and services-led growth (World Bank, 2020). The Saudi economy fell into a deep recession in 2020 in the aftermath of the twin shocks of COVID-19 and lower oil prices, creating large shortfalls in fiscal and external positions. While the impact of COVID-19 on the oil sector has accelerated the urgency to delink the path of the economy from the oil sector, the pandemic is also likely to change the nature of the services-led growth model in many countries, and oil will remain a valuable asset to finance the transformation and adaptation to this emerging model (World Bank, 2020).

## RESEARCH METHOD

A multiple regression analysis was applied to achieve the objectives of the paper. The variables included in the model are real gross domestic product (RGDP), total factor productivity (TFP) and employment level (EMP). Different forms of regression models (linear and nonlinear) have been tested to choose the most appropriate model that best fit the data. The results showed that the semi-logarithmic functional form provided the best fit for the variables included in analysis. The semi-logarithmic functional form is commonly used in econometrics because its coefficients represent useful concepts that are easily interpreted and measure the growth rate over a longer period of time. The regression model used is represented by the following equation:

$$Log(RGDP) = c + b_1 emp + b_2 TFP + e \quad (1)$$

Where c, $b_1$, and $b_2$ are coefficients to be estimated and e is the error term.

The data used in the analysis is a time series data covering the period 2005-2019. The data for real GDP, employment level, and TFP were collected from Penn World Table version 10.0 database (www.ggdc.net/pwt) which collects information on relative levels of income, output, input and productivity covering 183 countries between 1950 and 2019. The construction of the data on real GDP capital and productivity in PWT8.0 are discussed in detail in Feenstra *et al*. (2013) and Inklaar and Timmer (2013).

## RESULTS AND DISCUSSION

### Performance of Saudi Economy (2005-2019)

Table 1 and Figure 1 show the development of real GDP, number of employed people and total factor productivity for Saudi Arabia during 2005-2019. The annual variation of real GDP is used as a measure for economic growth. Real GDP performance of Saudi Arabia is fluctuating during the study period ranging from a high growth rate of 28% in 2011, due to increase of oil prices, to a contraction or negative growth of 10% in 2015 mainly due to a sharp decline in oil prices. This reflects the high dependency of the Saudi economy on oil exports (see also Yousif *et al.*, 2018). However, on average, the real GDP has grown by 6.4% during the study period.

With regards to creating jobs in the economy, it is obvious from the data in Table 1 that the number of employed people is increasing annually, on average, by 5.9%. The most recent employment data from the Saudi General Authority for Statistics (GASTAT) in 2021 shows that the unemployment rate of total working age population (Saudis and non-Saudis who are 15 years and above) decreased to 6.5% in the first quarter of 2021, compared to 7.4% during the last quarter of 2020. The country's labor force participation increased from 41% in 2013 to 61% in 2020 (CEIC data: https://www.ceicdata.com) possibly due to increased women participation and expansion of Saudization in labor market. CEIC data shows that labor productivity in Saudi Arabia has improved in 2020 from minus 6% to minus 3.59% in 2019.

The TFP level in Saudi Arabia is generally lower than one for the covered period averaging 0.75, reflecting more or less inefficient use of inputs and technology. TFP is relative productivity which under perfect competition can reflect relative technology (Feenstra *et al.*, 2015). Estimating growth in total factor productivity is difficult, but it is essential for assessing countries' past and potential economic performance (PREMnotes 42, 2000). Gains in TFP reflect more efficient use of inputs. The data in Table 1 shows variability in the TFP growth rate path in Saudi Arabia ranging from positive growth rate of 18% in 2011 to negative growth rate of 17% in 2009. This reflects inconsistent efficiency in the use of inputs and technology. The average productivity growth rate of 0.7% from 2005 to 2019 lagged behind that of many emerging economies. Saudi Arabia did not close the productivity gap with the US, the world productivity leader, but fell further behind.

**Table-1: Development of real GDP, employment, and TFP of Saudi Arabia (2005-2019)**

| year | Real GDP (Billion Saudi Riyal [1] SR) | Annual growth rate (%) | Employment level (million) | Growth rate (%) | TFP level at current PPPs (US=1) * | Growth rate (%) |
|---|---|---|---|---|---|---|
| 2005 | 763.5 | - | 7.20 | | 0.73 | |
| 2006 | 895.6 | 17.3 | 7.60 | 5.6 | 0.76 | 4.1 |
| 2007 | 993.9 | 11.0 | 7.84 | 3.2 | 0.74 | -2.6 |
| 2008 | 1249.9 | 25.8 | 8.07 | 2.9 | 0.85 | 14.9 |
| 2009 | 1134.0 | -9.3 | 8.24 | 2.1 | 0.70 | -17.6 |
| 2010 | 1390.0 | 22.6 | 8.93 | 8.4 | 0.76 | 8.6 |
| 2011 | 1778.5 | 28.0 | 10.04 | 12.4 | 0.90 | 18.4 |
| 2012 | 1894.2 | 6.5 | 10.37 | 3.3 | 0.94 | 4.4 |
| 2013 | 1881.5 | -0.7 | 10.80 | 4.1 | 0.90 | -4.3 |
| 2014 | 1901.9 | 1.1 | 11.10 | 2.8 | 0.94 | 4.4 |
| 2015 | 1710.1 | -10.1 | 11.48 | 3.4 | 0.80 | -14.9 |
| 2016 | 1605.0 | -6.1 | 12.16 | 5.9 | 0.72 | -10.0 |
| 2017 | 1604.8 | 0.0 | 12.87 | 5.8 | 0.73 | 1.4 |
| 2018 | 1732.8 | 8.0 | 13.38 | 4.0 | 0.78 | 6.8 |
| 2019 | 1775.7 | 2.5 | 13.74 | 2.7 | 0.76 | -2.6 |
| Average | 1487.4 | 6.4 | 10.2 | 4.4 | 0.75 | 0.7 |

**Source:** Penn World Table, version 10.0 database (www.ggdc.net/pwt).
PPP: purchasing power parity.
[1]one USD = 3.75 SR.

[*]TFP level at current PPPs (US=1) tracks total factor productivity (TFP) levels at constant purchasing power parity (PPP) rates for Saudi Arabia, relative to the US in terms of the prices in that period (i.e, current prices).

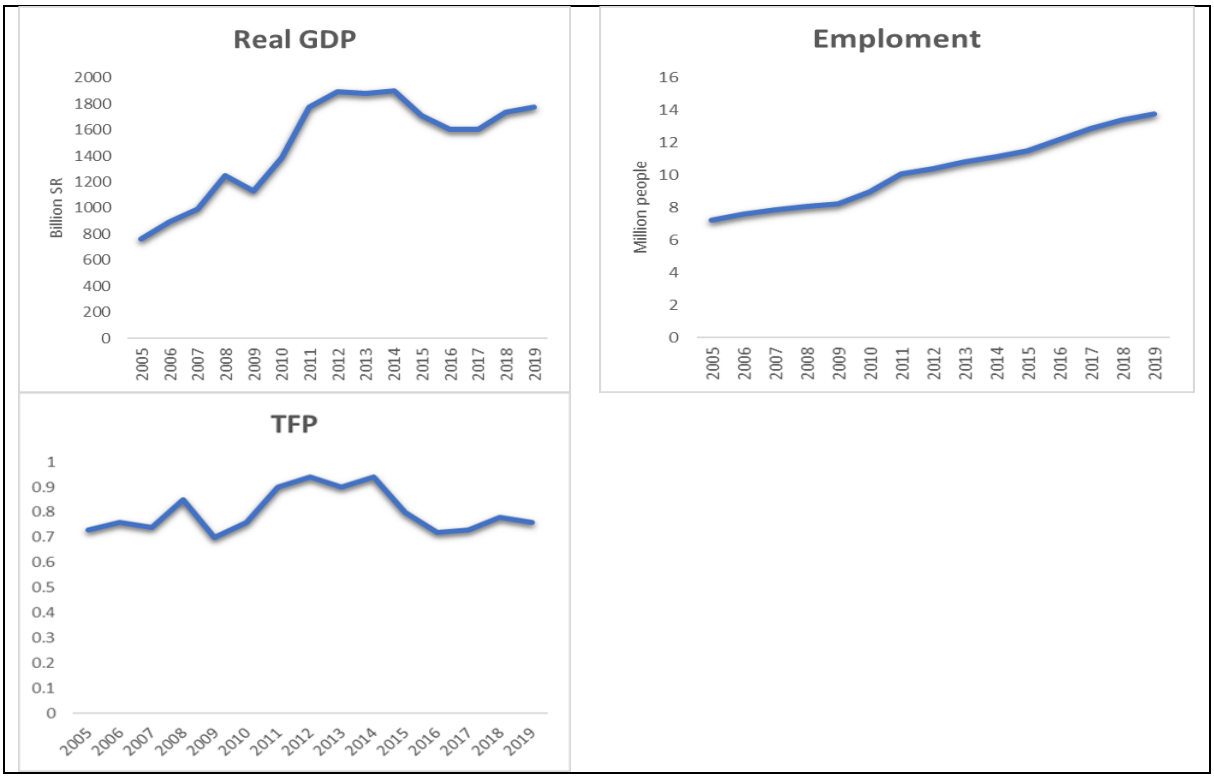


**Fig-1: Development of real GDP, employment and TFP of Saudi Arabia (2005-2019)**
**Source:** data in table 1

**Semi-log Regression Model Results**

The results of semi-log regression analysis are presented in table (2) and equation (2). The model results provide a good fit of the data with high adjusted R-square (0.89) and significant F-statistics. For statistical accuracy of estimated regression model, a number of diagnostic tests are performed on the residuals. As indicated by the results in Table 3, the residuals of the estimated model have no trace of autocorrelation or heteroskedasticity and are normally distributed. Therefore, we can consider the model a white noise and its results can be used as a basis for analytical and policy making purposes.

$$Log(RGDP) = 11.6 + 0.10\ emp + 1.82\ TFP \qquad (2)$$
(7.8) (5.3)
Adjusted R-squared = 0.89
F-statistic = 48.8

**Table-2: Semi-log regression analysis results: dependent variable (RGDP).**

| Variables | Coefficient | Elasticity* | Standard error | t- value | P- value |
|---|---|---|---|---|---|
| Constant (c) | 11.6 | | 0.295 | 39.48 | 0.00 |
| Employment (EMP) | 0.10 | 1.02 | 0.013 | 7.80 | 0.00 |
| Total factor productivity (TFP) | 1.82 | 1.36 | 0.344 | 5.30 | 0.00 |
| Adjusted R-squared | | 0.89 | | | |
| F-statistic | | 48.8 | | | 0.00 |

* Elasticity is calculated from the estimated coefficients of semi-log function by the following formula: $E = b.\bar{X}$ , where $\bar{X}$ is the mean value for the respective variables.

**Table-3: Diagnostic of the model error term**

| **Breusch-Godfrey Serial Correlation LM Test: Null: $H_0$: residuals are not serially correlated** | | | |
|---|---|---|---|
| statistic | value | | P-value |
| F-statistic | 1.45 | Prob. F(3,9) | 0.29 |
| R-squared | 4.89 | Prob. Chi-Square | 0.17 |
| Heteroskedasticity Test: ARCH Null: $H_0$: residuals are not heteroskedastic | | | |
| F-statistic | 1.65 | Prob. F(3,8) | 0.25 |
| R-squared | 4.60 | Prob. Chi-Square | 0.20 |
| Normality test Null: $H_0$: residuals are normally distributed | | | |
| Jarque-Bera | | | 0.96 |

The model results show that increments in labor force and improvement in productivity have positive effect on real GDP and, therefore, economic growth. However, the productivity impact is apparently relatively more important than of increasing labor force in the economy as the coefficient of TFP (1.82) is greater than coefficient of employment in the model (0.10). When the elasticity is calculated for both variables, using the coefficients of equation (2), it follows that improving of productivity by 1% would lead to an increase of real GDP by 1.36% while increasing the number of labor force by 1% would raise real GDP by 1.02%.

Increasing number of labors with low productivity is not an option to foster economic growth, but, a productivity-led transformation of the economy could double economic growth in the country and create more jobs. Policymakers in Saudi Arabia should concentrate on improving productivity of capital inputs and labor to foster economic growth through the use of proper technology, training, and research and development. Faster productivity growth requires better business regulation and more openness to competition, trade, investment, improved efficiency of spending, and new revenue sources.

## CONCLUSIONS

The research question of this paper was which path is better for Saudi Arabia: to concentrate on increasing labor force participation in the economy or improving productivity of inputs used. The results showed that the productivity improvement is more relevant for economic growth than increasing number of labor force in the economy. The paper recommends that Saudi Arabia will be better off if adopting a path to improve productivity of capital inputs and labor through the use of proper technology, labor force training, and research and development. Saudi Arabia should continue implementing initiatives of its 2030 vision which concentrate, among many other issues, on accelerating productivity of factors of production to achieve sustainable economic growth and development and improved competitiveness of the economy.

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