The Multi-Sectoral Determinants (linkages) for The Agricultural Total Factor Productivity in Egypt

Naglaa Ahmed Mohamed Abdelrahman
Assistant-Lecturer,
Dr. Gamal Siam
Professor Emeritus,
Department of Agricultural Economics, Faculty of Agriculture, Cairo University

Dr. Ali Ahmed Ibrahim
Professor, Department of Agricultural Economics
Faculty of Agriculture ,Zagazig University

Dr. Walid Yehia Sallam
Associate professor, Department of Agricultural Economics, Faculty of Agriculture, Cairo University

Abstract

The study aimed at figuring out the sources of growth in the agricultural TFP (Total Factor Productivity) in Egypt. Depending on the multi-sectoral development indicators published in the World Bank about Egypt. This was achieved through: first, illustrating the correlation between the TFP and the groups of development indicators; using the correlation coefficient matrix. Second, selecting the highly correlated indicators with the TFP and conducting multiple regressions. The indicators were divided into 3 groups according to data availability; 54 years (1961-2014), 44 years (1971-2014), and 25 years (1990-2014). As for the 54-year-analysis, the relationship among the TFP in the Egyptian agricultural sector and each of Gross Domestic Saving (GDS), and official exchange rate (OER) is positive and statistically significant. But, the relationship between the TFP and the Agri-row-material exports (ARMEX) is negative and statistically insignificant. As for the 44-year-analysis, the relationship among the TFP and each of net official development assistance (NODA), electric power consumption (EPC), and imports of goods and services (IMGS) were positive and statistically significant. But, the relationship between the TFP and the fossil fuel energy consumption (FFEC) is negative and statistically insignificant. As for the 25-year-analysis, the relationship among the TFP and each of Research and Development (RD), Rail lines (RL), and foreign direct investment inflows (FDII) were positive and statistically significant. But, the relationship between the TFP and the taxes on exports (TOEX) is negative and statistically significant.

Summary

The study aimed at figuring out the sources of growth in the agricultural TFP in Egypt. Depending on the multi-sectoral development indicators published in the World Bank about Egypt. These sectors were agriculture and rural development, aid effectiveness, climate change, economy and growth, gender, public sector, private sector, poverty, infrastructure, science and technology, public health, social protection and labor, trade, urban development, environment, financial sector, external dept., and finally education. They were used to figure out more explanatory variables the influence the agricultural TFP in Egypt.

This was achieved through:

- Illustrating the correlation relationship among the TFP and the above mentioned groups of indicators; using the simple correlation coefficient matrix.

- Selecting the highly correlated indicators with the TFP and conducting an in depth analysis (multiple regression) to get a closer insight into the relation of the agricultural TFP and these multi-sectoral indicators. However, in this step, the indicators were divided into 3 groups according to data availability; 54 years (1961-2014), 44 years (1971-2014), and 25 years (1990-2014).

As for the 54-year-analysis, the relationship among the TFP in the Egyptian agricultural sector and each of Gross Domestic Saving (GDS), and official exchange rate (OER) is positive and statistically significant. But, the relationship between the TFP and the Agri-row-material exports (ARMEX) was negative and statistically insignificant. As for the 44-year-analysis, the relationship among the TFP and the each of net official development assistance (NODA), electric power consumption (EPC), and imports of goods and services (IMGS) were positive and statistically significant. But, the relationship between the TFP and the fossil fuel energy consumption (FFEC) was negative and statistically insignificant. As for the 25-year-analysis, the relationship among the TFP and the each of Research and Development (RD), Rail lines (RL), and foreign direct investment inflows (FDII) were positive and statistically significant. But, the relationship between the TFP and the taxes on exports (TOEX) was negative and statistically significant.

The study highlights the :

- importance of Official exchange rate and its relative stability on the TFP growth as well as merchandise imports when it's relatively advanced technology as trade in this case works as a carrier of knowledge.
- Supporting export-oriented-activities that increase the value added, but not the raw materials.
- Redirecting and encouraging the ODA to agriculture, Loans should be kept to its minimum values to limit indebtedness levels and not burden the country with heavy external debts. Better management and coordination of external assistance will increase the positive impact and efficiency of aid system. Raising technical and financial support will improve the performance of projects financed by donors. Also, maximizing the utilization of external financial resources will make positive impacts on the national development capacity of Egypt.
- Fragmented aid that comes in many small slices from a large number of donors – creates high transaction costs and makes it difficult for partner countries effectively to manage their own development. Aid fragmentation also increases the risk of duplication and inefficient aid allocation among donors.
- Conducting development plans that are specific to each governorate especially those which receive lower proportions of assistance.
- Infrastructure is not only very important for productivity growth but even triggers it. However, it is important to closely monitor its management and financing. production of electricity.
- Strengthening the role of agricultural institutions and giving high attention to agricultural labor training programs either the domestically funded or the internationally funded.

- Adopting more efficient use of fossil fuel ; following the maintenance schedules of agricultural machinery, using energy-saving machinery, as well as fixing and constructing viable roads for efficient transport; this idea could be transmitted to rural areas through media alongside with agricultural extension.
- Rural transport services enhancement through: addressing inefficiencies and monopolistic practices of rural transport operators; improving efficiency of overall post-harvest storage and marketing operations; Improve load consolidation practices to reduce costs and increase bargaining power for farmers; Developing modern agricultural supply chains, particularly for high-value export crops and to meet demand of proliferating supermarkets; Increasing resilience to climate impacts, including through rural road improvements; and Establishing farmer's associations or cooperatives to lower the price of transport by arranging and purchasing farm inputs (such as fertilizer) in bulk
- Improving water resources in rural areas through.
    1. Ensure water supply for a secure and economically viable agriculture
    2. Develop new approaches in agricultural water management
    3. Develop pro-poor and affordable agricultural water management
    4. Mitigation of environmental and health impacts of new and existing systems
- Adopting foreign and domestic policies that encourages FDI, as it is a strong growth stimulant and redirecting it to give more priority to the agri-labor training as well as the neglected governorates.
- To avoid the negative repercussions of quantitative export restrictions such as export taxes, it would be useful to have in place an improved, multilaterally agreed regulatory framework governing the use of these measures. The alternatives to a conventional export tax: (1) a consumption subsidy, (2) a production tax, and (3) a modification of a conventional export tax that allows additional exports after producers meet a domestic sales requirement.

Introduction

The agricultural total factor productivity (TFP) growth provides society with opportunities to increase the welfare of people. It is, therefore, worth asking what determinants should policy makers focus on to enhance the performance of the agricultural TFP? This paper attempts to induce the determinants of agricultural productivity growth. It will also investigate to what extent the determinants have implications for policy. Having the calculated TFP as given from the previous work of Abdurrahman, N.et. al. (2018). The development indicators (or determinants) considered here are grouped under 18 headings (segments). They were used to figure out more explanatory variables the influence the agricultural TFP in Egypt. These are:

agriculture and rural development, aid effectiveness, climate change, economy and growth, gender, public sector, private sector, poverty, infrastructure, science and technology, public health, social protection and labor, trade, urban development, environment, financial sector, external dept., and finally education.

The research problem is that there has not been enough work on both areas of agricultural TFP in or the determinants of TFP growth in Egypt. All the previous work has highlighted the need for more studies in both areas.

The research broad objective is to figure out the sources of growth in the agricultural TFP in Egypt. This could be achieved through:

- Illustrating the direction and strength of the correlation relationship among the TFP and the above mentioned groups of indicators.
- Selecting the highly correlated indicators with the TFP and conducting an in depth analysis to get a closer insight into the relation of the agricultural TFP and these multi-sectoral indicators.

Data sources and Methodology:

Data sources:

The study depended mainly on the data for the development indicators published in the World Bank. These indicators were categorized into 18 groups as follows: agriculture and rural development, aid effectiveness, climate change, economy and growth, gender, public sector, private sector, poverty, infrastructure, science and technology, public health, social protection and labor, trade, urban development, environment, financial sector, external dept., and finally education.

The agricultural TFP in Egypt was already calculated in the work of Abdurrahman, N. et. al.(2018).

Methodology:

- The correlation coefficient matrix was applied to illustrate the correlation between the TFP and the above mentioned groups of indicators.
- Each indicator that had a correlation coefficient with the TFP that is greater than or equal to -0.5 or +0.5 was selected for running a multiple regression between agricultural TFP as a dependent variable and all the highly correlated indicators as explanatory variables. However, this second step was executed differently due to data availability of the mentioned indicators. There were divided into 3 groups according to data availability; 54 years (1961-2014), 44 years (1971-2014), and 25 years (1990-2014).
- The stationarity of each indicator in each group of data was tested using Augmented Dickey Fuller (ADF) test Eviews software.
- The serial correlation was tested using Durbin Watson and Breusch-Godfrey Serial Correlation LM Test using Eviews software.
- Heteroskedasticity was tested using Breusch-Pagan-Godfrey test by Eviews software.

1- **The correlation coefficient matrix**

A correlation is a number between -1 and +1 that measures the degree of association between two variables. A positive value for the correlation implies a positive association (large values of X tend to be associated with large values of Y and small values of X tend to be associated with small values of Y). A negative value

for the correlation implies a negative or inverse association (large values of X tend to be associated with small values of Y and vice versa). The correlation is computed as:

$$r = \frac{\sum_{i-1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{(n-1)S_X S_Y}$$

The correlation coefficient measures the strength of a linear relationship between two variables. The correlation coefficient is always between -1 and +1. The closer the correlation is to +/-1, the closer to a perfect linear relationship. Here is how I tend to interpret correlations.

- -1.0 to -0.7 strong negative association.
- -0.7 to -0.3 weak negative association.
- -0.3 to +0.3 little or no association.
- +0.3 to +0.7 weak positive association.
- +0.7 to +1.0 strong positive association.

2- **Unit root test, Augmented Dickey Fuller (ADF)**

augmented Dickey–Fuller test (ADF) tests the null hypothesis that a unit root is present in a time seriessample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. The testing procedure for the ADF test is the same as for the Dickey–Fuller test but it is applied to the model

The unit root test for a variable (Y) can be expressed as follows:

$$\Delta LY = B_1 + B_2 + B_3 L Y_{t-1} + u_t$$

We regress the first differences of the log of (y) on the trend variable and the one-period lagged value of the (y). The null hypothesis is that B_3, the coefficient of LY_{t-1}, is zero.This is called the unit root hypothesis. The alternative hypothesis is: $B_3 < 0$. A non-rejection of the null hypothesis would suggest that the time series under consideration is non-stationary.

We use the τ (tau) test, also known as the Dickey-Fuller (DF) test, whose critical values are calculated by simulations and modern statistical packages, such as EVIEWS and STATA.

Add the lagged values of the dependent variable as follows:

$$\Delta LY_t = B_1 + B_2 t + B_3 LY_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta LY_{t-i} + \varepsilon_t$$

The DF test can be performed in three different forms:

Random walk : $\Delta LY_t = B_3 LY_{t-1} + u_t$

Random walk with drift : $\Delta LY_t = B_1 + B_3 LY_{t-1} + u_t$

Random walk with drift around a deterministic trend : $\Delta LY_t = B_1 + B_2 t + B_3 LY_{t-1} + u_t$

- The error term in the Dickey-Fuller test usually has autocorrelation, which needs to be removed if the result is to be valid. The main way is to add lagged dependent variables until the autocorrelation has been mopped up.
- The test is the same as before in that it is the coefficient on the lagged dependent variable that is tested.
- The test is as follows, where the number of lagged dependent variables is determined by an information criteria:

$$\Delta y_t = \beta y_{t-1} + \sum_{i=0}^{N} \Delta y_{t-i} + u_t$$

- When a variable contains two unit roots, it is said to be I(2) and needs to be differenced twice to induce stationarity.
- When using the ADF test, the data is first tested to determine if it contains a unit root, i.e. it is I(1) and not I(0)
- If it is not I(0), it could be I(1), I(2) or have a higher order of unit roots
- In this case the ADF test needs to be conducted on the differenced variable to determine if it is I(1) or I(2). (It is very rare to find I(3) or higher orders).
- Software: Eviews

1- draw a line graph of the variable to determine with type of randome walk it is (random walk, RW with drift, or RW with trend)

2- view – unit root tests – Augmented Dicky Fuller Test- choose the unit root type

3- test results interpretation: if the p-value is > .05 then it is non- significant then we accept the null hypothesis that there is a unit root.

4- Durbin Watson

A test that the residuals from a linear regression or multiple regression are independent. Because most regression problems involving time series data exhibit positive autocorrelation, the hypotheses usually considered in the Durbin-Watson test areH0: p = 0, H1: p = 1, and the test statistic is:

$$\mathbf{d} = \frac{\sum_{i=2}^{n} (\mathbf{e_i} - \mathbf{e_{i-1}})^2}{\sum_{i=1}^{n} \mathbf{e_i^2}}$$

whereei = yi – ^yi and yi and ˆyi are, respectively, the observed and predicted values of the response variable for individual i. d becomes smaller as the serial correlations increase. Upper and lower critical values, dU and dL have been tabulated for different values of k (the number of explanatory variables) and n. If d <dL reject H0 ; If d >dU do not reject H0 ; If dL< d <dU test is inconclusive.

4- Breusch-Godfrey Serial Correlation LM

The Breusch–Godfrey serial correlation LM test is a test for autocorrelation in the errors in a regression model. It makes use of the residuals from the model being

considered in a regression analysis, and a test statistic is derived from these. The null hypothesis is that there is no serial correlation of any order up to *p*.The test is more general than the Durbin–Watson statistic (or Durbin's *h* statistic), which is only valid for nonstochasticregressors and for testing the possibility of a first-order autoregressive model (e.g. AR(1)) for the regression errors.The BG test has none of these restrictions, and is statistically more powerful than Durbin's *h* statistic.

Consider a linear regression of any form, for example

$$Y_t = \beta_1 + \beta_2 X_{t,1} + \beta_3 X_{t,2} + u_t$$

where the errors might follow an AR(*p*) autoregressive scheme, as follows:

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \varepsilon_t.$$

The simple regression model is first fitted by ordinary least squares to obtain a set of sample residuals u^t{\displaystyle {\hat {u}}_{t}}Breusch and Godfrey proved that, if the following auxiliary regression model is fitted

$$\hat{u}_t = \alpha_0 + \alpha_1 X_{t,1} + \alpha_2 X_{t,2} + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \cdots + \rho_p \hat{u}_{t-p} + \varepsilon_t$$

and if the usual R2 statistic is calculated for this model, then the following asymptotic approximation can be used for the distribution of the test statistic

$$nR^2 \sim \chi^2_p,$$

when the null hypothesis: H0: { pi = 0 for all i}

holds (that is, there is no serial correlation of any order up to *p*). Here *n* is the number of data-points available for the second regression, that for$\hat{u}_t$

$$n = T - p,$$

where*T* is the number of observations in the basic series. Note that the value of n depends on the number of lags of the error term (*p*).

Software: Eviews – excute the regression – obtain the results – view – Residual diagnostics - Serial Correlation LM Test.

5- Breusch-Pagan-Godfrey

the Breusch–Pagan test, developed in 1979 by Trevor Breusch and Adrian Pagan,[1] is used to test for heteroskedasticity in a linear regression model.It tests whether the variance of the errors from a regression is dependent on the values of the independent variables. In that case, heteroskedasticity is present. Suppose that we estimate the regression model

$$y = \beta_0 + \beta_1 x + u,$$

obtain from this fitted model a set of values for $\hat{u}$ the residuals. Ordinary least squares constrains these so that their mean is 0 and so, given the assumption that their variance does not depend on the independent variables, an estimate of this variance can be obtained from the average of the squared values of the residuals. If the assumption is not held to be true, a simple model might be that the variance is linearly related to independent variables. Such a model can be examined by regressing the squared residuals on the independent variables, using an auxiliary regression equation of the form $\hat{u}^2 = \gamma_0 + \gamma_1 x + v.$

This is the basis of the Breusch–Pagan test. It is a chi-squared test: the test statistic is distributed $n\chi^2$ with k degrees of freedom. If the test statistic has a p-value below an appropriate threshold (e.g. p<0.05) then the null hypothesis of homoskedasticity is rejected and heteroskedasticity assumed.

If the Breusch–Pagan test shows that there is conditional heteroskedasticity, one could either use weighted least squares (if the source of heteroskedasticity is known) or use heteroscedasticity-consistent standard errors.

Procedure:

Under the classical assumptions, ordinary least squares is the best linear unbiased estimator (BLUE), i.e., it is unbiased and efficient. It remains unbiased under heteroskedasticity, but efficiency is lost. Before deciding upon an estimation method, one may conduct the Breusch–Pagan test to examine the presence of heteroskedasticity. The Breusch–Pagan test is based on models of the type $\sigma_i^2 = h(z_i'\gamma)$

for the variances of the observations where $z_i = (1, z_{2i}, \ldots, z_{pi})$ explain the difference in the variances. The null hypothesis is equivalent to the (p-1) parameter restrictions:

$\gamma_2 = \cdots = \gamma_p = 0.$

The following Lagrange multiplier (LM) yields the test statistic for the Breusch–Pagan test

$$\mathrm{LM} = \left(\frac{\partial \ell}{\partial \theta}\right)^{\mathsf{T}} \left(-E\left[\frac{\partial^2 \ell}{\partial \theta\, \partial \theta'}\right]\right)^{-1} \left(\frac{\partial \ell}{\partial \theta}\right).$$

This test is analogous to following the simple three-step procedure:

Step 1: Apply OLS in the model $y = X\beta + \varepsilon.$ and compute the regression residuals

Step 2: Perform the auxiliary regression $e_i^2 = \gamma_1 + \gamma_2 z_{2i} + \cdots + \gamma_p z_{pi} + \eta_i.$

Always, z could be partly replaced by independent variables x.

Step 3: The test statistic is the result of the coefficient of determination of the auxiliary regression in Step 2 and sample size with $\mathrm{LM} = nR^2$.

The test statistic is asymptotically distributed as χ^2_{p-1} under the null hypothesis of homoskedasticity.

Software: Eviews – excute the regression – obtain the results – view – Residual diagnostics - Heteroscedasticity Tests - Breusch–Pagan test – if (p-value) > 0.05 then we accept the null hypothesis and there is no Heteroscedasticity.

Results and Discussion

The results consist of two main parts. First part is executing the simple correlation coefficient matrix among the TFP and the development indicators with respect to their sector. Then selecting the indicators that had highly simple correlationcoefficients, i.e., that is above +0.5 or -0.5. this paves the way for the second part, which is running a multiple regression among the TFP as a dependent variable and the development indicators as explanatory variables. However, the possible multi sectoral determinants of agricultural TFP in Egypt are presented in

three groups according to data availability and regardless of their sector; 54 years 1961-2014, 44 years 1971-2014, and 25 years 1990-2014.

In this section the simple correlation coefficient matrix was applied to illustrate the correlation between the TFP and the development indicators published in the World Bank. These indicators were categorized into 18 groups as follows: agriculture and rural development, aid effectiveness, climate change, economy and growth, gender, public sector, private sector, poverty, infrastructure, science and technology, public health, social protection and labor, trade, urban development, environment, financial sector, external dept., and finally education.

The agricultural Development segment, there was a relatively strong positive correlation (more than 0.5) among the TFP and Access to electricity, rural 0.95; Agriculture value added per worker 0.98; Agricultural machinery, tractors per 100 sq. km of arable land 0.92; Permanent cropland 0.89; Land under cereal production 0.96; Rural population 0.98. However, there was a relatively strong negative correlation (less than -0.5) among the TFP and Agricultural raw materials imports -0.73; Agricultural raw materials exports -0.53; Agriculture, value added (% of GDP) -0.91; Employment in agriculture -0.69; Employment in agriculture, male -0.83. However, there was a relatively weak negative correlation among the TFP and Rural population (% of total) 0.01; Rural population growth -0.38; Employment in agriculture, female 0.08, Table 1.

Table 1. The simple Correlation coefficient matrix among TFP and agricultural development indicators.

Agricultural Development															
	TFP	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*	*12.*	*13.*	*14.*
TFP	1														
1. Agricultural raw materials exports (% of merchandise exports)	-0.53	1													
2. Agricultural raw materials imports (% of merchandise imports)	-0.73	0.51	1												
3. Rural population (% of total population)	0.01	0.18	-0.05	1											
4. Rural population growth (annual %)	-0.38	0.06	0.38	-0.62	1										
5. Rural population	0.98	-0.51	-0.76	0.05	-0.37	1									
6. Employment in agriculture (% of total employment)	-0.69	0.23	0.52	-0.46	0.53	-0.72	1								
7. Employment in agriculture, male (% of male employment)	-0.83	0.36	0.63	-0.16	0.46	-0.85	0.86	1							
8. Employment in agriculture, female (% of female employment)	0.08	-0.19	-0.11	-0.63	0.24	0.07	0.48	0.03	1						
9. Agriculture, value added (% of GDP)	-0.91	0.66	0.72	0.09	0.18	-0.92	0.54	0.75	-0.19	1					
10. Access to electricity, rural (% of rural population)	0.95	-0.44	-0.76	0.13	-0.54	0.96	-0.75	-0.85	0.02	-0.82	1				
11. Agriculture value added per worker (constant 2010 US$)	0.98	-0.52	-0.75	0.02	-0.33	1.00	-0.71	-0.85	0.08	-0.93	0.94	1			
12. Agricultural machinery, tractors per 100 sq. km of arable land	0.92	-0.59	-0.70	0.09	-0.46	0.92	-0.64	-0.73	0.02	-0.84	0.94	0.91	1		
13. Permanent cropland (% of land area)	0.89	-0.68	-0.68	-0.14	-0.30	0.89	-0.49	-0.71	0.21	-0.90	0.86	0.89	0.92	1	
14. Land under cereal production (hectares)	0.96	-0.60	-0.71	0.06	-0.35	0.95	-0.64	-0.81	0.13	-0.94	0.91	0.95	0.91	0.91	1

Source: Author's calculations using MS.Excel software.

Aid Effectiveness segment, there was a relatively strong positive correlation among the TFP and Net ODA received per capita 0.51; Technical cooperation grants

-0.89. On the other hand, there was a relatively weak negative correlation among the TFP and Grants, excluding technical cooperation -0.18, Table 2.

Table 2. The simple Correlation coefficient matrix among TFP and aid effectiveness indicators.

aid Effectiveness	*TFP*	*1.*	*2.*	*3.*
TFP	**1**			
1. Net ODA received per capita (current US$)	0.51	1		
2. Technical cooperation grants (BoP, current US$)	-0.89	0.46	1	
3. Grants, excluding technical cooperation (BoP, current US$)	-0.18	0.89	0.12	1

Source: Author's calculations using MS.Excel software.

Climate Change segment, there was a relatively strong positive correlation among the TFP and Improved water source (% of population with access) 0.99; Energy use 0.93; Electric power consumption 0.98; Electricity production from renewable sources, excluding hydroelectric % total 0.92; Electricity production from renewable sources, excluding hydroelectric (kWh) 0.90; Access to electricity 0.95. However, there was a relatively strong negative correlation among the TFP and Mortality rate -0.95; Electricity production from oil sources -0.68; Renewable energy consumption -0.94. On the other hand, there was a relatively weak positive correlation among the TFP and Foreign direct investment, net inflows (% of GDP) 0.32. And, there was a relatively weak negative correlation among the TFP and Population growth -0.12, Table 3.

Table 3. The simple Correlation coefficient matrix among TFP and climate change indicators.

Climate Change	*TFP*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*
TFP	1											
1. Population growth (annual %)	-0.12	1										
2. Improved water source (% of population with access)	0.99	-0.15	1									
3. Mortality rate, under-5 (per 1,000 live births)	-0.95	0.35	-0.97	1								
4. Energy use (kg of oil equivalent per capita)	0.93	-0.14	0.92	-0.87	1							
5. Electric power consumption (kWh per capita)	0.98	-0.05	0.99	-0.93	0.96	1						
6. Renewable energy consumption (% of total final energy consur	-0.94	0.12	-0.93	0.89	-0.97	-0.95	1					
7. Electricity production from renewable sources, excluding hydrc	0.92	0.05	0.93	-0.85	0.93	0.97	-0.93	1				
8. Electricity production from renewable sources, excluding hydrc	0.90	0.17	0.91	-0.80	0.89	0.95	-0.88	0.98	1			
9. Electricity production from oil sources (% of total)	-0.68	0.31	-0.75	0.76	-0.70	-0.73	0.64	-0.71	-0.66	1		
10. Access to electricity (% of population)	0.95	-0.32	0.97	-0.99	0.90	0.94	-0.91	0.87	0.82	-0.76	1	
11. Foreign direct investment, net inflows (% of GDP)	0.32	-0.44	0.29	-0.32	0.51	0.31	-0.43	0.27	0.18	-0.32	0.36	1

Source: Author's calculations using MS.Excel software.

Economy Growth segment, there was a relatively strong positive correlation among the TFP and Gross domestic savings 0.92; Gross capital formation 0.93; Gross national expenditure 0.89; Imports of goods and services 0.94; Price level ratio

of PPP conversion factor (GDP) to market exchange rate 0.65. However, there was a relatively strong negative correlation among the TFP and Agriculture, value added (% of GDP) -0.91; Trade in services -0.53. On the other hand, there was a relatively weak positive correlation among the TFP and Adjusted savings: natural resources depletion 0.02; Adjusted savings: energy depletion 0.00; Agriculture, value added annual % growth 0.19. And, there was a relatively weak negative correlation among the TFP and Terms of trade adjustment -0.16; Net taxes on products -0.07; Net taxes on products -0.16; GNI growth -0.05; GDP per capita growth -0.01; GDP growth -0.02; Trade (% of GDP) -0.09; Inflation, consumer prices -0.10; Food, beverages and tobacco (% of value added in manufacturing) -0.18, Table 4.

Table 4. The simple Correlation coefficient matrix among TFP and economy growth indicators.

Economy Growth	TFP	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
TFP	1																			
1. Price level ratio of PPP conversion factor (GDP) to market ex	0.65	1																		
2. Terms of trade adjustment (constant LCU)	-0.16	-0.50	1																	
3. Net taxes on products (current LCU)	-0.07	-0.40	0.09	1																
4. Net taxes on products (current US$)	-0.16	-0.37	0.01	0.98	1															
5. GNI growth (annual %)	-0.05	-0.22	0.31	0.19	0.21	1														
6. Gross domestic savings (current LCU)	0.92	0.58	-0.10	0.14	0.02	-0.09	1													
7. GDP per capita growth (annual %)	-0.01	-0.23	0.06	0.45	0.49	0.86	0.02	1												
8. GDP growth (annual %)	-0.02	-0.21	0.04	0.41	0.44	0.86	0.01	1.00	1											
9. Adjusted savings: natural resources depletion (% of GNI)	0.02	-0.30	0.40	0.04	-0.10	0.19	0.18	0.14	0.19	1										
10. Adjusted savings: energy depletion (% of GNI)	0.00	-0.32	0.41	0.04	-0.10	0.19	0.16	0.14	0.20	1.00	1									
11. Food, beverages and tobacco (% of value added in manufact	-0.18	-0.67	0.26	0.72	0.67	0.31	-0.10	0.54	0.50	0.22	0.24	1								
12. Agriculture, value added (% of GDP)	-0.91	-0.64	0.04	0.33	0.43	0.06	-0.84	0.13	0.13	-0.06	-0.04	0.36	1							
13. Agriculture, value added (annual % growth)	0.19	0.12	-0.16	0.28	0.35	0.28	0.11	0.39	0.35	-0.47	-0.46	0.26	-0.01	1						
14. Trade (% of GDP)	-0.09	-0.62	0.49	0.36	0.23	0.39	0.08	0.36	0.37	0.70	0.70	0.54	0.02	-0.27	1					
15. Gross capital formation (current LCU)	0.93	0.79	-0.25	-0.21	-0.30	-0.17	0.92	-0.14	-0.14	0.07	0.04	-0.38	-0.92	0.05	-0.14	1				
16. Gross national expenditure (current LCU)	0.89	0.82	-0.27	-0.40	-0.47	-0.25	0.82	-0.27	-0.26	0.01	-0.01	-0.51	-0.92	-0.01	-0.26	0.97	1			
17. Inflation, consumer prices (annual %)	-0.10	-0.16	0.07	-0.08	-0.18	-0.01	0.09	-0.06	0.00	0.65	0.63	0.01	-0.04	-0.62	0.62	0.07	0.03	1		
18. Imports of goods and services (BoP, current US$)	0.94	0.71	-0.15	-0.14	-0.24	-0.03	0.94	-0.01	-0.01	0.16	0.14	-0.29	-0.92	0.07	0.00	0.98	0.93	0.13	1	
19. Trade in services (% of GDP)	-0.53	-0.88	0.57	0.29	0.22	0.38	-0.40	0.32	0.32	0.49	0.51	0.57	0.40	-0.28	0.83	-0.58	-0.64	0.41	-0.47	1

Source: Author's calculations using MS.Excel software.

Education segment, there was a relatively strong positive correlation among the TFP and Labor force, total 0.98. However, there was a relatively strong negative correlation among the TFP and Government expenditure on education, total (% of GDP) -0.66. On the other hand, there was a relatively weak positive correlation among the TFP and Unemployment, total (% of total labor force) 0.41, Table 5.

Table 5. The simple Correlation coefficient matrix among TFP and education indicators.

Education	TFP	1.	2.	3.
TFP	1			
1. Unemployment, total (% of total labor force)	0.41	1		
2. Labor force, total	0.98	0.50	1	
3. Government expenditure on education, total (% of GDP)	-0.66	-0.29	-0.70	1

Source: Author's calculations using MS.Excel software.

Energy segment, there was a relatively strong negative correlation (more than 0.5) among the TFP and Fossil fuel energy consumption -0.93.On the other hand, there was a relatively weak positive correlation among the TFP and Total natural resources rents 0.20, Table 6.

Table 6. The simple Correlation coefficient matrix among TFP and Energy indicators.

Energy	TFP	1.	2.
TFP	1		
1. Total natural resources rents (% of GDP)	0.20	1	
2. Fossil fuel energy consumption (% of total)	-0.93	0.43	1.00

Source: Author's calculations using MS.Excel software.

External Debt Segment, there was a relatively strong positive correlation among the TFP and Official exchange rate 0.90; Foreign direct investment, net inflows 0.60; Foreign direct investment, net outflows 0.56. However, there was a relatively strong negative correlation among the TFP and Lending interest rate -0.84.And, there was a relatively weak negative correlation among the TFP and Inflation, consumer prices -0.10, Table7.

Table 7. The simple Correlation coefficient matrix among TFP and external debt indicators.

External Debt.	TFP	1.	2.	3.	4.	5.
TFP	1					
Official exchange rate (LCU per US$, period average)	0.90	1				
2. Lending interest rate (%)	-0.84	-0.73	1			
3. Inflation, consumer prices (annual %)	-0.10	-0.09	0.47	1		
4. Foreign direct investment, net inflows (BoP, current US$)	0.60	0.53	-0.47	0.16	1	
5. Foreign direct investment, net outflows (BoP, current US$)	0.56	0.40	-0.44	0.40	0.63	1

Source: Author's calculations using MS.Excel software.

Gender segment, there was a relatively strong negative correlation among the TFP and Employment in agriculture, male (% of male employment) -0.87.On the other hand, there was a relatively weak positive correlation among the TFP and Employment in agriculture, female (% of female employment) 0.05, Table 8.

Table 8. The simple Correlation coefficient matrix among TFP and gender indicators.

Gender	TFP	1.	2.
TFP	1		
1. Employment in agriculture, male (% of male employment)	-0.87	1	
2. Employment in agriculture, female (% of female employment)	0.05	0.02	1

Source: Author's calculations using MS.Excel software.

Infrastructure segment, there was a relatively strong positive correlation among the TFP and Improved water source0.99; Improved water source, rural 0.98; Rail lines 0.86; Air transport, freight 0.75; Electric power consumption 0.98, Table 9.

Table 9. The simple Correlation coefficient matrix among TFP and infrastructure indicators.

Infrastructure	TFP	1.	2.	3.	4.	5.
TFP	1					
1. Improved water source (% of population with access)	0.99	1				
2. Improved water source, rural (% of rural population with access	0.98	1.00	1			
3. Rail lines (total route-km)	0.86	0.87	0.87	1		
4. Air transport, freight (million ton-km)	0.75	0.81	0.81	0.73	1	
5. Electric power consumption (kWh per capita)	0.98	0.99	0.99	0.83	0.77	1

Source: Author's calculations using MS.Excel software.

Health segment, there was a relatively strong positive correlation among the TFP and Improved sanitation facilities, rural 0.97; Health expenditure, private (% of GDP) 0.74; Health expenditure per capita, PPP 0.98; Health expenditure per capita (current US$) 0.90; Health expenditure, total (% of GDP) 0.71; Health expenditure, public (% of GDP) 0.56. However, there was a relatively strong negative correlation among the TFP and Health expenditure, public (% of total health expenditure) -0.74; Depth of the food deficit -0.57. On the other hand, there was a relatively weak positive correlation among the TFP and Health expenditure, public (% of government expenditure) 0.03, Table 10.

Table 10. The simple Correlation coefficient matrix among TFP and health indicators.

Health	TFP	1.	2.	3.	4.	5.	6.	7.	8.	9.
TFP	1									
1. Improved sanitation facilities, rural (% of rural population with	0.97	1								
2. Health expenditure, total (% of GDP)	0.71	0.75	1							
3. Health expenditure, public (% of GDP)	0.56	0.62	0.93	1						
4. Health expenditure, public (% of government expenditure)	0.03	0.10	0.60	0.63	1					
5. Health expenditure, public (% of total health expenditure)	-0.74	-0.75	-0.83	-0.57	-0.40	1				
6. Health expenditure, private (% of GDP)	0.74	0.77	0.99	0.87	0.56	-0.90	1			
7. Health expenditure per capita, PPP (constant 2011 internationa	0.98	0.96	0.77	0.64	0.09	-0.75	0.79	1		
8. Health expenditure per capita (current US$)	0.90	0.84	0.61	0.44	0.02	-0.67	0.65	0.93	1	
9. Depth of the food deficit (kilocalories per person per day)	-0.57	-0.52	-0.70	-0.49	-0.33	0.78	-0.76	-0.66	-0.73	1

Source: Author's calculations using MS.Excel software.

Private Sector segment, there was a relatively strong positive correlation among the TFP and Subsidies and other transfers 0.88. However, there was a relatively strong negative correlation among the TFP and Net lending (+) / net borrowing (-) (% of GDP) -0.84, Table 11.

Table 11. The simple Correlation coefficient matrix among TFP and private sector indicators.

Private Sector	*TFP*	*1.*	*2.*
TFP	1		
1. Subsidies and other transfers (current LCU)	0.88	1	
2. Net lending (+) / net borrowing (-) (% of GDP)	-0.84	-0.70	1

Source: Author's calculations using MS.Excel software.

Public Sector segment, there was a relatively strong positive correlation among the TFP and GDP per person employed 0.98; Fuel imports 0.89; Research and development expenditure 0.78. However, there was a relatively strong negative correlation among the TFP and Food imports -0.78; Agricultural raw materials imports -0.73; Employment in agriculture (% of total employment) -0.69; Trade in services -0.53. On the other hand, there was a relatively weak positive correlation among the TFP and Unemployment, total 0.41; Unemployment, male 0.49; Unemployment, female 0.11. And, there was a relatively weak negative correlation among the TFP and Vulnerable employment -0.09, Table 12.

Table 12. The simple Correlation coefficient matrix among TFP and public sector indicators.

Public Sector	*TFP*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*	*8.*	*9.*	*10.*	*11.*
TFP	1											
1. Fuel imports (% of merchandise imports)	0.89	1										
2. Food imports (% of merchandise imports)	-0.78	-0.76	1									
3. Agricultural raw materials imports (% of merchandise imports)	-0.73	-0.71	0.73	1								
4. Trade in services (% of GDP)	-0.53	-0.36	0.18	0.36	1							
5. Research and development expenditure (% of GDP)	0.78	0.70	-0.51	-0.58	-0.61	1						
6. Unemployment, total (% of total labor force) (modeled ILO esti	0.41	0.43	-0.14	-0.35	-0.30	0.68	1					
7. Unemployment, male (% of male labor force) (modeled ILO est	0.49	0.50	-0.16	-0.39	-0.43	0.74	0.96	1				
8. Unemployment, female (% of female labor force) (modeled ILC	0.11	0.14	-0.04	-0.15	0.00	0.27	0.77	0.58	1			
9. GDP per person employed (constant 2011 PPP $)	0.98	0.87	-0.71	-0.77	-0.64	0.82	0.46	0.55	0.15	1		
10. Vulnerable employment, total (% of total employment)	-0.09	-0.06	-0.09	0.21	0.52	0.03	0.12	0.09	0.03	-0.22	1	
11. Employment in agriculture (% of total employment)	-0.69	-0.55	0.52	0.52	0.72	-0.47	-0.20	-0.31	-0.04	-0.73	0.47	1

Source: Author's calculations using MS.Excel software.

Trade segment, there was a relatively strong positive correlation among the TFP and Commercial service imports 0.95; Merchandise exports 0.93; Insurance and financial services 0.92; Merchandise imports 0.90; Fuel imports 0.89; Transport services 0.73;; International tourism, 0.89;. However, there was a relatively strong negative correlation among the TFP and Tariff rate, applied, simple mean, all products -0.89; Food imports -0.78; Agricultural raw materials imports -0.73; Share of tariff lines with specific rates, primary products -0.68; Taxes on exports -0.63;

Food exports -0.61Tariff rate, applied, weighted mean, primary products -0.64; Trade in services -0.53; Agricultural raw materials exports -0.53. On the other hand, there was a relatively weak positive correlation among the TFP and Manufactures exports 0.25; Insurance and financial services 0.25; Travel services 0.06. And, there was a relatively weak negative correlation among the TFP and Manufactures imports -0.39; Tariff rate, most favored nation, weighted mean, primary products -0.47; Trade (% of GDP) -0.09, Table 13.

Table 13. The simple Correlation coefficient matrix among TFP and trade indicators.

Trade	TFP	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
TFP	1																						
1. Merchandise exports (current US$)	0.93	1																					
2. Manufactures exports (% of merchandise exports)	0.25	0.33	1																				
3. Insurance and financial services (% of commercial service exports)	0.25	0.31	0.24	1																			
4. Food exports (% of merchandise exports)	-0.61	0.71	0.73	0.25	1																		
5. Agricultural raw materials exports (% of merchandise exports)	-0.53	-0.62	0.09	-0.09	-0.36	1																	
6. Travel services (% of commercial service imports)	0.06	-0.06	0.00	0.15	0.05	-0.08	1																
7. Transport services (% of commercial service imports)	0.73	0.82	0.22	0.02	0.56	-0.46	-0.36	1															
8. Commercial service imports (current US$)	0.95	0.96	0.29	0.36	0.64	-0.63	0.02	0.73	1														
9. Merchandise imports (current US$)	0.90	0.97	0.48	0.31	0.78	-0.57	-0.03	0.80	0.95	1													
10. Manufactures imports (% of merchandise imports)	-0.39	-0.25	0.53	0.18	0.27	0.06	0.12	-0.28	-0.26	-0.16	1												
11. Insurance and financial services (% of commercial service imports)	0.92	0.85	0.12	0.27	0.54	-0.41	-0.09	0.77	0.85	0.80	-0.48	1											
12. Fuel imports (% of merchandise imports)	0.89	0.88	0.05	0.19	0.45	-0.57	-0.15	0.77	0.88	0.84	-0.58	0.91	1										
13. Food imports (% of merchandise imports)	-0.78	-0.72	-0.01	-0.33	-0.44	0.62	0.01	-0.58	-0.77	-0.66	0.21	-0.81	-0.76	1									
14. Agricultural raw materials imports (% of merchandise imports)	-0.73	-0.71	-0.13	-0.39	-0.50	0.51	-0.12	-0.34	-0.76	-0.68	0.22	-0.69	-0.71	0.73	1								
15. Tariff rate, most favored nation, weighted mean, primary products (%)	-0.47	-0.62	-0.16	-0.24	-0.39	0.38	0.04	-0.58	-0.57	-0.59	0.25	-0.50	-0.56	0.38	0.33	1							
16. Tariff rate, applied, weighted mean, primary products (%)	-0.64	-0.78	-0.29	-0.32	-0.57	0.49	0.05	-0.69	-0.73	-0.77	0.21	-0.64	-0.69	0.51	0.47	0.95	1						
17. Share of tariff lines with specific rates, primary products (%)	-0.68	-0.51	0.11	-0.18	-0.15	0.25	0.02	-0.31	-0.56	-0.46	0.46	-0.60	-0.59	0.44	0.56	-0.04	0.12	1					
18. Tariff rate, applied, simple mean, all products (%)	-0.89	-0.95	-0.34	-0.33	-0.73	0.59	0.05	-0.79	-0.93	-0.94	0.24	-0.84	-0.86	0.74	0.70	0.71	0.86	0.45	1				
19. International tourism, number of arrivals	0.89	0.92	0.12	0.26	0.59	-0.58	-0.07	0.77	0.91	0.84	-0.31	0.88	0.87	-0.80	-0.70	-0.52	-0.67	-0.58	-0.88	1			
20. Trade (% of GDP)	-0.09	0.03	-0.60	0.06	-0.29	-0.36	-0.22	0.12	0.02	-0.14	-0.13	-0.01	0.05	-0.22	0.10	-0.30	-0.20	0.13	-0.05	0.20	1		
21. Taxes on exports (% of tax revenue)	-0.63	0.75	0.43	0.39	0.72	-0.43	-0.05	0.62	0.71	0.72	0.23	0.60	0.50	-0.60	-0.51	-0.34	-0.52	-0.28	-0.69	0.81	0.11	1	
22. Trade in services (% of GDP)	-0.53	-0.44	-0.70	-0.06	-0.60	-0.02	-0.10	-0.36	-0.42	-0.58	-0.05	-0.46	-0.36	0.18	0.36	0.02	0.18	0.32	0.39	-0.26	0.83	-0.31	1

Source: Author's calculations using Ms.Excel software.

In this section, each indicator that had a correlation coefficient with the TFP that is greater than or equal to -0.5 or +0.5 was selected for running a multiple regression between agricultural TFP as a dependent variable and all the highly correlated indicators as explanatory variables. However, this second step was executed differently due to data availability of the mentioned indicators. There were divided into 3 groups according to data availability; 54 years (1961-2014), 44 years (1971-2014), and 25 years (1990-2014). The stationarity of each indicator in each group of data was tested using Augmented Dickey Fuller (ADF) test Eviews software Tables 14 , 15, 16.

Table 14.summary of the highly correlated indicators, and their stationarity level.(1961-2014).

Indicators according to data availability (54 years)	Indicator abbrev.	Correlation with TFP	Stationarity Level*	form iserted into multiple regression
TFP**				
Technical cooperation grants (BoP, current US$)	TCG	-0.89	I(1) Random walk	D(TCG)
Mortality rate, under-5 (per 1,000 live births)	MR	-0.95	Random walk with trend	MR_Resids
Gross domestic savings (current LCU)	GDS	0.92	Random walk with trend	GDS_Resids
Gross capital formation (current LCU)	GCF	0.93	Random walk with trend	GCF_Resids
Gross national expenditure (current LCU)	GNE	0.89	Random walk with trend	GNE_Resids
Official exchange rate (LCU per US$, period average)	OER	0.90	Random walk with trend	OER_Resids
Merchandise exports(current US$)	MEX	0.93	I(0)	MEX
Food exports (% of merchandise exports)	FOEX	-0.61	I(1) Random walk	FOEX.Resids
Agricultural raw materials exports (% of merchandise exports)	ARMEX	-0.53	I(1) Random walk with trend	ARMEX _Resids
Merchandise imports (current US$)	MIM	0.90	I(1) Random walk with trend	MIM_Resids
Fuel imports (% of merchandise imports)	FUIM	0.89	I(1) Random walk with trend	FUIM_Resids
Food imports (% of merchandise imports)	FOIM	-0.78	I(0)	FOIM
Agricultural raw materials imports (% of merchandise imports)	ARMIM	-0.73	I(0)	ARMIM

* Stationarity was tested according to Augmented Dicky-Fuller test in Eviews

** TFP was estimated for 54 years (1961-2014)

Source: Author's calculations using eviews software.

Table 15.summary of the highly correlated indicators, and their stationarity level.(1971-2014).

Indicators according to data availability (44 years)	Indicator abbrev.	Correlation with TFP	Stationarity Level*	form iserted into multiple regression
TFP**				
Net ODA received per capita (current US$)	NODA	0.51	I(1) Random walk	D_NODA
Employment in agriculture (% of total employment)	EIA-T	-0.69	I(0)	EIA-T
Employment in agriculture, male (% of male employment)	EIA-M	-0.83	Random walk with trend	EIA-M_Resids
Energy use (kg of oil equivalent per capita)	EU	0.93	Random walk with trend	EU_Resids
Electric power consumption (kWh per capita)	EPC	0.98	Random walk with trend	EPC_Resids
Electricity production from oil sources (% of total)	EPFOS	-0.68	Random walk with trend	EPFOS_Resids
Imports of goods and services (BoP, current US$)	IMGS	0.94	Random walk with trend	IMGS_Resids
Government expenditure on education, total (% of GDP)	GEOE-T	-0.66	I(0)	GEOE-T
Fossil fuel energy consumption (% of total)	FFEC-T	-0.93	Random walk with trend	FFEC-T_Resids
Lending interest rate (%)	LIR	-0.84	I(1) Random walk with drift	D(LIR)
Air transport, freight (million ton-km)	ATF	0.75	I(0)	ATF
Net lending (+) / net borrowing (-) (% of GDP)	NL/NB	-0.84	I(0)	NL/NB
Commercial service imports (current US$)	CSI	0.95	Random walk with trend	CSI_Resids
Insurance and financial services (% of commercial service imports)	IFS	0.92	Random walk with trend	IFS_Resids

** TFP was estimated for 54 years, however due to the data availability of the indicators, it was altered to each group. In this table, it was altered to be 44 years.

Source: Author's calculations using eviews software.

Table 16.summary of the highly correlated indicators, and their stationarity level.(1990-2014).

Indicators according to data availability (25 years)	Indicator abbrev.	Correlation with TFP	Stationarity Level*	form inserted into multiple regression
TFP**				
Rural population	RP	0.98	Random walk with trend	RP_Resids
Access to electricity, rural (% of rural population)	ATE-R	0.95	Random walk with trend	ATE-R_Resids
Permanent cropland (% of land area)	PC-T	0.89	Random walk with trend	PC-T_Resids
Land under cereal production (hectares)	LUCP	0.96	Random walk with trend	LUCP_Resids
Renewable energy consumption (% of total final energy consumption)	REC	-0.94	Random walk with trend	REC_Resids
Electricity production from renewable sources, excluding hydroelectric (% of total)	EPFRS/T	0.92	Random walk with trend	EPFRS/T_Resids
Electricity production from renewable sources, excluding hydroelectric (kWh)	EPFRS	0.90	Random walk with trend	EPFRS_Resids
Access to electricity (% of population)	ATE	0.95	Random walk with trend	ATE_Resids
Price level ratio of PPP conversion factor (GDP) to market exchange rate	PLRppp	0.65	Random walk with trend	PLRppp_Resids
Labor force, total	LF-T	0.98	Random walk with trend	LF-T_Resids
Improved water source (% of population with access)	IWS	0.99	Random walk with trend	IWS_Resids
Improved water source, rural (% of rural population with access)	IWSR	0.98	I(0)	IWSR
Rail lines (total route-km)	RL	0.86	I(0)	RL
Health expenditure, total (% of GDP)	HE-T	0.71	Random walk with trend	HE-T_Resids
Health expenditure, public (% of GDP)	HE-P	0.56	Random walk with trend	HE-P_Resids
Health expenditure, public (% of total health expenditure)	HEPT	-0.74	Random walk with trend	HEPT_Resids
Health expenditure, private (% of GDP)	HE-Pr	0.74	I(0)	HE-Pr
Health expenditure per capita (current US$)	HEPC	0.90	Random walk with trend	HEPC_Resids
Depth of the food deficit (kilocalories per person per day)	DFD	-0.57	Random walk with trend	DFD_Resids
Subsidies and other transfers (current LCU)	SOT	0.88	I(0)	SOT
Research and development expenditure (% of GDP)	RD-T	0.78	Random walk with trend	RD-T_Resids
Tariff rate, applied, simple mean, all products (%)	TR	-0.89	Random walk with trend	TR_Resids
Transport services (% of commercial service imports)	TS	0.73	Random walk with trend	TS_Resids
Foreign direct investment, net inflows (BoP, current US$)	FDI-I	0.60	Random walk with trend	FDI-I_Resids
Foreign direct investment, net outflows (BoP, current US$)	FDI-O	0.56	Random walk with trend	FDI-O_Resids
Trade in services (% of GDP)	TIS	-0.53	Random walk with trend	TIS_Resids
Taxes on exports (% of tax revenue)	TOEX	-0.63	Random walk with trend	TOEX_Resids
International tourism, number of arrivals	IT	0.89	Random walk with trend	IT_Resids

**** TFP was estimated for 54 years, however due to the data availability of the indicators, it was altered to each group. In this table, it was altered to be 25 years to fit into the multiple regression.**

I (1) : it means that the indicator is itegrated of order 1 or at 1st difference; in this case the indicator is either Random walk or Random walk with a drift, in both cases the first difference (due to the level of integration, as shown in the table) was taken to represent the stationary form of the indicators.

I(0): integrated at level Resids: it means that the indicator was regressed with time-as it has a trend component-, the residuals of this regression were considered the new stationary indicator.

Source: Author's calculations using eviews software.

TFP Determinants

This section is mainly running multiple regressions after selecting the indicators that had a correlation coefficient that is above +0.5 or -0.5. then running a multiple regression between the TFP as a dependent variable and the development

indicators as explanatory variables. However, the possible multi sectoral determinants of agricultural TFP in Egypt are presented in three groups according to data availability and regardless of their sector; 54 years 1961-2014, 44 years 1971-2014, and 25 years 1990-2014 table 17.

Before running the multiple regressions, the stationarity level of all variables was tested using Augmented Dikkey Fuller test, then inserted into the regression analysis in stationary form as shown in tables 14,15 and 16 respectively. After the regression, the serial correlation was tested using Durbin Watson and Breusch-Godfrey Serial Correlation LM Test. In addition to Heteroscedasticity tested using Breusch-Pagan-Godfrey test.

Table 17: TFP determinants in the Egyptian agricultural sector (1961–2014)

Dependent Variable (LN TFP) **Parameters**	**Coefficient**	**T-statistic**	**Prob.**
OER	0.971047	2.876041	0.0097
GDS	2.87E-11	4.820010	0.0001
ARMEX	-0.031255	-0.793356	0.4374
Constant	1.761829	4.025130	0.0007
R-squared			0.594983
F-statistic (prob.)			0.000537
Durbin Watson			1.561265
Breusch-Godfrey Serial Correlation LM Test (p-value)			0.9946
Heteroskedasticity Test: Breusch-Pagan-Godfrey (p-value)			0.1300

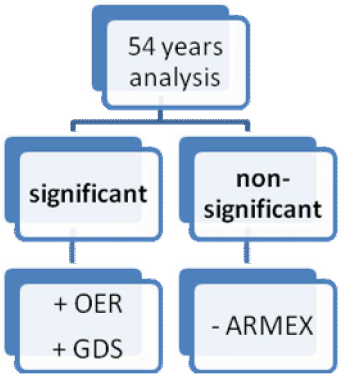
TFP = f (*GDS,OER, ARMEX*)

Where:

TFP = Total Factor Productivity in the Egyptian agricultural sector;

GDS (+) =Gross domestic savings (current LCU)
OER (+) = Official exchange rate (LCU per US$, period average)
ARMEX (-) = Agricultural raw materials exports (% of merchandise exports)
Source: Author's calculations using Eviews software.

Fig.1. Summary of Regression results of the TFP determinants 1961-2014



Source: Author's elaboration.

The log-linear form of the above equation shown in table 17 and summarized in figure 1, allows for estimating coefficients that can be directly interpreted as elasticities. The estimations shown in table 17 indicate that: (i) the estimation output

have no serial correlation according to the Durbin Watson Value 1.56 and this is confirmed by the non-significant(more than .05) p-value of Breusch-Godfrey Serial Correlation LM Test 0.994. On the other hand there is no heteroscedasticity according to the non-significant p-value of Breusch-Pagan-Godfrey test 0.13. (ii) The relationship among the TFP in the Egyptian agricultural sector and each of Gross Domestic Product (GDS), Official Exchange Rate (OER) is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector and ARMEX is negative and statistically non-significant.

As for the Official exchange rate (OER), from a general perspective in a market-based economy; household, producer, and government choices about resource allocation are influenced by relative prices, including the real exchange rate, real wages, real interest rates, and other prices in the economy. Relative prices also largely reflect these agents' choices. Thus relative prices convey vital information about the interaction of economic agents in an economy and with the rest of the world.

On the other hand the depreciating, however relatively stable exchange rate causes the agricultural exports to be cheaper therefore more competitive in the global market, thus more demand for exports. This creates opportunities for processing leading to more value added, increasing exporter's income creating additional demand. So the devaluation of the OER could cause a boost to the economic growth. Habib, M.M et. al., (2016) found that currency depreciation raises annual real GDP growth only for the developing countries. In addition, Gluzmannet. al. (2012) found that the undervaluation leads to greater domestic savings and therefore investment in the developing countries.

- Agricultural raw materials exports (ARMEX),had a negative effect on TFP comes as no surprise. The specialization of some countries in the export of raw materials and lightly processed goods is an important cause of their underdevelopment, Delacroix, J. (1977). It is proved that raw material exports is a fast but rather short-handed way of making profit for any exporter. Also, it is a strong deterrent of growth regardless of the sector. Egypt's government supports export-oriented-activities that increase the value added, but not the raw materials. The government supports funds that aim at developing production practices for improving export capabilities. Similarly, the Export Development Bank of Egypt provides short and medium term loans to finance inputs for export industries. Moreover, the processed agricultural products are among the beneficiaries of such credits.

Gross Domestic Savings (GDS), was proved to be positively associated with productivity growth in poor countries (Aghion, P. 2009) Domestic saving is more critical for adopting new technologies in developing rather than developed economies.

The linear form of the above equation, the estimations shown in table 18 and summarized in figure 2 indicates that: (i) the estimation output has no serial correlation according to theDurbin Watson Value 2.01 and this is confirmed by the non-significant(more than .05) p-value of Breusch-Godfrey Serial Correlation LM Test 1.0. On the other hand there is no heteroscedasticity according to the non-

significant p-value of Breusch-Pagan-Godfrey test 0.15. (ii) The relationship among the TFP in the Egyptian agricultural sector and each of Net Official Development Assistance (NODA), Electric Power Consumption (EPC), Imports of goods and services (IMGS) is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector andFossil Fuel Energy Consumption (FFEC) is negative and statistically non-significant.

Table 18: TFP determinants in the Egyptian agricultural sector (1971–2014)

Dependent Variable (LN TFP) **Parameters**	**Coefficient**	**T-ratio**	**P-value**
IMGS	1.18E-10	4.921088	0.0004
EPC	0.008076	4.927391	0.0003
NODA	0.025501	3.960465	0.0019
FFEC	-0.216012	-1.401194	0.1865
Constant	1.445861	7.415390	0.0000
R-squared			0.878231
F-statistic (prob.)			0.000020
Durbin Watson			2.016678
Breusch-Godfrey Serial Correlation LM Test (p-value)			1.0000
Heteroskedasticity Test: Breusch-Pagan-Godfrey (p-value)			0.1532

TFP = f (*NODA,EPC, IMGS,FFEC*)

Where:

TFP = Total Factor Productivity in the Egyptian agricultural sector;

NODA (+) = Net ODA received per capita (current US$)

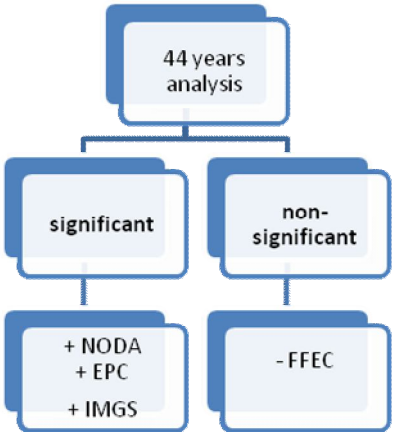
EPC (+) = Electric power consumption (kWh per capita)

IMGS(+) = Imports of goods and services (BoP, current US$)

FFEC(-) = Fossil fuel energy consumption (% of total)

Source: Author's calculation using Eviews software.

Fig2. Summary of Regression results of the TFP determinants 1971-2014



Source: Author's elaboration.

- As for Net Official Development Assistance (NODA), The Foreign aid can play an important and vital role in realizing the development goals and poverty reduction especially in the developing countries**.** The coordination of aid focuses on the procedures that lead to transfer the official development assistance to private institution or government recipient. Egypt still needs to develop its capacities**,** human resources and solve the difficulties in the resource management and investments. These difficulties have a negative effect on the country's potential for undertaking an accelerated process of development. Egypt needs to ensure efficient

allocation of both internal and external resources to increase the level of development. The ministry of international cooperation in Egypt is mandate to achieve the optimum utilization of external assistance to improve the effectiveness of Egypt's development programs. Few studies have focused on evaluating the effect of aid on economic growth in some developing countries(Roodman, 2006).

The major donors to Egypt are the United States Agency for International Development (USAID), European Commission (EC), European member states (EU), Japan and the World Bank. The United States is the dominant donor for Egypt accounting for 50% of the total development assistance in 1990s. The United Nation agencies contributed 1.3% of all aid, while the USA and EU jointly contributed about 89% of the total aid to Egypt during this period. The international donors assisted Egypt in implementing the Economic Reform and Structural Adjustment Program (ERSAP) to promote the private sector and increase economic growth. Egypt received aid from the donors in the form of bilateral agreement (51.84%) and multilateral agreement (48.19%). NGOs represented by Ford Foundation that reached about (0.0002%) and others (0.0032%). Aou el nour, K., 2014.

The cumulative ratio indicates that USAID maintained its top rank as the first donor (66.77%), Germany is the second (10.58%), Italy (4.29%), Abu Dhabi Fund (3.96%) and Kuwait Fund (2.512%). The other donors participated by ratio between (1.052% up to 1.890%) such as Danish international Development Agency (DANIDA), Spain, Japan, Canadian International Development Agency (CIDA), Netherlands and Switzerland.

The analysis of ODA by geographic location indicate that the central government and lower Egypt governorates received the highest proportions of the total official development assistance disbursements. Therefore, the distribution of aid is biased for the urban governorates such as Alexandria (8.7%) and Grand Cairo (7.66%). In contrast, some governorates in Upper Egypt and out of valley such as Assyout, Suhag and north Sinai governorates received lower proportions of assistance, although they still need more water sanitation, health care and education services. Burnside and Dollar (1997) and Azamet al. (1999).

Agriculture sector: It ranked third among recipient sectors after energy and industry. It received 10.71% of the total value of disbursements by sectors. The allocation of aid funds to the agricultural research, industrial and export crops, post harvest and also agricultural development and livestock activities is still very low although, if increased, it can enhance and empower the agricultural sector in Egypt. Where the majority of agricultural producers are small farmers. Supporting this sector does not only mean boosting the Egyptian national economy, but will also raise agricultural production and increase agricultural exports. Moreover, supporting the agricultural sector will help carry out the national development policy for reducing poverty especially in the rural areas. Successful examples of aid effectiveness in Egypt:

micro level (socio economic impacts of IEDS projects):

started since the year 2000 for eight years, under the Italian and Egyptian cooperation development swap, with a total value of about L E 850 million. Such as

West Noubaria Rural Development Project, employment generation and poverty alleviation. The farmers benefited from improved living standards and increased micro enterprises for women's. The program led to other projects such as establishment of databases in rural areas. Also, the sustainable rural development of Wadi El Rayan, New Land Settlements and Marketing Link Program.

macro level (aid effectiveness on the national capacity development in Egypt)

Economic policy initiative consortia (EPIC)1996: a four years period and was financed by the USAID as provided advice on economic policy reform to Egyptian policy makers and introduced technical support to improve the Egyptian performance in national development.

Education sector assistance: The government of Egypt has worked with the European Commission and the World Bank since 1996 on the framework of education reform.

UNDP program at the Institute of National Planning (INP): This program received financial and technical support from United Nations Development Program (UNDP), United Nations Population Fund (UNFPA), World Food Program (WFP) and the Social Fund for Development (SFD) in Egypt. The program aimed at providing an annual report on human development in Egypt

Banking institute: This institute was financed by different donors such as (European Commission (EC), United States Agency for International Development (USAID), United Kingdom (UK) and the Canadian International Development Agency (CIDA). The institute's objective was to enhance the capacity for development, expertise of Egyptian bankers and strengthen the banking leadership.What could be done in this regard is:

- Loans should be kept to its minimum values to limit indebtedness levels and not burden the country with heavy external debts. Better management and coordination of external assistance will increase the positive impact and efficiency of aid system. Raising technical and financial support will improve the performance of projects financed by donors. Also, maximizing the utilization of external financial resources will make positive impacts on the national development capacity of Egypt.
- Fragmented aid that comes in many small slices from a large number of donors – creates high transaction costs and makes it difficult for partner countries effectively to manage their own development. Aid fragmentation also increases the risk of duplication and inefficient aid allocation among donors.
- Conducting development plans that are specific to each governorate especially those which receive lower proportions of assistance.

- Electric Power Consumption (EPC), In developing economies growth in energy use is closely related to growth in the modern sectors - industry, motorized transport, and urban areas - but energy use also reflects climatic, geographic, and economic factors (such as the relative price of energy). Energy use has been growing rapidly in low- and middle-income economies. An economy's production and consumption of electricity are basic indicators of its size and level of development. Although a few countries export electric power, most production is for domestic consumption. Expanding the supply of electricity to meet the

growing demand of increasingly urbanized and industrialized economies without incurring unacceptable social, economic, and environmental costs is one of the great challenges facing developing countries. Energy use also reflects climatic, geographic, and economic factors (such as the relative price of energy). Governments in many countries are increasingly aware of the urgent need to make better use of the world's energy resources. Improved energy efficiency is often the most economic and readily available means of improving energy security. Comin and Hobijn (2004), proved that production of electricity have a positive effect on the degree of adoption of the current technology. Besides, Aschauer (1989) highlighted that physical infrastructure (for example, roads, water and sewage systems, and electricity supply) improvements are correlated with productivity. However, Hulten (1996) stressed that those countries that use infrastructure inefficiently pay a growth penalty in the form of a much smaller benefit from new infrastructure investment.
The derived conclusion is that infrastructure is not only very important for productivity growth but even triggers it. However, it is important to closely monitor its management and financing.

- **Imports of goods and services (IMGS);**in an open-trade-regime, like Egypt, there is a better access to imported intermediate inputs of higher quality with a broad variety; this definitely enhances productivity. Egypt's main imports are machinery equipment, foodstuff, chemicals, and fuels. Each aspect of these imports affects the agricultural inputs and outputs, therefore the agricultural TFP. Keller and Yeaple (2003), established a positive link between imports and productivity growth. Also Coe and Helpman, (1995) highlighted the possibility that international R&D are driven by imports, most importantly machinery. Griffith, Redding and Van Reenen (2000) proved that Trade with a country on the world technology frontier showed a slight positive effect on TFP growth. Mayer (2001) argued that trade is a carrier of knowledge and focused on imports as a way of introducing foreign (relatively advanced) technology into domestic production, which in turn has a positive effect on TFP.
- **Fossil Fuel Energy Consumption (FFEC),** In developing economies growth in energy use is closely related to growth in the modern sectors - industry, motorized transport, and urban areas - but energy use also reflects climatic, geographic, and economic factors (such as the relative price of energy). Energy use has been growing rapidly in low- and middle-income economies. The current food system depends on non-renewable fossil fuel resources; its global status quo is scarce and expensive. This dependence is a threat to agriculture therefore the food supply. Egypt's fossil fuel consumption of total energy use reached almost 96% in 2014. The consistent rises in fuel prices have their negative effect on agricultural income and agricultural growth. This effect is expected to deepen, especially after the government oil-subsidy- reduction-program. It will take decades for Egypt to substitute the non-environmentally friendly fossil fuel in agriculture or even to reduce its consumption. However, a lot could be done in that concern including a more efficient use of fossil fuel ; following the maintenance schedules of

agricultural machinery, using energy-saving machinery, as well as fixing and constructing viable roads for efficient transport.

Table 19 : TFP determinants in the Egyptian agricultural sector (1990–2014)

Dependent Variable (LN TFP) Parameters	Coefficient	T-ratio	P-value
FDI_I_RESIDS	3.55E-10	2.177021	0.0416
TOEX_RESIDS	-0.680107	-1.166424	0.2572
RL	0.002077	11.51679	0.0000
RD_RESIDS	0.914530	1.878475	0.0750
Constant	-5.205000	-5.725966	0.0000
R-squared			0.872238
F-statistic (prob.)			0.000000
Durbin Watson			2.593061
Breusch-Godfrey Serial Correlation LM Test (p-value)			0.2362
Heteroskedasticity Test: Breusch-Pagan-Godfrey (p-value)			0.1023

TFP = f (*TOEX, RL, RD, FDII*)

Where:

TFP = Total Factor Productivity in the Egyptian agricultural sector;

TOEX (-) = Taxes on exports (% of tax revenue)

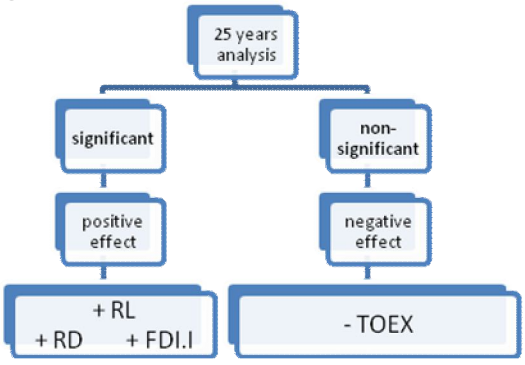
RL(+) = Rail lines (total route-km)

RD (+) = Research and development expenditure (% of GDP)

FDII (+) = Foreign direct investment, net inflows (BoP, current US$)

Source: Author's calculation using Eviews software.

Fig.3. Summary of Regression results of the TFP determinants 1990-2014



Source: Author's elaboration.

The linear form of the above equation, shown in table 19 and summarized in figure 3 the estimations shown in table 19 indicate that: (i) the estimation output have no serial correlation according to the Durbin Watson Value 2.5 and this is confirmed by the non-significant (more than .05) p-value of Breusch-Godfrey Serial Correlation LM Test 0.236. On the other hand there is no heteroscedasticity according to the non-significant p-value of Breusch-Pagan-Godfrey test0.102. (ii) The relationship among the TFP in the Egyptian agricultural sector and each of RD, RL, FDII is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector and of TOEX is negative and statistically non-significant.

Transport Services (TS), Ellis, S.D. and Hine.J.L.(2001) examined the relationship between accessibility, marketing and agricultural development; and found that transport plays a crucial role in identifying the link between accessibility

and agricultural development. Ajiboye, A.O.andAfolayan, O.(2009), revealed that improved transportation will encourage farmers to work harder in the rural areas to increase production and products value added as well as the reduction of spoilage and wastage. Afterall increasing productivity and income.Reducing rural transport costs can raise farm-gate prices, increase farmers' incomes and help reduce the price of food in urban areas. It can also facilitate timely distribution of farm inputs (e.g. fertiliser, insecticide), increase agricultural yields and extend cultivated areas, and reduce post-harvest losses. Yet at present, rural transport systems in most developing countries, particularly in Africa, are still far from optimal.

Strategies for Improving Rural Transport and Agriculture: addressing inefficiencies and monopolistic practices of rural transport operators; improving efficiency of overall post-harvest storage and marketing operations; Improve load consolidation practices to reduce costs and increase bargaining power for farmers; Developing modern agricultural supply chains, particularly for high-value export crops and to meet demand of proliferating supermarkets; Increasing resilience to climate impacts, including through rural road improvements; and Establishing farmer's associations or cooperatives to lower the price of transport by arranging and purchasing farm inputs (such as fertilizer) in bulk

Research and Development (RD), despite the fact that all literature proved that R&D is the main source of long term growth { Furman and Hayes(2004), Ulka(2004), Jones(2004), Chen and Dahlman(2004)}; R&D is often said to have two faces: the first is innovation, while the second is to facilitate the understanding and imitation of others' discoveries.Guellec and van Pottelsberghe de la Potterie (2001), displayed three sources of R&D were considered,namely, domestic business research, public research (for example, by universities) andbusiness research undertaken by other countries. The first and third sources lead to newgoods and services, higher output quality and new production processes, while the secondone generates and increases basic and scientific knowledge. The results show that allthree sources of R&D are important for TFP growth, with foreign-sourced R&D having the largest effect. While public R&D only produces scientific knowledge, and there is a very weak linkage between public reseachresults and the application process.Ahn (2001) argues that, in reality, it is not innovation input (in other words, R&D investment) per se that counts for productivity, but the actual use of innovation output (in other words, use of advanced technology). Hasan (2002) pointed that investment in disembodied capital affects productivity positively only if it is of foreign origin; in house R&D is never statistically significant. This all is to be in line with aninstitutional view, which suggests that countries with strong institutions achieve a higher output from investment in R&D.

Foreign Direct Investment Inflows (FDI), Knowledgeis created by a small number of leader countries in technological terms. It could be imported through several channels. One important channel can be FDI, which theoretically brings knowledge into a country. R&D activities in foreign countries, and thus contact with such countries, have been shown to spur growth domestically.FDI is believed to generate positive externalities in the form of knowledge spillovers to the domestic

economy. However, negative externalities are also possible as barriers to accessing technology and competition may be raised. In the literature, the view adopted is often that positive externalities outweigh the negative ones and, for this reason, FDI is generally seen as a welcome addition to the domestic economy. In many cases, FDI is also encouraged (by governments and often also by international organizations) by offering grace periods for taxation purposes and different business support schemes. Hanafy, S.(2015) showed the sectoral distribution of FDI inflows to Egypt by origin in average (1972-2009) The fraction of Arab FDI that targets manufacturing is a bit smaller than non-Arab FDI, whereas a slightly larger share of Arab FDI targets the finance, tourism and agriculture sectors. Manufacturing sector accounted for 43%, agriculture 4%, aggregated services 53 %(finance 24%m tourism 11%, construction 6%, ICT 3 %, others 9%).Agricultural FDI at the National Level, there was a significant increase of real FDI inflows to the agriculture sector in the second half of the last decade.The biggest share of FDI to agriculture targets land reclamation and cultivation (FAO, 2009).Despite the relatively small amount and fraction of FDI inflows that target the agriculturalsector, FDI on average contributed 18% of the sector's private investments since the 1970s the contribution has grown in the last two decades, reaching 24% of privateinvestments in the 2000s. This indicates that private investment in agriculture in Egypt isrelatively low, which, according to FAO (2009), is one of the sector's major problems.

As to the source of agricultural FDI, Arab countries accounted for two-thirds (67%) onaverage however, agricultural FDI accounts for only 5% of Arab FDI inflows to Egypt. Hanafy, S. (2015)

Agricultural FDI at the Governorate Level, agricultural FDI is highly concentrated in Cairo, which accumulated 44% of the sector's FDI-stock. Despite the strong spatial concentration of agricultural FDI in general and in Cairo in particular, the agricultural sector still shows the second highest geographical dispersion of FDI after the manufacturing sector.Agricultural FDI is mostly concentrated in Cairo (44%), Lower Egypt (22%), Giza (13%) and Upper Egypt (12%), that is, along the Nile River, whereas a smaller amount of agriculture FDI stock targeted the Suez Canal governorates (5%), the Frontier governorates (3%), and Alexandria (2%). Lower Egypt's governorate Sharkia actually ranks second after Cairo among the 27 Egyptian governorates in accumulating FDI stock (15%) and Upper Egypt's Aswan ranks fourth (10%). Although Giza (13%) ranks third in agricultural FDI, its fraction in agricultural FDI is less than half its fraction in aggregate FDI stock. Similar to the manufacturing sector,but different from all service sub-sectors, all Egyptian governorates received some agricultural FDI flows during the last four decades. However, and again similar to manufacturing, 15 of the 27 governorates (56%) accumulated less than 1% of agricultural FDI stock.

Detailed breakdown of economic activities in agriculture, reclamation and cultivation, stock breeding (livestock), poultry farming, fishing, slaughter houses

Taxes on Exports (TOEX), export taxes on agricultural products created a bias against agriculture in developing countries during the 1980s Jensen, T., et. al.(2002).export taxes are the most commonly employed form of export restrictions

on agricultural products, Estrades et al. (2017). They are applied either as a percentage of product value (an ad valorem tax) or as a fixed rate per physical unit of product (a specific tax)Kazeki(2006).According to FAO policy brief (October 2017) Countries usually apply the export restrictions in an attemptto contain the growth of domestic prices and ensure sufficient internal supplies, however these measures served as disincentives to farmers in exporting countries. In addition, evidence shows that export restrictions were not effective at preventing an increase in food prices, since the value share of the primary product (for example, wheat) in the final price of food (such as bread) is relatively low, ranging between 10 and 20 percent. Regions that apply export taxes would have an increase in production and exports if they removed export taxes. Estrades et al. (2017).

Egypt does not have any direct export subsidies. However, producers and exporters are supported through incentives such as tax concessions, and loans from the Export Development Bank of Egypt (EDBE). The EDBE was established in 1983, under Law 95; its main purpose was to encourage the development of Egyptian exports. It provides short- and medium-term loans to finance capital assets of export companies, and bank guarantees required for financing exports either directly to the exporter, or through other banks. The Bank also provides credit to finance imports primarily meant as inputs for export production, and acts as an insurer for exports against commercial and non-commercial risks. Around 200 projects were approved by the Bank in 1997. At the time of Egypt's Review in 1992, it was estimated that around 25% of Egypt's non-traditional exports were financed by the EDBE. To avoid the negative repercussions of quantitative export restrictions, it would be useful to have in place an improved, multilaterally agreed regulatory framework governing the use of these measures. According to ERS-USDA alternatives to a conventional export tax: (1) a consumption subsidy, (2) a production tax, and (3) a modification of a conventional export tax that allows additional exports after producers meet a domestic sales requirement.

Conclusion and Recommendations

The agricultural total factor productivity (TFP) growth provides society with opportunities to increase the welfare of people. It is, therefore, worth asking what determinants should policy makers focus on to enhance the performance of the agricultural TFP?. Having the calculated TFP as given from the previous work of Abdelrahman, N. (2018). The development indicators (determinants) considered here are grouped under 18 headings (sectors). They were used to figure out more explanatory variables the influence the agricultural TFP in Egypt:

agriculture and rural development, aid effectiveness, climate change, economy and growth, gender, public sector, private sector, poverty, infrastructure, science and technology, public health, social protection and labor, trade, urban development, environment, financial sector, external dept., and finally education.

By running a multiple regression between the TFP as a dependant variable and the development indicators as explanatory variables. However, the possible multi sectoral determinants of agricultural TFP in Egypt are presented in three groups

according to data availability and regardless of their sector; 54 years 1961-2014, 44 years 1971-2014, and 25 years 1990-2014.

As for the 54-year-analysis, the relationship among the TFP in the Egyptian agricultural sector and each of GDS, OER is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector and each of ARMEX is negative and statistically insignificant. As for the 44-year-analysis, the relationship among the TFP in the Egyptian agricultural sector and each of NODA, EPC, IMGS is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector and FFEC is negative and statistically insignificant. As for the 25-year-analysis, the relationship among the TFP in the Egyptian agricultural sector and each of RD, RL, FDII is positive and statistically significant. But, the relationship among the TFP in the Egyptian agricultural sector and TOEX is negative and statistically insignificant.

- The depreciating, however relatively stable exchange rate causes the agricultural exports to be cheaper therefore more competitive in the global market, thus more demand for exports. This creates opportunities for processing leading to more value added, increasing exporter's income creating additional demand.
- Trade with a country on the world technology frontier showed a slight positive effect on TFP growth. Also, trade is a carrier of knowledge and focused on imports as a way of introducing foreign (relatively advanced) technology into domestic production, which in turn has a positive effect on TFP.
- Supporting export-oriented-activities that increase the value added, but not the raw materials. The government supports funds that aim at developing production practices for improving export capabilities.
- The agricultural sector ranked third among recipient sectors of net official development after energy and industry. The allocation of aid funds to the agricultural research, industrial and export crops, post-harvest and also agricultural development and livestock activities is still very low although, if increased, it can enhance and empower the agricultural sector in Egypt. Where the majority of agricultural producers are small farmers. Supporting this sector does not only mean boosting the Egyptian national economy, but will also raise agricultural production and increase agricultural exports. Moreover, supporting the agricultural sector will help carry out the national development policy for reducing poverty especially in the rural areas.
- The analysis of ODA by geographic location indicate that the central government and lower Egypt governorates received the highest proportions of the total official development assistance disbursements. Therefore, the distribution of aid is biased for the urban governorates such as Alexandria (8.7%) and Grand Cairo (7.66%). In contrast, some governorates in Upper Egypt and out of valley such as Assyout, Suhag and north Sinai governorates received lower proportions of assistance, although they still need more water sanitation, health care and education services. What could be done in this regard is:

- Loans should be kept to its minimum values to limit indebtedness levels and not burden the country with heavy external debts. Better management and

coordination of external assistance will increase the positive impact and efficiency of aid system. Raising technical and financial support will improve the performance of projects financed by donors. Also, maximizing the utilization of external financial resources will make positive impacts on the national development capacity of Egypt.

- Fragmented aid that comes in many small slices from a large number of donors – creates high transaction costs and makes it difficult for partner countries effectively to manage their own development. Aid fragmentation also increases the risk of duplication and inefficient aid allocation among donors.
- Conducting development plans that are specific to each governorate especially those which receive lower proportions of assistance.

- Infrastructure is not only very important for productivity growth but even triggers it. However, it is important to closely monitor its management and financing. Production of electricity has a positive effect on the degree of adoption of the current technology. Improved energy efficiency is often the most economic and readily available means of improving energy security.
- Agricultural labor could be characterized as casual or informal with low skill and productivity. On the other hand, the technological absorptive capacity of the country, an essential determinant of TFP growth, increases along with well-trained employment. A large share of agricultural labor is untrained which produces inefficiency in every aspect of the agricultural production that needs human labor. Institutions are weak, strengthening the role of agricultural institutions and giving high attention to agricultural labor training programs either the domestically funded or the internationally funded.
- Adopting more efficient use of fossil fuel ; following the maintenance schedules of agricultural machinery, using energy-saving machinery, as well as fixing and constructing viable roads for efficient transport; this idea could be transmitted to rural areas through media alongside with agricultural extension.
- Rural Transport services improving through : addressing inefficiencies and monopolistic practices of rural transport operators; improving efficiency of overall post-harvest storage and marketing operations; Improve load consolidation practices to reduce costs and increase bargaining power for farmers; Developing modern agricultural supply chains, particularly for high-value export crops and to meet demand of proliferating supermarkets; Increasing resilience to climate impacts, including through rural road improvements; and Establishing farmer's associations or cooperatives to lower the price of transport by arranging and purchasing farm inputs (such as fertilizer) in bulk
- Domestic Research and development was found insignificant; this is to be in line with an institutional view, which suggests that countries with strong institutions achieve a higher output from investment in R&D.
- Adopting foreign and domestic policies that encourages FDI, as it is a strong growth stimulant and redirecting it to give more priority to the agri-labor training as well as the neglected governorates.

- To avoid the negative repercussions of quantitative export restrictionssuch as export taxes, it would be useful to have in place an improved, multilaterally agreed regulatory framework governing the use of these measures. According to ERS-USDA alternatives to a conventional export tax: (1) a consumption subsidy, (2) a production tax, and (3) a modification of a conventional export tax that allows additional exports after producers meet a domestic sales requirement.

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الملخص

تهدف الدراسة إلى معرفة مصادر النمو في الانتاجية الزراعية الكلية في مصر. اعتمادا على مؤشرات التنمية متعددة القطاعات المنشورة في البنك الدولي عن مصر. وكانت هذه القطاعات هي الزراعة والتنمية الريفية، وفعالية المعونة، وتغير المناخ، والاقتصاد والنمو، والنوع الاجتماعي، والقطاع العام، والقطاع الخاص، والفقر، والبنية التحتية، والعلوم والتكنولوجيا، والصحة العامة، والحماية الاجتماعية والعمل، والتجارة، والتنمية الحضرية، والبيئة، والمالية. القطاع، قسم الخارجية، وأخيرا التعليم. تم استخدامها لمعرفة المزيد من المتغيرات التوضيحية التي تؤثر علي الإنتاجية الزراعية الكلية (TFP) في مصر.

وقد تحقق ذلك من خلال:

- توضيح العلاقة بين TFP ومجموعات المؤشرات المذكورة أعلاه ؛ باستخدام مصفوفة معاملات الارتباط البسيط.
- اختيار المؤشرات المرتبطة بشكل كبير مع TFP وإجراء تحليل متعمق (الانحدار المتعدد) للحصول على نظرة أعمق على العلاقة بين TFP الزراعية وهذه المؤشرات متعددة القطاعات. ومع ذلك ، في هذه الخطوة ، تم تقسيم المؤشرات إلى ٣ مجموعات وفقًا لتوافر البيانات ؛ ٥٤ سنة (١٩٦١-٢٠١٤) ، ٤٤ سنة (١٩٧١-٢٠١٤) ، و ٢٥ سنة (١٩٩٠-٢٠١٤).

بالنسبة للتحليل(٥٤ سنة) ، فإن العلاقة بين TFP في القطاع الزراعي المصري وكل من الإدخار المحلي الإجمالي، سعر الصرف الرسمي إيجابية وإحصائية ذات دلالة إحصائية. ولكن ، العلاقة بين TFP في القطاع الزراعي المصري وصادرات المواد الخام الزراعية كانت سلبية وليست ذات دلالة إحصائية. أما بالنسبة للتحليل (٤٤ سنة) ، فإن العلاقة بين TFP في القطاع الزراعي المصري وكل من صافي المعونات الرسمية للتنمية، استهلاك الطاقة الكهربية، الواردات من السلع والخدمات إيجابية وذات دلالة إحصائية. ولكن ، العلاقة بين TFP في القطاع الزراعي المصري واستهلاك الوقود الحفري كانت سلبية وليست ذات دلالة إحصائية. أما بالنسبة للتحليل(٢٥ سنة) ، فإن العلاقة بين TFP في القطاع الزراعي المصري وكل من خدمات النقل(ممثلة في خطوط السكك الحديدية)، والاستثمار الاجنبي المباشر إيجابية وذات دلالة إحصائية كبيرة. ولكن العلاقة بين TFP في القطاع الزراعي المصري و الضرائب علي الصادرات هي سلبية وليست ذات دلالة إحصائية.

تبرز الدراسة :

- أهمية سعر الصرف الرسمي واستقراره النسبي في نمو TFP وكذلك الواردات السلعية عندما تكون التكنولوجيا متقدمة نسبياً حيث أن التجارة في هذه الحالة تعمل كحامل للمعرفة.
- دعم الأنشطة الموجهة للتصدير التي تزيد من القيمة المضافة ، وليس المواد الخام.
- إعادة توجيه وتشجيع المساعدات الخارجية الإنمائية الرسمية على الزراعة ، ينبغي إبقاء القروض إلى الحد الأدنى من قيمها للحد من مستويات المديونية وعدم تحميلها على الديون الخارجية الثقيلة. إن تحسين إدارة المساعدات الخارجية وتنسيقها سيزيدان من الأثر الإيجابي والكفاءة لنظام المعونة. سيؤدي رفع الدعم الفني والمالي إلى تحسين أداء المشروعات التي تمولها الجهات المانحة. كما أن الاستفادة القصوى من الموارد المالية الخارجية ستؤثر إيجابيا على القدرة التنموية الوطنية لمصر.
- المساعدات المجزأة التي تأتي في العديد من الشرائح الصغيرة من عدد كبير من المانحين – تخلق تكاليف معاملات مرتفعة وتجعل من الصعب على الدول الشريكة إدارة تنميتها بشكل فعال. كما أن تجزئة المعونة يزيد من خطر الازدواجية وعدم كفاية توزيع المعونة بين المانحين. ايضا تنفيذ خطط تطوير خاصة بكل محافظة خاصة تلك التي تتلقى نسباً أقل من المساعدة.

- البنية التحتية ليست مهمة فقط لنمو الإنتاجية بل إنها تثيرها أيضًا. ومع ذلك ، من المهم مراقبة إدارته وتمويله عن كثب. إنتاج الكهرباء.
- تعزيز دور المؤسسات الزراعية وإيلائها اهتمام كبير لبرامج التدريب على العمالة الزراعية سواء الممولة محليا أو الممولة دوليا.
- اعتماد استخدام أكثر كفاءة للوقود الأحفوري ؛ باتباع جداول الصيانة الخاصة بالآلات الزراعية ، وذلك باستخدام الآلات الموفرة للطاقة ، وكذلك إصلاح وبناء الطرق الصالحة للنقل الكفء ؛ يمكن نقل هذه الفكرة إلى المناطق الريفية من خلال وسائل الإعلام إلى جانب الإرشاد الزراعي.
- تعزيز خدمات النقل الريفي من خلال: معالجة أوجه القصور والممارسات الاحتكارية لمشغلي النقل في المناطق الريفية ؛ تحسين كفاءة عمليات التخزين والتسويق الشاملة بعد الحصاد ؛ تحسين ممارسات دمج الأحمال لخفض التكاليف وزيادة القدرة على المساومة للمزارعين ؛ تطوير سلاسل الإمداد الزراعي الحديثة ، خاصة لمحاصيل التصدير ذات القيمة العالية وتلبية الطلب من محلات السوبر ماركت المتكاثرة؛ زيادة القدرة على التكيف مع تأثيرات المناخ ، بما في ذلك من خلال تحسين الطرق الريفية ؛ إنشاء جمعيات أو تعاونيات المزارعين لخفض سعر النقل من خلال ترتيب وشراء مدخلات زراعية (مثل الأسمدة) بكميات كبيرة
- تحسين الموارد المائية في المناطق الريفية من خلال.
  ١. ضمان إمدادات المياه لزراعة آمنة
  ٢. تطوير مناهج جديدة في إدارة المياه الزراعية
  ٣. تطوير إدارة المياه الزراعية المناسبة للفقراء
  ٤. تخفيف الآثار البيئية والصحية للأنظمة الجديدة والقائمة
- تبني السياسات الخارجية والداخلية التي تشجع الاستثمار الأجنبي المباشر وإعادة توجيهه لإعطاء أولوية أكبر للتدريب على العمل الزراعي وكذلك للمحافظات المهملة.
- ولتجنب التداعيات السلبية لقيود التصدير الكمية مثل ضرائب التصدير ، سيكون من المفيد وجود إطار تنظيمي محسّن ومتفق عليه من جانب الأطراف ينظم استخدام هذه التدابير. البدائل لضريبة التصدير التقليدية: (١) إعانة الاستهلاك ، (٢) ضريبة الإنتاج ، و (٣) تعديل ضريبة تصدير تقليدية تسمح بصادرات إضافية بعد أن يفي المنتجون بمتطلبات المبيعات المحلية.