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PRODUCTIVITY GROWTH AND FACTORS AFFECTING LABOR PRODUCTIVITY IN EGYPTAIN ECONOMIC SECTORS*

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ABSTRACT

This paper analyzes sources of productivity growth in Egypt for the past 25 years. Single productivity indexes, such as Labor Productivity (LP), MultiFactor Productivity (MFP) and Incremental Capital Output Ratio (ICOR) were used to examine the performance of labor and capital. The paper approaches the task of forecasting 20 years into the future. Sensitivity analysis helps to decide which sector more effective to maximize the total Gross Domestic Product (GDP). By improving productivity, we can increase the price competitiveness of Egyptian products and create the necessary conditions for increasing our standard of living. Although productivity improvement is important, it does not always succeed. A firm may have a real intention to improve productivity, but there are many things which restrain their ability to achieve this aim. The factors which make the efforts to improve productivity ineffective, or even prevent improvement operations can be called obstacles to productivity improvement. In this paper an attempt is made to analyze the factors negatively affect labor productivity, and rank these according to their relative importance.

KEY WORDS: Productivity growth, Labor productivity, Forecasting, Importance index.

PRODUCTIVITE ET CROISSANCE DE FACTEURS AFFECTANT LA PRODUCTIVITE DU TRAVAIL DANS LES SECTEURS ÉCONOMIQUES EGYPTAIN

RÉSUMÉ

Ce document analyse les sources de croissance de la productivité en Egypte pour les 25 dernières années. Indices de productivité unique, tels que la productivité du travail (LP), la productivité multifactorielle (PMF) et incrémentale coefficient de capital (ICOR) ont été utilisés pour examiner le rendement du travail et du capital. Le document aborde la tâche de la prévision 20 ans dans le futur. L'analyse de sensibilité permet de décider quel secteur plus efficace pour maximiser le total produit intérieur brut (PIB). En améliorant la productivité, nous pouvons accroître la compétitivité des prix des produits égyptiens et créer les conditions nécessaires pour accroître notre niveau de vie. Bien que l'amélioration de la productivité est importante, elle ne réussit pas toujours. Une entreprise peut avoir une réelle intention d'améliorer la productivité, mais il ya beaucoup de choses qui limitent leur capacité à atteindre cet objectif. Les facteurs qui font des efforts pour améliorer la productivité inefficaces, voire empêcher les opérations d'amélioration peuvent être appelés des obstacles à l'amélioration de productivité. Dans ce papier une tentative est faite pour analyser les facteurs qui influent négativement sur la productivité du travail, et de classer ces derniers selon leur importance relative.

MOTS CLÉS: CROISSANCE DE LA PRODUCTIVITE, LA PRODUCTIVITE DU TRAVAIL, DE LA PROSPECTIVE, DE L'INDICE D'IMPORTANCE.

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1. INTRODUCTION

Productivity is one of a number of key indicators of the vitality or strength of an economy, and possibly the most fundamental determinant of long-term economic growth. There are two widely accepted measures of productivity: LP and MFP. There is a definite link between productivity and standard of living; it is not a direct one. A precise mathematical formula does exist to explain this relationship [1]. Standard of living or GDP per capita, is equal to:

$$\frac{GDP}{Hours\ Worked} \times \frac{Hours\ Worked}{Employment} \times \frac{Employment}{Labour\ Force} \times \frac{Labor\ Force}{Population} = \frac{GDP}{Population} \quad \ldots\ldots\ldots (1)$$

The eminent growth after the 1973 war was driven by high growth in capital accumulation and productivity. The poor performance in the 1980s could be attributed to the slowdown in capital growth as well as the dismal growth in productivity. This downward trend in capital growth continued even after the structural adjustment program in 1991 raising the contribution of labor in economic growth to a level close to the contribution of capital. Productivity, on the other hand, has shown signs for improvement starting from the second half of the 1990s [2]. Egypt's productivity performance has been uneven, the period 1962-2000 exhibited frequent fluctuations in the annual growth rate of total factor productivity (TFP) and of real gross domestic product (GDP). The mean rate of TFP growth was modest, averaging 0.93 percent per annum, with a moderately high mean rate of GDP growth exceeding 5 percent annually [3]. The statistical trend for growth in total economy of U.S. labor productivity (LP) ranged from 2.75 percent in early 1962 down to 1.25 percent in late 1979 and recovered to 2.45 percent in 2002, the task of forecasting 20 years into the future by extracting relevant precedents from the growth in labor productivity and in MFP over the last seven years, the last 20 years, and the last 116 years. Over the next 20 years (2007-2027) growth in real potential GDP will be 2.4 percent, growth in total economy LP will be 1.7 percent, and growth in NFPB sector labor productivity will be 2.05 percent. The implied forecast 1.50 percent growth rate of per-capita real GDP falls far short of the historical achievement of 2.17 percent between 1929 and 2007 [4]. Long-term forecasting is likely to be dominated by trend curves, particularly the simple linear and exponential trends [5].

2. PRODUCTIVITY ESTIMATION

This section explains the methods used for calculation and estimation of productivity, and identifying the variables used in our case study. The major economic variables included in this study are:

1. Gross Domestic Product (GDP) in constant prices of year1982, the growth rate of GDP is taken as an indicator of economic growth.
2. Total employment per year (L).
3. Capital (K). Due to the lack of data on capital stock, incremental capital-output ratio (ICOR) and a perpetual inventory method as demonstrated below were used to construct the capital data series [6]. The ICOR was computed using the following formula:

$$ICOR_{2007-1982} = \sum_{1982}^{2007} I_t \Big/ (GDP_{2007} - GDP_{1982}) \ldots (2)$$

where I_t is investment in year t. The calculated ICOR was multiplied by the 1982 GDP in real terms to generate capital stock in that year. Then, the perpetual inventory method was used to construct the capital stock series, according to the following formula:

$$K_t = K_{t-1} + I_t \quad \ldots\ldots\ldots (3)$$

where, K_t and K_{t-1} are capital stocks in period t and t-1, respectively. The utilization of capital and labor will be explored. For this purpose, the Incremental Capital-Output Ratio (ICOR) and labor productivity (LP) indices will be used:

$$ICOR = I/\Delta GDP \quad \ldots\ldots\ldots \quad (4)$$

$$LP = GDP/L \quad \ldots\ldots\ldots \quad (5)$$

These indices will be estimated for the economy as a whole and for its major sectors. A comprehensive analysis of the relative contribution of growth will be performed. These sources include capital, labor, and multifactor productivity (MFP). This analysis will also be conducted for the whole economy and for its major sectors. The methods used to conduct this task are the Kendrick's arithmetic measure [7]. The Kendrick's arithmetic measure is computed from the formula:

$$\Delta A/A = \Delta Q/Q - \alpha \times \Delta K/K - \beta \times \Delta L/L \quad \ldots (6)$$

$$Or \quad g(MFP) = g(Y) - \alpha \times g(K) - \beta \times g(L) \quad \ldots (7)$$

where g (MFP) is the growth in Multifactor productivity, g(Y) is the growth in Output (GDP), g (K) is the growth in capital, and g (L) is the growth in labor input. The parameters α and β are, respectively, the capital and labor shares of the output. The sum of α and β is unity.

3. EVALUATING INDUSTRIAL SECTOR

This section compares the industrial sector productivity growth and capital efficiency with those for major sectors in Egypt.

3.1. Gross Domestic Product

Gross Domestic Product (GDP) at constant prices increased from EGP 21526 to 66005.4 Million, i.e., rose by 206% during the 1982-2007 period, Egypt population increased from 46755000 to 80061000, i.e., rose by 71% during the same period, The Gross Domestic Product per capita (GDPP) obtained by dividing GDP by population, GDPP at constant prices increased from EGP(Egyptian Pound) 460.4 to 824.439, i.e., rose by 79%, Fig.(1).

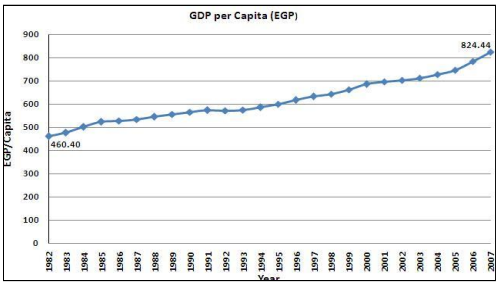

Fig.(1): GDP per Capita at Constant Price

The average ratio of industrial sector GDP to that for total sector is 17%, and the average ratio of labor in industrial sector to that for total sector is 11%, GDP for Industrial is less than that for Agriculture sector before 1990, at the beginning of this year (1990) the GDP for Industrial sector takes in increase by high rates, Fig. (2). GDP for Industrial sector exceeds that for Oil sector at the beginning of year 1987 and the difference between them increased with time, Fig. (3). For our entire period, the Industrial sector GDP was higher than that for Construction sector with increased difference, as shown in Fig. (4). GDP for Suez Canal sector is very small compared with Industrial sector, as shown in Fig. (5). The average value of GDP growth for industrial sector is 6.46 which is the highest value of all sectors.

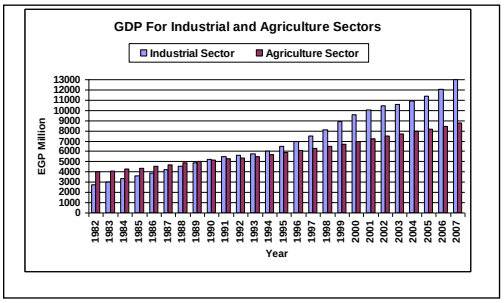

Fig.(2): GDP for Industrial and Agriculture sectors

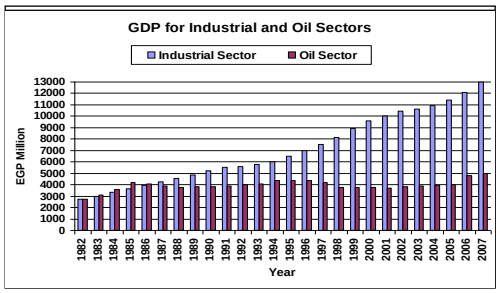

Fig.(3): GDP for Industrial and Oil Sectors

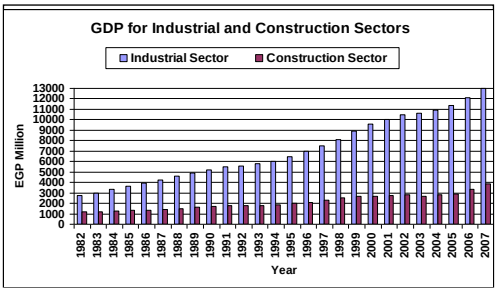

Fig.(4): GDP for Industrial and Construction Sectors

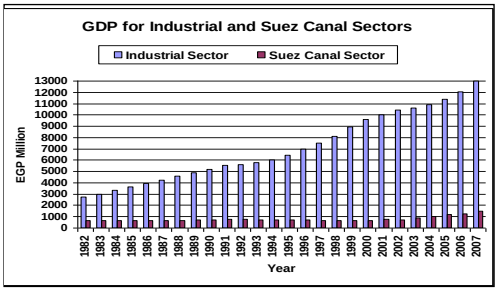

Fig.(5): GDP for Industrial and Suez Canal Sectors

3.2. Labor Productivity

Labor productivity is helpful in demonstrating the effective use of labor, and in determining the optimal allocation of labor among sectors. The only sustained manner in the long run to increase per capita income is by increasing the amount of output produced per worker that is by raising labor productivity. Labor productivity is calculated by dividing GDP by Workers number (employee). Figs. (6) through

(11) show labor productivity (LP) for industrial sector compared with each sector and total sectors. In Fig. (6) LP for industrial sector is higher than that for total sectors, that is because the labor number in total sectors is large number, the difference between labor productivity for industrial sector and that for Total sectors increased with time. It is clear from Figs. (7), (9), and (11) that the labor productivity for industrial sector is higher than that for Agriculture, Construction and Service sectors. In Figs. (8) and (10) labor productivity for Oil and Suez Canal sectors is higher than that for industrial sector, that is because the labor number in Oil and Suez Canal sectors is very small compared with other sectors. On the other hand the GDP for industrial sector is higher than that for Oil and Suez Canal sectors see Figs. (3) and (5).

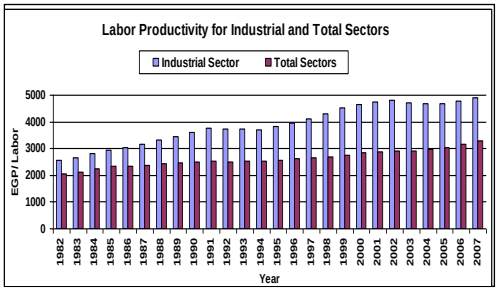

Fig.(6): LP for Industrial and Total Sectors

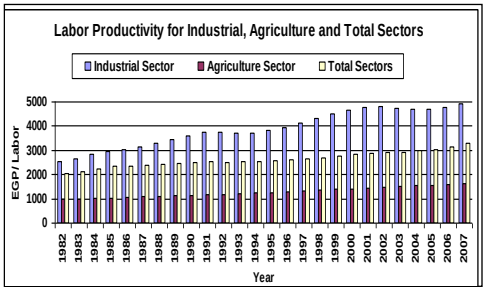

Fig.(7): LP for Industrial, Agriculture and Total Sectors

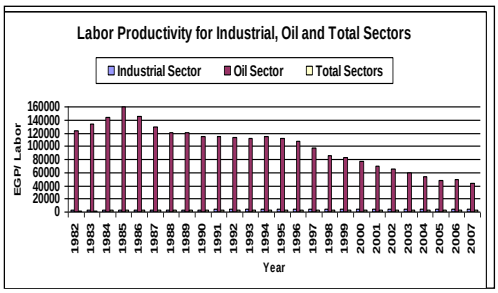

Fig.(8): LP for Industrial, Oil and Total Sectors

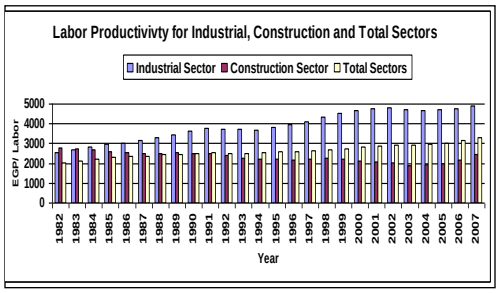

Fig.(9): LP for Industrial, Construction and Total Sectors

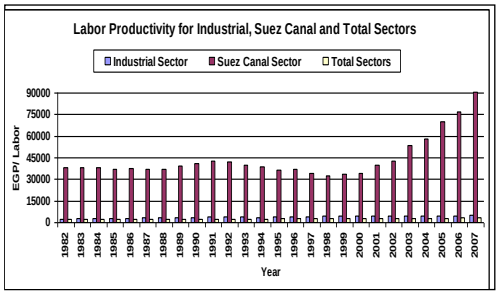

Fig.(10): LP for Industrial, Suez Canal and Total Sectors

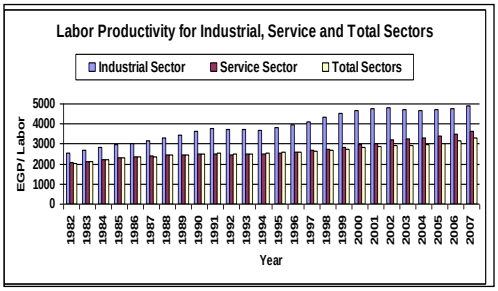

Fig.(11): LP for Industrial, Service and Total Sectors

3.3. Investment

This section discusses the investment in each sector. The total investment in EGP Million is the summation of investment in the public and private sectors. Figs. (12) through (17) showing the investment in each sector for our period compared with industrial sector. As shown in figures the investment in industrial sector is the highest value of the major sectors

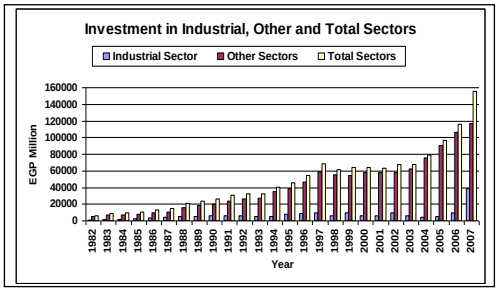

Fig.(12): Investment in Industrial, Other and Total Sectors

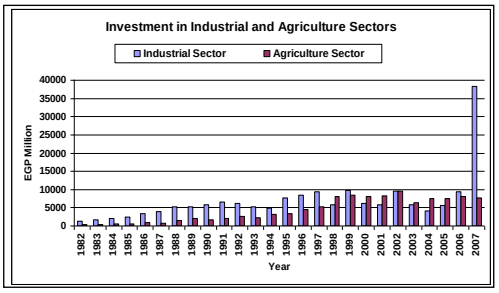

Fig.(13): Investment in Industrial and Agriculture Sectors

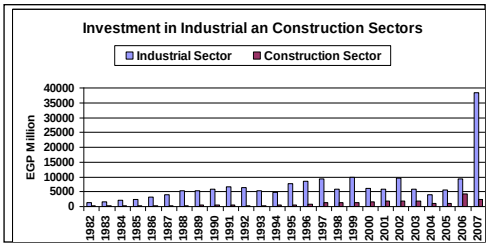

Fig.(14): Investment in Industrial and Construction Sectors

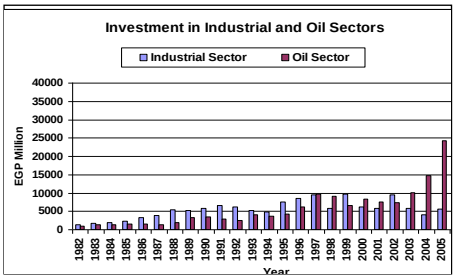

Fig.(15): Investment in Industrial and Oil Sectors

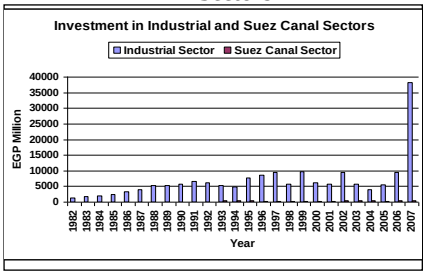

Fig.(16): Investment in Industrial and Suez Canal Sectors

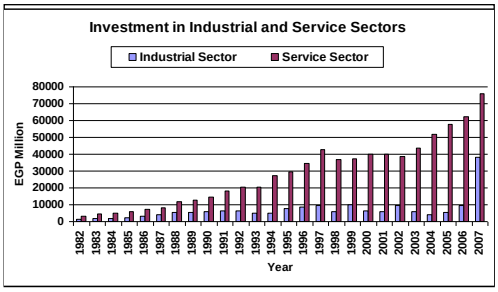

Fig.(17): Investment in Industrial and Service Sectors

3.4. Incremental Capital-Output Ratio (ICOR)

One measurement of the effective utilization of capital is ICOR. It is calculated by the division of investment (I) by the change in related output (GDP). This ratio indicates the level of capital's productivity, i.e. the effect of increase in capital on output. Although it is not always satisfactory, this measure is helpful in: (a) Evaluating the efficiency of capital utilization over time, (b) Determining the level of saving and investment required to fulfill a targeted level of economic growth, (c) Evaluating investment consistent with the growth attained rate, and (d) Finding the optimal allocation of investment among economic sectors. The reciprocal of ICOR is the marginal productivity of capital. Hence the smaller the ICOR, the higher is the return to capital, the higher the ICOR the lower the productivity of capital. The ICOR can be thought of as a measure of the inefficiency with which capital is used. In most countries the ICOR is in the neighborhood of 3. It is a topic discussed in Economic growth. Fig. (18) is constructed for ICOR of the total sector as indicated the higher the ICOR the lower the productivity of capital, for example in year 1992 the ICOR is higher value 10.699 from definition the efficiency with which capital is used in this year is the lower value. Figs. (19) through (23) ICOR for each sector is calculated, and represented in graphs, it is clear that for industrial sector the productivity of capital is the best except years 1992 and 2007.

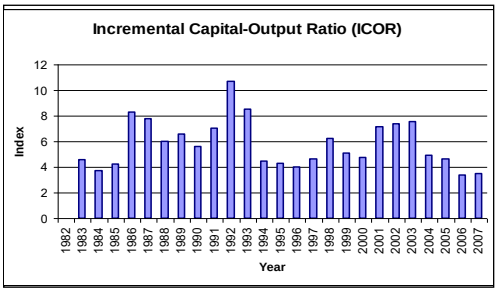

Fig.(18): ICOR for Total Sectors

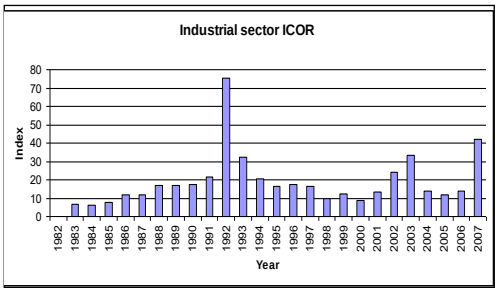

Fig.(19): ICOR for Industrial Sector

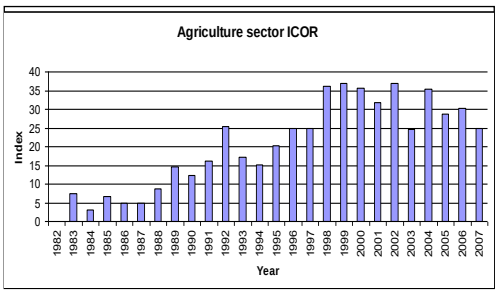

Fig.(20): ICOR for Agriculture Sector

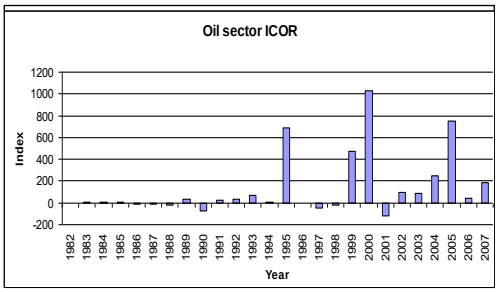

Fig.(21): ICOR for Oil Sector

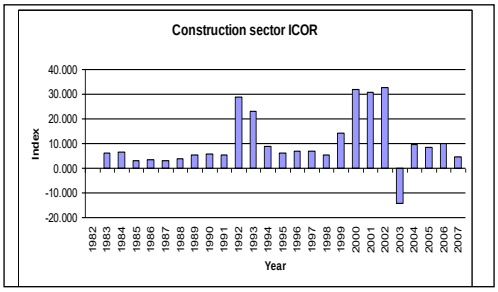

Fig.(22): ICOR for Construction Sector

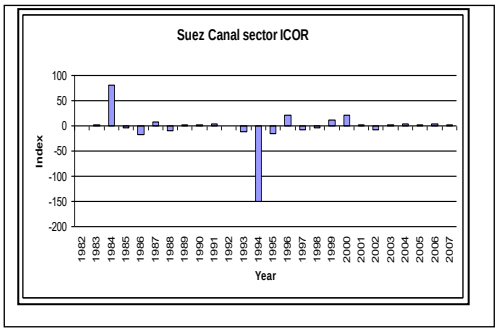

Fig.(23): ICOR for Suez Canal Sector

3.5 Multifactor Productivity

MFP growth refers to the amount of output growth not accounted by the growth in capital and labor quantity. It measures the growth in output that is not due to growth in inputs. That is, relates change in output to composite change in input performance. MFP for total and each sector is indicated in the following Figs. (24) through (29). The average MFP is negative for all sectors as shown in Table (1).

Table (1). Average MFP for sectors

Sector	Average MFP
Industrial	-1.147
Agriculture	-1.129
Oil	-7.911
Construction	-0.998
Suez Canal	-0.332

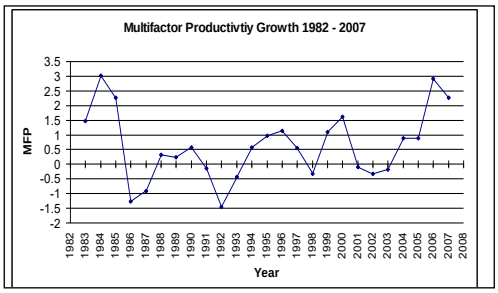

Fig.(24): MFP for Total Sectors

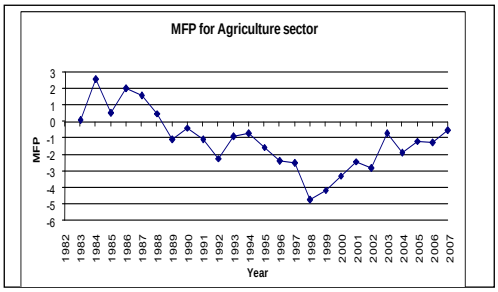

Fig.(25): MFP for Agriculture Sector

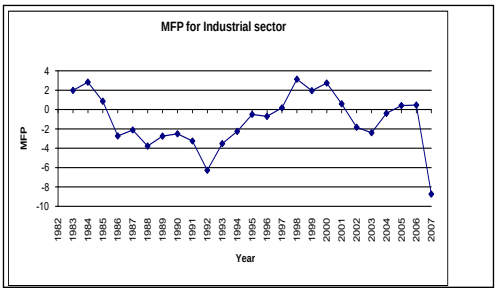

Fig.(26): MFP for Industrial Sector

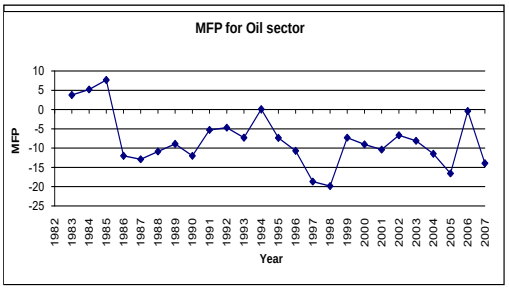

Fig.(27): MFP for Oil Sector

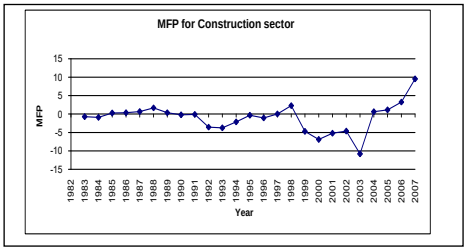

Fig.(28): MFP for Construction Sector

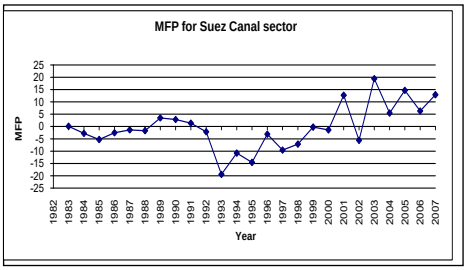

Fig.(29): MFP for Suez Canal Sector

4. FUTURE FORECASTING: PRODUCTIVITY AND GDP GROWTH

An examination of data in this paper going back to 1982 yields several possible criteria to bound the likely growth rates of GDP, GDP/capita, and labor productivity and of MFP in the future. The following Tables (2), (3) and (4) summarize the forecasting data for 20 years in the future.

MFP is fluctuating about the mean value of 0.6299. Figs. (30) and (31) show the curve estimation of GDP and LP. The cubic curve is the best prediction rather than linear, quadratic, growth and exponential.

Table (2). Average GDP forecasting

Period	Average GDP		Average GDP growth	
	Actual	Forecast	Actual	Forecast
1982-2007	39928	39930	4.595	4.551
1982-2027		75790.8		5.063
2007-2027		122410		5.755

Table (3). Average GDP/capita forecasting

Period	Average GDP/capita		Average GDP/capita growth	
	Actual	Forecast	Actual	Forecast
1982-2007	616.652	616.671	2.370	2.286
1982-2027		885.622		3.031
2007-2027		1235.259		3.961

Table (4). Average LP forecasting

Period	Average LP		Average LP growth	
	Actual	Forecast	Actual	Forecast
1982-2007	2625	2625.4	1.916	1.84
1982-2027		3917		3.35
2007-2027		5596		5.23

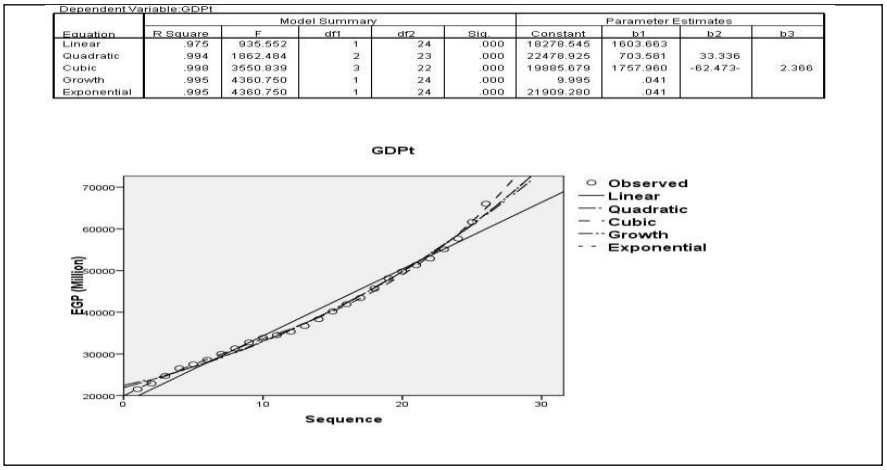

Fig.(30): Curve estimation of GDP

Dependent Variable:LPt

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.957	540.155	1	24	.000	2092.678	39.428		
Quadratic	.963	299.888	2	23	.000	2149.492	27.253	.451	
Cubic	.990	727.073	3	22	.000	1984.059	94.517	-5.661-	.151
Growth	.960	569.770	1	24	.000	7.663	.015		
Exponential	.960	569.770	1	24	.000	2128.202	.015		

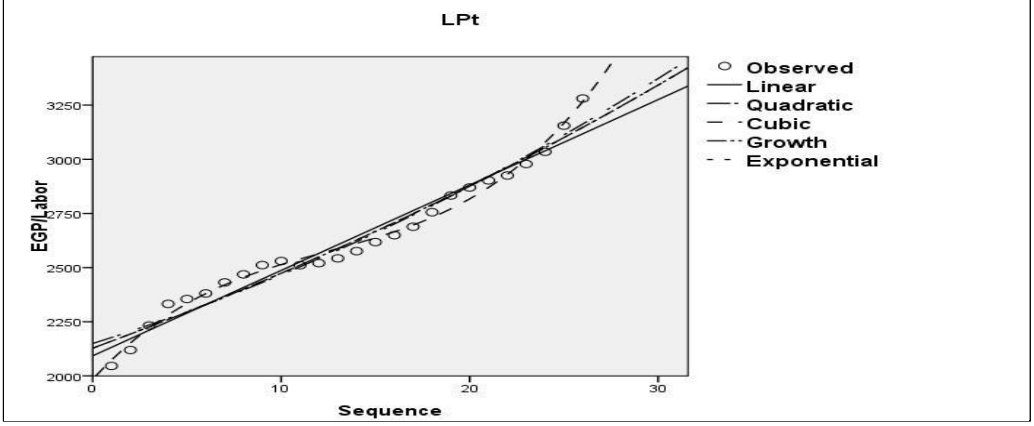

Fig. (31): Curve estimation of LP

The cubic regression equation for Total GDP

$GDP_t = 19886 + 1758\ t - 62.47\ t^{**}2 + 2.366\ t^{**}3$

S = 601.156 R-Sq = 99.8% R-Sq(adj) = 99.8%

Analysis of Variance

Source	DF	SS	MS
Regression	3	3849698549	1283232850
Error	22	7950550	361389
Total	25	3857649099	

F=3550.84 P=0.000

Sequential Analysis of Variance

Source	DF	SS	F	P
Linear	1	3761162824	935.55	0.000
Quadratic	1	72813201	70.74	0.000
Cubic	1	15722524	43.51	0.000

The cubic regression equation for Total LP

$LP_t = 1984 + 94.52\ t - 5.661\ t^{**}2 + 0.1509\ t^{**}3$

S = 32.8295 R-Sq = 99.0% R-Sq(adj) = 98.9%

Analysis of Variance

Source	DF	SS	MS
Regression	3	2350869	783623
Error	22	23711	1078
Total	25	2374580	

F=727.07 P=0.000

Sequential Analysis of Variance

Source	DF	SS	F	P
Linear	1	2273562	540.15	0.000
Quadratic	1	13322	3.49	0.074
Cubic	1	63986	59.37	0.000

5. SENSITIVITY ANALYSIS

This section helps to decide which sector more effective to maximize the total gross domestic product (GDP). By looking to the following (figures (32) through (38)), industrial sector appears more effective. Inspection of trend equations indicates that, when the slope closes to one the sector output is close to the total output (GDP) i.e. The contribution of this sector in the total GDP is larger than the others. The average output for our period is 7099.1 EGP Million for the industrial sector, which is the largest value of the major sectors, and referring back to Fig. (19) the efficiency of capital utilization over time is the best in Industrial sector. So from this study of the past the future investment must be put in the Industrial sector to maximize the total output of our country.

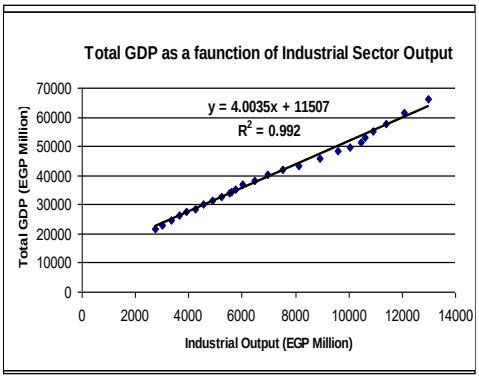

Fig.(32): Total GDP as a Function of Industrial Sector Output

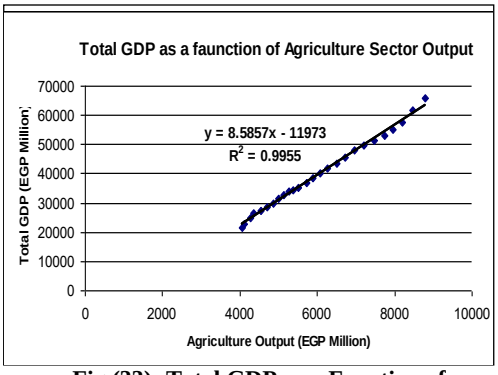

Fig.(33): Total GDP as a Function of Agriculture Sector Output

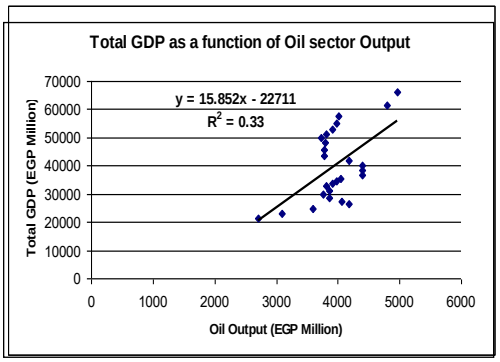

Fig.(34): Total GDP as a Function of Oil Sector Output

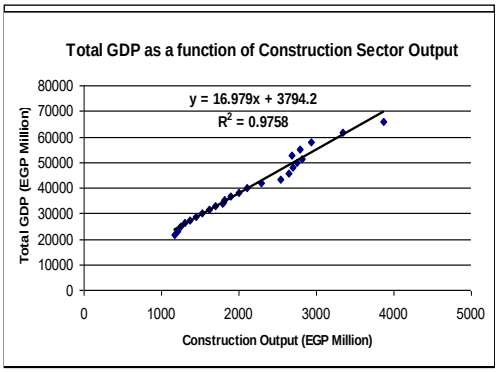

Fig.(35): Total GDP as a Function of Construction Sector Output

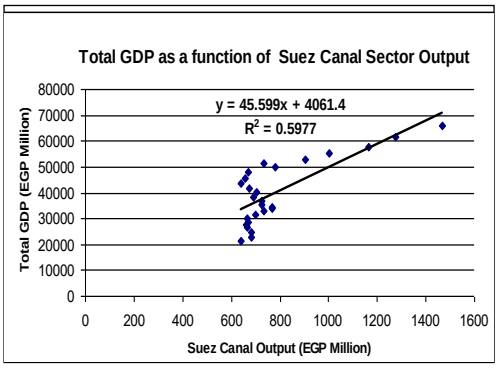

Fig.(36): Total GDP as a Function of Suez Canal Sector Output

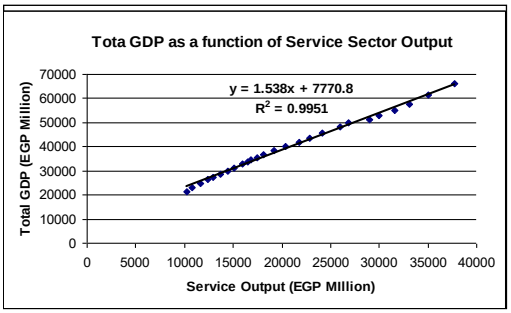

Fig.(37): Total GDP as a Function of Service Sector Output

6. FACTORS AFFECTING LABOR PRODUCTIVITY

This section analyzes the factors affecting labor productivity. The "importance index" was derived for each factor using the following formula [8&9]:

$$Importance\ index = \frac{5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \quad \ldots (8$$

where n_1 is the number of respondents who answered "strongly important", n_2 is the number of respondents who answered "important", n_3 is the number of respondents who answered "neutral", n_4 is the number of respondents who answered "not important", and n_5 is the number of respondents who answered "strongly not important".

Results indicated that out of 16 factors listed in the questionnaire, the six most important factors causing low labor productivity as shown in Table (6) are as follows:

(1) Lack of training (important index=82.2)

(2) Worker do not feel they belong in the business (important index=79.7)

(3) Worker believe that inadequate commission is giving to their dependants' needs (important index=78.8)

(4) Lack of goal orientation and awareness of mission (important index=78.7)

(5) Insufficient or unreliable tools and machinery (important index=77.7)

(6) Inadequate maintenance planning, execution and/or records (important index=77.2).

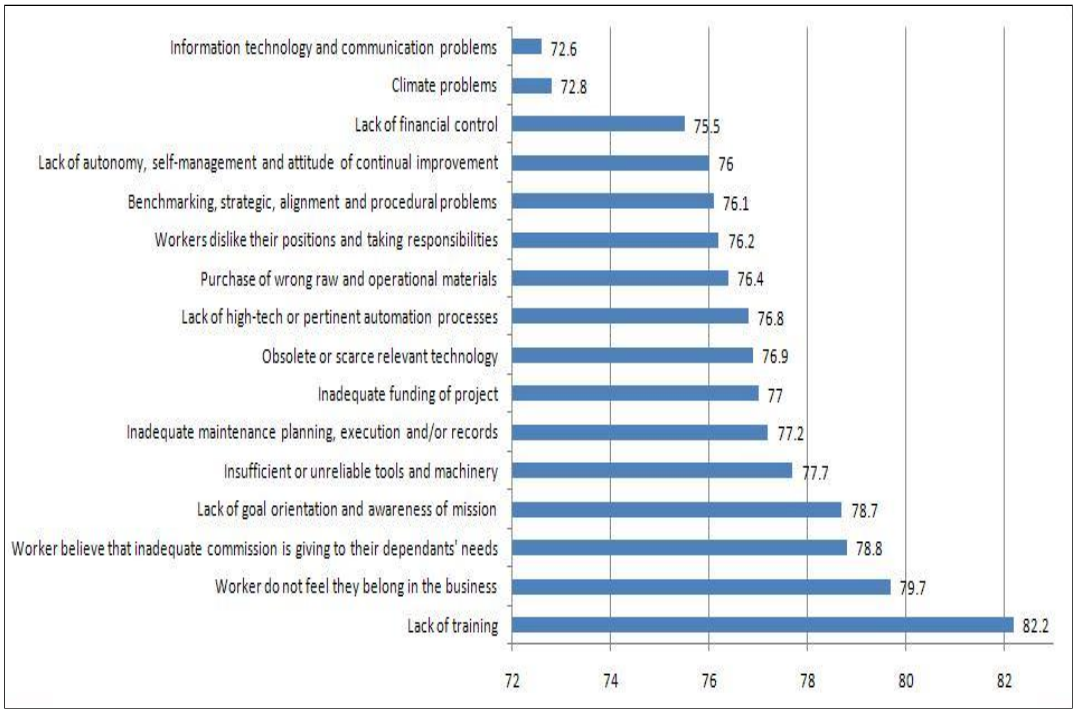

Fig.(38): Ranking of Factors Affecting LP in the Egyptian Industrial Sector

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This paper provides three perspectives on long-run growth rates of LP and of MFP for the Egyptian economy sectors, and compares the investment efficiency (ICOR) in industrial sector with the rest sectors for (1982-2007) period. From this study, the average value of output growth for industrial sector is 6.46 which is the highest value of all sectors, and that is for total economy is 4.59 and GDP/capita 2.37. LP for industrial sector is higher than that for total sectors, because the labor number in total sectors is large number. For industrial sector the productivity of capital is the best except years 1992 and 2007, the average MFP is negative for all sectors. The average growth forecast for the next 20 years of GDP, GDP/capita and LP are respectively 5.75, 3.96 and 5.23 per year. This study use the past to decide for the future which sector more effective to maximize the total GDP, so the future investment must be put in that sector. The average ratio of industrial sector GDP to that for total sector is 17%, and the average ratio of labor in industrial sector to that for total sector is 11%. GDP at constant prices increased from EGP 21526 to 66005.4 Million, i.e., rose by 206% during the period, Egypt population increased from 46755000 to 80061000, i.e., rose by 71% during the same period, The Gross Domestic Product per capita (GDPP) at constant prices increased from EGP 460.4 to 824.439, i.e., rose by 79%. The LP for industrial sector is higher than that for Agriculture, Construction and Service sectors.

But LP for Oil and Suez Canal sectors is higher than that for industrial sector that is because the labor number in Oil and Suez Canal sectors is very small compared with other sectors. On the other hand the GDP for industrial sector is higher than that for Oil and Suez Canal sectors.

The average output for the industrial sector is 7099.1 EGP Million, which is the largest value of the major sectors, and the efficiency of capital utilization over time is the best in Industrial sector. So from sensitivity analysis and the study of the past the future investment must be put in the Industrial sector to maximize the total output of our country. Lack of training was ranked as the most critical factor causing low labor productivity and the second most important factor resulting in low labor productivity is the Worker do not feel they belong in the business. Some recommendations were listed to improve productivity in the industrial sector.

7.2 Recommendations

It is recommended that companies should assign or recruit the right people to do the job, and should also keep a close eye on labor work to make sure they understand job instructions. Furthermore, it ought to maintain friendly relations with labor and let them know they are important to the organization, and involve them in decisions affecting their jobs, such as process improvements. It is important for each company to adopt motivational or personnel management measures to boost workers' morale. For example, tying compensation to performance; ensuring that pay, fringe benefits, safety, and working conditions are all at least adequate; companies have to conduct productivity studies at the operation level, such as studying factors affecting labor productivity and labor productivity measurement to describe the detailed tasks performed for an operation by individual or group in order to establish problem areas and propose ways to improve labor productivity. Companies are also encouraged to keep historical data

of productivity studies in completed projects to improve the effectiveness and accuracy of cost estimation of future projects. It is necessary to conduct training courses and seminars in the topics that will improve productivity in industrial projects. There is a need to increase the number of trade schools. More efforts should be made by companies to benefit from what other developed countries have achieved through technology transfer and best use of benchmarking.

DATA SOURCES

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-CAPMAS (Central Agency for Public Mobilization And Statistics).
-The Egyptian Cabinet, Information and Decision Support Center.
-IDA (Industrial Development Authority).

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