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An Empirical Analysis of Total Factor Productivity in the Economy of Iran

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***Abstract*-One of the key macroeconomic objectives of most countries is attaining sustainable economic growth which needs to be achieved through enhancing productivity. According to the Iranian 4th Five -Year -Plan, 31.3 percent of GDP growth is projected to be financed through enhancement of productivity.**

This study presents a model capturing sources of total factor productivity using annual time series data from 1974 to 2007. Total factor productivity in this model is determined by labor and capital stock. This paper attempts to estimate the total factor productivity and show its share on economic growth in the economy of Iran.

The findings show that productivity growth of each production factor directly affects internal grass production positively. Empirical estimates indicate that the share of productivity growth of production factors has been reduced from 9.5 percent at the beginning of period (1974) to 5.3 percent at the end of period (2007).

Key Words- Total Factor Productivity, Economic Development, Economy of Iran

I. INTRODUCTION

The word productivity has been used in economic culture since two centuries. In many places of the world especially in industrial countries, productivity is assumed as a thought and culture Productivity is a subject which has been attended from different aspects and its importance is enhanced day by day. It is a common subject of economy and management. As there is limitation of resources and innumerable needs of humankinds, increasing of population, and extreme competition in universal economy, so the improvement of productivity is not a choice but a necessity. Undoubtedly, nowadays, economic growth and development of various societies depend on the growth of productivity.

There is a consensus among economists that productivity growth plays a substantial role in enhancing standards of living and international competitiveness. As higher productivity translates into higher per capita income, individuals benefit from higher standards of health care, better education and public welfare. Romer (1990) demonstrates the way in which public and private resources devoted to the development of new ideas and new products can accelerate economic growth and productivity [1]. On the other hand, the neo-Schumpeterian models of Aghion and Howitt (1998) analyzed the economic impact of research into product improvement rather than product diversity [2]. Nevertheless their overall conclusions were the same as those of Romer. That is, increase in productivity, brought about by new or improved products and processes, such as information and communication technologies (ICTs), will directly and indirectly result in increased returns to capital investment and consequently lead to a sustained level of growth of GDP. Therefore, it can be stated that the estimates based on growth-accounting procedures underestimate the true contribution of productivity growth.

There are various types of the productivity in economic texts where all of them show the appropriate ways of using the sources to achieve the assumed aims. There are three kinds of productivity: Minor Productivity, Total Productivity of Factors and Total Productivity.

Minor Productivity: it means the ratio of the output to one of the inputs. For instance, the productivity of labor which is equal to the ratio of output to the labor input and this is a minor productivity scale. Similarly, capital productivity is equal to the ratio of output to the capital stock. Also material productivity is equal to the ratio of output to the material input which is a minor productivity.

Total Productivity: it means the ratio of genuine output to the total input of labor expenditure and capital stock. To achieve of genuine output, we should minus the purchased goods and dealing services from the total output. It should be noticed that in this scale only labor and capital stock inputs must be considered.

Total Factor Productivity: TFP means, the ratio of total output to the collection of all input factors. In this case, total productivity reflects the effects of all inputs on output production. In other words, total productivity of production factors is a combined productivity of all inputs.

The aim of this study is to estimate the TFP growth during 1974-2007 and to identify their share in the economy of Iran along with the estimation of the share of labor factor growth and amount of the capital on the internal gross product during the mentioned period.

II. DEFINITION

Generally over two centuries, the concept of productivity is defined as the relation between output and input, and applied in different circumstances of various levels of aggregation in the economic system. It is argued that productivity is one of the basic variables governing economic production activities, perhaps the

most important one [3]. However, productivity is often relegated to second rank, and neglected or ignored by those who influence production processes [3, 4, 5, 6]. A major reason for this could be that many managers do not understand what the term productivity actually means. In fact, productivity is frequently discussed by managers but rarely defined, often misunderstood and confused with similar terms, and seldom measured in an appropriate way, leading to productivity being disregarded Due to Koss and Lewis (1993) remarkably many managers who makes decisions every day about improving plant efficiency do not know how to answer the simple question: "What do we really mean by productivity?" Nevertheless, if we do not fully understand what productivity is, how can we decide what productivity measures to use? How can we interpret them correctly? How can we know what actions to take to improve productivity? Evidently, the confusion surrounding the subject makes it necessary to further investigate and emphasize the basic meaning of productivity [7]. Hence, an improper definition of productivity will often result in that action is being misdirected [8].

The term productivity is commonly used within academic and commercial circles; it is however rarely adequately defined or explained. Indeed it is often confused and considered to be interchangeable, along with terms such as efficiency, effectiveness, performance and profitability [9, 10, 11, 12, 13].

Measurement and improvement regimes are often built without a clear understanding of what is being measured or improved. This can be regarded as simply a pragmatic approach to improvement, or a missed opportunity to fully understand important factors relating to competitiveness and success. Certainly, shared vocabulary and grammar is helpful within academia, for ensuring rigorous and robust development of shared understanding.

Over two centuries ago, Quesnay used the term productivity [14]. Since then it has been applied in many different circumstances at various levels of aggregation, and in relation to economic systems [15]. It has been argued that productivity represents one of the most important basic variables governing economic activities [16]. Grossman (1993), for example, discusses productivity improvement as one of the key competitive advantages of an enterprise [17].

Companies need to realize that a gain in productivity is one of their major weapons to achieve cost and quality advantages over their competition. In spite of the fact that productivity is seen as one of the most vital factors affecting competitiveness of economic activities, many researchers argue that productivity is often relegated to second rank, and neglected or ignored by those who influence production processes [18].One reason for this is the lack of common agreement on what the term represents. Though the term widely used, it is often misunderstood, leading to productivity being disregarded or even to contra productive decision making [6,9].Chew suggests that even though the concept of productivity has existed for a long time, people who make decisions every day about improving plant efficiency do not know how to answer the simple question of what productivity is. This suggests that productivity is a multidimensional term, the meaning of which varies, depending on the context within which it is used. However, common characteristics are there which tend to be embraced by the term [10].However; there are numerous variations on this basic ratio, which is often a wide definition to be useful in practice such as; [19]

- There are three broad categorizations:
  - *a)* The technological concept: the relationship between ratios of output to the inputs used in its production.
  - *b)* The engineering concept: the relationship between the actual and the potential output of a process.
  - *c)* The economist concept: the efficiency of resource allocation.
- Productivity is efficient use of human and capital resources
- Productivity is what man can accomplish with material, capital and technology.
- Productivity is personal issue. It is an attitude which we must continuously improve ourselves and the things around us.
- Productivity is unit of output to the unit of input.
- Productivity is actual output to the expected resources used.
- Productivity is value added to the input of production factors.
- Productivity is the central long-run factor determining average living of any population.
- Productivity is a comparison of the physical inputs to a factory with the physical outputs from the factory.
- Productivity is the ability to satisfy the market's need for goods and services with a minimum of total resource consumption.

III. Review of Literature

There have been many studies on productivity within past decades. Dowrick (1990), in his empirical examination of labor productivity in Australia, identified the major determinants of the 1980s productivity slump. His econometric results indicate that slowing down of labor productivity after 1983 was mainly associated with capital dilution, reflecting a small fall in investment as well as a sharp expansion of hours worked between 1983 and 1988. [20].

A study done by Hauner (2005) on productivity by using data envelopment analysis (DEA). He found that, there was no evidence to which average productivity would respond to deregulation during the period 1995-1999 among large German and Austrian banks [21].

Amini (2006), measured and analyzed labor, capital, and total factors as mentioned in the Iranian 4th 5-year-

programme for development from 1991 to 2003. Due to the outcomes the productivity index of labor has increased 0.9 percent during the mentioned periods in the economy of Iran. Cogel (2005) surveyed the effect of person age on total productivity. In his research, He concludes that according to the temporary data of the countries the ratio of the young dependence deduces the total productivity of the product factors [22].

Kong and Tongzon (2006) examined the total factor productivity for ten major sectors of Singapore during 1985-2000. They used the non-parametric, frontier methodology known as data envelopment analysis to calculate the Malmquist Productivity Index at sectoral level. The analysis of the results identified the best practiced sectors and straggler in terms of efficiency change, technical change and total factor productivity change [23].

Afzal (2006) estimated total factor productivity for the large scale manufacturing sector from 1975 to 2001 using three different approaches. Overall results showed that productivity was affected by many factors like labor, capital, gross national product and per capita income [24].

Diaz and Sanchez (2008) analyzed the performance of the small and medium Spanish manufacturing firms during 1995-2001. The findings of the results suggested that small and medium firms are more efficient than large firms [25].

Basti and Akin (2008) compared the productivity of domestic owned and foreign owned firms operating in Turkey. They selected non financial firms listed on Istanbul Stock Exchange for period 2003-2007. The results of the study indicated that there were no differences in terms of productivity of domestic owned and foreign owned firm [26].

IV. Methodology

The simple definition of TFP means the productivity average weight of all inputs in which every input weight is equal to their shares in total production expenditure. Suppose that the in-puts are measuring regarding to the physical unit like ton, hence, TFP is calculated as the ratio of output Y to accumulated input X: TFP=X/Y (1)

$$dX/X = \sum_{i=1}^{n} V_i \frac{d X_i}{X_i} \quad (2)$$

If the function be as follows:

$$Y = A K^{\beta} L^{\alpha} \quad (3)$$

Therefore, for computation of output growth(Y) we have: dY/Y=d A/A+ β d K/K + α d L/L (4) in which; d Y/Y shows the percentage rate of the changes of Y during the investigated period. The amount of output due to every worker can increase for two reasons: first TFP, the coefficient of A should increase and secondly, the rate of capital due to every labor should also increase. To calculate each production factor we should do the following: The share of capital factor growth = Capital factor coefficient in product growth × function annual average growth of capital factor

The share of labor factor growth= labor factor coefficient in product growth × function annual average growth of labor factor

The share of TFP growth= factor growth (capital growth factor share + labor factor growth share) – annual average growth of economy.

For this research, Cobb-Douglas function has been used. This function is homogenous to the degree of one.

$$GDP = AL^{\alpha}K^{\beta} \quad (5)$$

One of the known methods of model estimation is the ordinary least squares (OLS) method. Estimation and calculation by Cobb-Douglas production function has been done in this part by considering the collected data of product function during 1974-2007.

By assuming labor and capital stock variables and product function, GDP= A Lα Kβ, the following results for t, F, and R^2 have been achieved.

TABLE 2

Statistics(t)	Value of Estimated Coefficient	Coefficient
2.25	6.0	α
2.40	4.0	B

Ln GDP = 0.6Ln L + 0.4 Ln K

R^2=0.69 F=72.3 n=33

The revealed model regarding to the theoretical, statistical, and economic scales is one of the acceptable indexes which can be used as a model.

V. Findings

The coefficient of labor in this model is 0.69. It means, due to the exponent product function this number shows the share of labor in GDP. According to statistics, this coefficient has sufficient liability because the achieved number is 53.2 is bigger than t statistic (96.1) with 95 percent insured which is meaningful. Here H_0 base of α=0 is rejected and H_1 shows the meaningfulness of the coefficient. The achieved t for capital coefficient in product function is 4.2 which statistically approve the amount of capital coefficient which is 4.0 because the achieved t is 4.2 bigger than the table t (96.1) which is acceptable. If the total of α and β coefficients be 1, the fixed outcome will be equal to the ratio of scale and in this function the total of product function coefficients is 1 and theoretically it is acceptable. According to existing formulas, labor, capital and TFP productivity growth are calculated. Due to the calculated t for labor and capital, the productivity growth of every product factor had positive effect on economic growth and therefore, first and second assumptions are accepted.

The revealed table shows the outcomes of labor-force, capital, and TFP shares in different years. As it shows, the share of productivity of labor-force and capital in 1974 was more than 2007. And also it is alleged that the

deduction of labor productivity share in economic growth is 85percent and it is more than the deduction in capital productivity share. TFP share is available for each decade and table 2 shows that it is negative in 1978, 1987, and 1997. The deduction of TFP was 36 percent. The negative growth of each product factor share is considerable and it should be considered by policy-makers and the aim should be the appropriate usage of the existing sources for economic growth.

TABLE 3

Share of TFP	Share of K	Share of L	Year
5.91195178	7.254443	1.990570274	1974
-13.23108312	4.268585	1.586893736	1978
-2.353766054	-0.27868	1.637281553	1987
-1.600670083	1.848811	2.557286893	1997
3.575329833	2.781166	0.298559618	2007

VI. Conclusion and Recommendation

In this research with existing statistics of labor-force and capital along with the Cobb-Douglas production function, the productivity share of each product factor and TFP Productivity share have been calculated. The results of the model are as follows:

The productivity share of TFP in 1974 was 9.5 and this amount has been reduced to 5.3 at the end of period.

As it was seen the total 2 model, theoretically the product function is acceptable. Now, according to the present formulas, labor, capital and TFP productivity growth are calculated. Calculated (t) of labor and capital show that the productivity growth of each product factor directly has a positive effect on GDP (economic growth). Therefore, the first assumption of this study (the productivity growth of TFP in Iran has had a positive effect on GDP within (1974-2007) is acceptable. Due to the results, the second assumption (the average productivity growth of capital is more than the average productivity growth of the labor) is also acceptable. The outcomes also show that the share of productivity growth of all product factors has been reduced from 9.5 percent in 1974 to 5.3 percent in 2007.

Because of the outcomes, the increase of productivity growth of labor can have positive effect on economic growth and for more affectivity of it the education and capital accumulation should be considered and hence the first step of productivity growth will be started.

Summing up, we can say that the economic growth have correspondence with the increase of product factors and also the growth of productivity. Therefore, economic planners and policy-makers should consider both the growth of product factors and productivity growth of TFP.

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