*I J A B E R*, Vol. 13, No. 4, (2015): 1953-1962

# INVESTIGATING THE EFFECT OF LABOR PRODUCTIVITY IN INDUSTRY ON IRAN'S ECONOMIC GROWTH

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***Abstract:*** *The importance of economic growth in all countries and defined economies is an obvious issue. Numerous studies have proven that economic growth is the function of a number of internal and external factors. Therefore, identification and assessment of various influential factors is necessary and important. Given the existing theoretical basics on variables affecting economic growth; capital per capita, research and development expenditures, human capital as well as labor productivity in the industrial sector over the years 1987-2011 were used in the present study as explanatory variables. The desired model using the Generalized Method of Moments (GMM) was estimated and the results indicated the positive impact of all variables with the exception of the dummy variable (years of imposed war), and accordingly all the existing theories in this field were accepted.*

***Keywords:*** *labor productivity in industry, human capital, research and development expenditure, economic growth*

## INTRODUCTION

The best indicator to measure the economic growth is the real gross domestic product (GDP). The growth in real production can derive from the increase in the raw material and productivity, wherein growth in production can be observed in the increase in the income of the production factors (Kendrick, 1961). In general, economic development is dependent on a country's capacity and productive power. Two major factors which play roles in the formation of this capacity and power are the degrees of physical and human capital accumulation. In fact, the presence of productivity in these fields is a guarantee of the economic growth of the country. Labor productivity as one of the national productivity factors as well as industry as an important sector of economy were employed in the present study to evaluate the effect of productivity on economic growth. Thus, the Generalized Method of Moments (GMM) was used to investigate and discuss the effect of labor productivity in the industrial sector on Iran's economic growth.

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## DEFINITIONS AND CONCEPTS

Today, most countries pay particular attention to the improvement of productivity as one of the most important sources of economic growth through their large investments. Productivity is an integral part of the labor and manufacturing sectors; that is, the more this number is growing, the more the development of a country. Simply, productivity means efficiency in production: that is how much output (production) will be resulted from a fixed amount of input. It can also refer to the ratio of output to input (Syverson, 2011). The term "productivity" has several meanings in the literature of economics. Despite its widespread use, lots of scholars who play a major role in the productivity movement do not still have a clear understanding of it. Productivity as it is known today was first used by Quesnay in 1776 as the production power (Zra'nejad and Ghanadi, 2005).

In 1958, the European Productivity Agency (EPA) defined productivity as the degree and the extent of the effective use of each production factor. As well, this organization stated that productivity is a kind of mentality and attitude. It could be based on the notion that each person can accomplish their tasks and duties each day better than the day before. In view of this agency, belief in productivity refers to having firm faith in human progress and excellence. Productivity also means the ratio of output to input or an average product per unit. In other words, productivity is actually the relative degree of the efficiency of resources such as labor and capital. In this concept, productivity is an index of effective, useful and efficient use of various resources (Gharabaghian, 1997).

Along with the definition provided by different organizations and international agencies; other definitions have been also proposed, these definitions are as follows:

Stigle: the ratio of output to productive operation costs

Mundel: productivity is defined as the ratio between the manufacturing outputs to the inputs used compared with the base year.

Davis: productivity is the change obtained in the amount of the product to the inputs used.

In general, there are two types of productivity:

- Partial productivity which is expressed with respect to the individual factors of production and represents the amount produced per unit of a specific factor of production. Labor productivity is the most widely used partial productivity. Capital productivity and productivity of the raw materials are to a certain extent used (Syverson, 2011).
- Total productivity which is determined based on the entire factors of production.

In developing countries, the need to improve the performance of productivity is strongly dependent on the (undesirable) status of the economy, which has been more apparent than developing countries (Udabah, 2000).

According to Todaro (1985), development is an economic phenomenon, wherein there are rapid economic gains, the growth of GDP per capita, creation of the right conditions for the distribution of economic benefits and the like. Sustainable increase in productivity is the only way to achieve these economic and social goals. The expected increase in national productivity will occur in the following economic sectors:

- Industry
- Agriculture
- Services

High productivity in the industrial sector is necessary for economic growth and development. In this way, development will be repeated when industrialization programs are implemented. This is achieved according to the empirical observations which show that rich and developed countries are also industrialized countries. Industry is a requirement, because it brings about skilled labor, trained managers and also key issues essential for developing countries (Udabah, 2000).

Among the different types of productivity including multi-factor productivity or capital productivity; labor productivity is of utmost importance in the economic and statistical analyses of each country. Labor productivity is considered as a highlighted index among economic indices which reflects the dynamics of economic growth, competitiveness and existing standards within the economy (Freeman, 2008).

## HUMAN ROLE IN ECONOMIC GROWTH

The history of human role in the economic growth and development of societies originates back to the ideas of Adam Smith and his established economic science. In fact, the initial emphasis of these theories has been on human's instrumental role in the growth and development of the economy. For example, Marx considered human resources due to their role in the accumulation of physical capital and noted that the growth of capital accumulation is caused by increased working hours as well as rise in production acceleration due to improvements in efficiency and labor productivity.

In the 1950s, Schultz introduced the significance of human capital as an important production factor similar to physical capital. In the models of economic growth which were presented in the 1950s by neoclassic economists such as Solow and Swan, the economic growth was only associated with the amount of capital and the existing labor in economy; here, variables such as the quality of human capital and labor health were not taken into account. In these models, technology was considered as an exogenous variable.

## PRODUCTIVITY AND ECONOMIC GROWTH

In general, the literature and the conducted studies in the field of productivity and its impact on economy consist of two general approaches. A modeling approach is a model for the calculation of growth in an economy or a sector. This approach attempts to link the output of an economy or a sector with the production factors based on defined assumptions specific to the nature of the production. The inputs usually incorporated into the method include labor and capital. Another approach is focused on the manufacturing economy. In this approach, a specific production function is selected for modeling the process of production and it is more commonly used in firm-level studies. Particularly, the growth in the level of inputs is among the factors that increases the amount of outputs. In other words, one of the reasons for increasing the output can be an increase in working hours, but on the condition that it has no impact on labor productivity (Poorjowla, 2001).

On the other hand, the theoretical and experimental research about the impact of productivity on economic growth has a long history which dates back to the studies conducted by Jorgenson, Gallop and Fraumeni in 1987. Moreover, there are several theoretical models that examine the mutual interactions between the improvement of productivity factors and growth in the product. Solow (1957) presented a simplified model of economic growth which became the basis for the development of other models. This model reiterated the neoclassical function, in which physical capital, labor and technology have an effect on the production level.

As it was mentioned earlier, the accumulations of human capital and physical capital have been identified as important factors in economic growth. Important objective manifestations are evident in all aspects of both advanced and developing economies. The manifestation of the qualitative and quantitative growth in production is also obvious in the strategies for national production growth and development or the productivity of labor and capital. In other words, growth in production is the result of either an increase in the quality of labor and capital or other production factors employed in the process of production; or an increase in productivity and efficiency which in fact are in a two-way interaction. In the endogenous growth models such as the one presented by Romer (1990), the accumulation of human resources is considered as one of the most important factors for growth.Labor productivity is an important factor of economic growth. Comparing indices such as GDP, low price level, low unemployment rate, improvement in payment balance, a high proportion of production and international exchanges and the like; show that the mentioned indices have direct relationships with productivity. Increase in the level of production is one of the most important effects of improvement in productivity. Along with growth in the use of the inputs (labor, capital, etc.), productivity and production growth also increase (Soltani and Baha'dini, 2012).

In general, the relationship between productivity growth and economic growth could be theoretically stated as follows. According to this method, the implicit production function is considered for the industries in a country:

2-11 $Q_{manufac.T} = A_{manufact.T} \times f(K_{manufact.T}, L_{manufact.T})$

$K_{manufact.T}$ and $L_{manufac.T}$ represent the capital and labor in the industrial sector and $A_{manufact.T}$ shows the coefficient for the technological change or total productivity of production factors in time T.

Through calculating the growth in the function, this relationship results:

2-12 $$\frac{dQ_{manufact.T}}{Q} = \frac{dA_{manufact.T}}{A_{manufact.T}} + \alpha\frac{dK_{manufact.T}}{K_{manufact.T}} + \beta\frac{dL_{manufact.T}}{L_{manufact.T}}$$

The above relationship is known as the idex of Solow, in this relationship:

$\frac{dQ_{manufact.T}}{Q}$: production growth

$\frac{dA_{manufact.T}}{A_{manufact.T}}$: total productivity growth for the production factor

$\frac{dK_{manufact.T}}{K_{manufact.T}}$: growth in capital factor

$\frac{dL_{manufact.T}}{L_{manufact.T}}$: labor growth

$\alpha$: production elasticity to the capital factor

$\beta$: production elasticity to the labor factor

Given the above relationships as well as the related literature on economic growth, the set of changes could be explained by Kaldor's laws which are a set of changes that seek to describe the growth in the economy. These laws would be stated as follows:

First Law: the growth rate of the economy is directly related to the growth of the manufacturing sector. The manufacturing sector as the "engine of growth and development" has been widely discussed in the literature of "economic development". Hirschman (1958) analyzed the chains of backward and forward links in the production sector. Allyn Young (2003) and Rosenstein- Rodan (1943) have also pointed to the increasing returns related to the growth in outputs of the manufacturing companies, and the industry in its total concept.

Second Law: the increase in the rate of output growth in the manufacturing sector increased labor productivity in this sector. A part of the increase in growth is the output from the increase in the productivity of the production factors of the mentioned sector. This, in the relevant literature, is known as Kaldor-Verdon law.

Third Law: with an increase in the rate of output growth in the manufacturing sector, productivity in the non-manufacturing sector subsequently increases.

Despite the theoretical and experimental discussions; Kaldor's laws as a whole are an important step to analyze the growth process in an economy in general and growth in production sector and industry in particular, indicating the importance of productivity in this process (Hirschman, 1958; Fotros, 2013).

## RESEARCH LITERATURE

The Department for International Development (2010) in a study entitled "Sources of Growth" examined the stimuli for economic growth and acknowledged that economic growth is the result of an increase in the scale of production and improvement in productivity. In this line, the factors that improve productivity are characterized as an important source of economic growth. Azomahou *et al*. (2009) in the article entitled "Cross-border technology, labor productivity and economic growth", studied 29 OECD-member countries and found that with the advancement of technology and the rise in labor productivity; specified goals and objectives for the economic growth would be achieved. Van der Eng (2009) in the article appearing on "Productivity and economic growth in Indonesia" investigated the growth of total factor productivity and economic growth in Indonesia during the periods of 1970-2007, and concluded that Indonesian economic growth in the predetermined period is exogenous. Mehmet Adak (2009) in the article appearing under the title of "Productivity and economic growth" studied the relationship between economic growth and the productivity of all production factors between the years 1986-2007. The results of this study showed a linear mutual relationship between these two variables.

Abolfazl Shahabady (2010) in the article entitled "The role of total productivity growth factors in the growth of non-oil sector of the Iranian economy" examined the contribution of total factor productivity growth, labor force and capital stock in the non-oil sector value-added using Cobb-Douglas' Production Function during the third, fourth and fifth programs before the Islamic Revolution (1963-2007) and the first to fourth economic, social and cultural programs of Islamic Republic of Iran (1989-2007). Mehrara *et al*. (2009) in a research entitled "The Role of total factor productivity in the manufacturing growth in the major sections of the Iranian economy" concluded that the average growth of TFP in the non-oil sector of the economy during the first, second, and third economic development programs was respectively 39.5%, 12.2% and 24.8%. Akbar Komayjani *et al*. (2004) in a study titled

"The importance of labor productivity, research and development in economic growth" designed a model for economic growth through the economic growth model with endogenous changes in technology by Romer (1990). He measured the positive effect of labor, human capital, physical capital; income from oil exports and other variables on Iran's economic growth.

**Explanation of the Model using the GMM**

In order to estimate the impact of labor productivity in industry on economic growth, other explanatory variables were also used. Considering the various studies conducted in terms of the incorporation of human capital variables in the production functions, the model proposed in this study is based on Lin (2003), and it is adjusted as the generalized function of Cobb-Douglas. Thus, based on the model presented by Chun Lin (2004), the mentioned model is as follows:

1-4 $$y_t = AAPL_t^{\alpha} KL_t^{\beta} H_t^{\delta} RDS^{\gamma}$$

Wherein; y: GDP, APL: labor productivity in industry, KL: the ratio of capital to total labor in country, H: human capital of country, RDS: the ratio of research and development capital to labor, A: technology factor, $\alpha$: elasticity of production growth to labor productivity in the industrial sector, $\beta$: elasticity of production growth, $\delta$: elasticity of production growth to human capital per capita, and $\gamma$: output growth elasticity research and development capital per capita. By taking the natural logarithm of both sides of the relationship, the following equation results:

2-4 $$lny_t = lnA + \alpha lnAPL_t + \beta lnKL_t + \delta lnH + \gamma ln\, RDS$$

In this equation, $\alpha$, $\beta$, $\delta$ and $\gamma$ are the parameters that must be estimated.

In order to present an optimized estimate of the model and to examine the effect of labor productivity in the industrial sector on economic growth, the growth rate is extracted from the above equation:

3-4 $$Gy_t = \alpha + \beta_1 GKL_t + \beta_2 GRD_S + \beta_3 GH_t + \beta_4 GAPLM_t + u_t$$

It should be noted that in order to provide an optimal estimate of the model, the dummy variable of the years of war was also used. First, testing the reliability of variables was conducted, because the use of traditional and conventional econometric methods to estimate the coefficients of the model using time-series data is based on the assumption that the model parameters are stable.

The result of the reliability examination of the variables showed that they are stable at the level of 90%. Therefore, the GMM is used to estimate the model. In this method, there is no need to specify the distribution element and just the presence of moment conditions to estimate the model is sufficient. There are simple assumptions for this method. However, there are several limitations and problems

**Table 1**
**Results of the generalized Dickey-Fuller test for the investigation of the reliability of variables at the level of 90%**

| *Variable* | *Variables* | *ADF* | *Critical Value 5%* | *Result* |
|---|---|---|---|---|
| | | No process | No process | |
| GDP | Y | -4.055 | -2.610 | Stable |
| Labor productivity in industry | APL | -3.981 | -2.610 | Stable |
| Capital per capita | KL | -2.955 | -2.611 | Stable |
| Human capital | H | -3.854 | -2.9434 | Stable |
| Research and development capital | RDs | -1.609 | -1.609 | Stable |

in this method. One of the reasons for the application of this model in this study is the reliability of all the variables at the level of 90%. Therefore, the GMM is the best option for this model.

## The Results of the Model Estimation

Here, the results of the model estimation are explained:

**Table 2**
**Results of the model estimation of GMM**

| *Variable* | *Coefficient* | *Variable* | *Coefficient* |
|---|---|---|---|
| Y (-1) | 0.21 | H | 2.14 |
| | (10.6)* | | (4.27) |
| APL | 0.19 | RD | 0.63 |
| | (10.4) | | (1.78) |
| KL | 0.79 | DUM | -0.07 |
| | (6.64) | | (-11.36) |
| C | -0.09 | Durbin-Watson | 1.59 |
| | (-8073) | value | |
| $R^2$ | 0.75 | | |

* Indicates a t-value at the significance level of 90%.

According to the results reported in Table 2, it is observed that the variables are statistically significant with a high level of confidence. The coefficients of all the variables are also consistent with the theories associated with the economic growth. The effect of all the variables, including labor productivity in the industrial sector, human capital, research and development expenditures, and capital per capita on economic growth are positive. And as it is expected, the dummy variable of the years of war has a negative impact on the economic growth. In this model, human capital has the highest effect on economic growth with a coefficient equal to 2.14 and economic growth is a function of GDP in previous years with respect to the existing interruption in the model with a coefficient equal to 0.21.

## SUMMARY AND CONCLUSION

In this study, the effects of labor productivity in industry on Iran's economic growth over the years 1987-2011 were examined. In this regard; the variables of human capital, research and development expenditures, capital per capita, and the dummy variable of the years of war were used to provide an optimal estimation of the model. The results showed a positive and a significant impact on all variables with the exception of the years of war as a dummy variable.

Given the role of labor productivity in economic growth and the increase in domestic production; education and increase in the level of labor quality along with the effective use of machinery and equipment in the production process would be considered as influential steps to achieve the economic growth. Therefore, policies should be directed, in a way that lead to programs to encourage domestic and foreign investment, the efficient allocation of production factors of labor and capital between the different sections, linking wages and productivity, improvement and development of business environment, expansion of technical and professional skills appropriate to the business environment in all sectors particularly the industrial sector.

Consequently, attention to the increase in labor productivity in industry is recommended using the following solutions:

- Support for research and development activities in firms
- Managers' good behavior and right deeds in the industrial sector
- Provision of the necessary conditions of job developments for all people
- In-service training for the labor force depending on their jobs
- Appropriate and fair payment with regard to hard work
- Healthy and safe working conditions
- Ability to learn and use new skills
- Clarification of all duties, instructions, and regulations and the absence of any ambiguity
- Establishment of responsibility in the workforce via granting the necessary authority to them and trying to engage employees in decision-making as well as development of goals and programs

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