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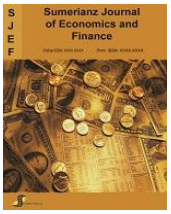

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Total Factor Productivity through the Ghosh Model: The Paradox of Developing Countries?

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Abstract

This study is an attempt to give an overview of the total factor productivity (TFP) through the Leontief - Ghosh system. In principle, the change in the technical factor of input matrix coefficient is due to a change in technology, but in some developing countries the total of intermediate input increase is not due to the influence of technological process changes but due to other non-economic factors. The efficiency seen from the Leontief - Ghosh relationship is that the ratio of intermediate costs will be small and the rate of value added progressively to 1. In these cases the less efficient the economy lead to the aggregate factor productivity greater. Is that a paradox of developing countries? Do mathematical - economic models seem to make no sense in these cases?

Keywords: Input; Output; Total factor productivity; Value added.

1. Introduction

During the world economic crisis of the 1930s of 20th century J.M Keynes introduced the concept of aggregate demand and suggested that when the demand side increased by 1 unit, it would stimulate the supply side. Keynes's idea was quantified by Leontief (1941) a linear function system. However, by transposing the input output system of Leontief, Ghosh (1958) changed the position of supply and demand variables in the standard input - output system of Leontie.

In the System of National Accounts (SNA), the calculation of GDP by three methods is understood as "equalizing" the concepts of supply and demand. Countries that have used the MPS system often calculate total of net products by the production approach and indirect taxes, **some** countries still consider this the most basic method to calculate GDP such as Vietnam.

Most traditional studies when calculating aggregate productivity (TFP) use Cobb-Douglas and estimating the contribution of labor and capital by regression or growth accounting methods such as Lê Xuân Bá and Nguyễn (2006) or Trần Thọ Đạt (2010). The calculation results assume that the increase of TFP is a more positive change in the quality of growth or efficiency of the economy.

This article outlines another approach to explaining the limitations of the Solow model by calculating growth-related factors with an input-output model (I-O model). Calculation results show that measuring the efficiency of the economy through traditional approaches may be inaccurate. The increase of TFP is not necessarily a more effective economy than (Bui, 2017).

In addition to the introduction, the structure of the paper consists of 3 parts: in the second part we will explain the theoretical methods of assessing growth based on combining the Leontief - Ghosh model with the Solow - Swan model. The next section will apply this approach to the calculation for the case of Vietnam. The end of the article is conclusive. In this paper, it is not possible to provide a comprehensive career study due to the poor data of Vietnam.

2. Leontief – Ghosh – Solow

Both the Leontief and Ghosh systems rely on direct intermediate cost matrices, some experts arguing that both models are linear, although mathematically there is no assertion that they are linear. Nonlinearity is better. However, if we consider Ghosh inverse as a parameter and the value added depends on the total factor productivity, capital, labor, and the elasticities of capital and labor, then the Ghosh function will become a nonlinear function, the output will depend on labor, capital, elasticity coefficients, technical norms and total factor productivity.

Approaching the I-O model, in the economy, the relationship between output and the final demand expressed by Leontief equation has the form:

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$$X = (I-A)^{-1}Y \quad (1)$$

Where X is an column vector of gross output, $A = (a_{ij})_{nxn}$, with:

$a_{ij} = X_{ij}/X_j$;

In Which: X_{ij} present sector j used product i for intermediate input, Y is a vector of final demand.

In the Leontief system the gross output includes intermediate demand (AX) and final demand, the equation (1) can be rewritten as follow:

$$X = AX + Y \quad (2)$$

Transposing the Leontief's input - output system, then the position of the final demand (Y) and the value added (V) are interchangeable. Since then Ghosh's relationship has been developed as follow:

$$X^* = A^*.X + V \quad (3)$$

Where: X is a total supply includes intermediate input (A*X) and value added (V).

With: $A^* = (a^*_{ji})$ and

$a^*_{ji} = X_{ji}/X_i$.

Due to the nature of overall equilibrium X = X *' (X*' is transpose of X*)

Equation (3) can be rewritten:

$$X^* = (I - A^*)^{-1}.V \quad (5)$$

Matrix $(I - A)^{-1}$ is Leontief inverse matrix

Matrix $(I - A^*)^{-1}$ is Ghosh inverse matrix

On Leontief system, final demand (Y) induced to output (X) after that induced to value added (V):

Y===➔ X===➔ V

On Ghosh system:

V===➔ X* ==➔Y

In the explanation of growth, to represent the sản lượng Solow model uses the Cobb - Douglas function of the form

$$X = \Omega.\ K^{\alpha}.\ L^{\beta} \quad (6)$$

Where: Ω represents the total factor productivity or in other words the contribution of factors other than capital and labor to growth.

From (5) and (6) we have:

$$X = (I - A^*)^{-1}\ .\mu.K^{\alpha}.L^{\beta} \quad (7)$$

In this relation, α and β (with the assumption of constant returns to scale). Compare with the relation (6) the total factor productivity is divided as follows:

$$\Omega = (I - A^*)^{-1}.\mu \quad (8)$$

Thus, if the intermediate input (A) matrix increases due to changes in technological processes, this is consistent with the theoretical model. But if matrix A increases due to corruption, the firm has to allocate the cost of corruption to intermediate inputs, which shows inefficiencies that can lead to increased total factor productivity. This is also the case when the country does not have ancillary products and its inputs depend on imports, as the world price increases also leads to higher input inputs. This also often happens with FDI enterprises raising the price of input costs to reduce income tax avoidance

The coefficient of capital and labor elasticity was calculated by the regression method and was fixed for a relatively long time; the nature of this elasticity is the slope, when the slope is constant. ie the graph is only translational and this reduces the meaning of the production function.

Therefore, the elasticity's labor and capital can be calculated by the input - output system sheet to ensure the change of these coefficients in a given time (usually 5 years).) as follows:

α_i = Operating surplus of sector i / (Vi – Depreciation of fixed assets of sector i)

$\beta = 1 - \alpha$

Separate derivative of 2 sides of relationship (7) to convert to growth form:

$$\partial X = \partial.\Omega + \alpha.\partial K + \beta.\partial L \quad (9)$$

Estimate capital stock (K): Application of Harrod - Domar relation:

Put:

$k_i = K_i/X_i$

With K_i is capital stock of sector i, k_i is ratio of capital – output)[1], From (5) we have

$$K = k^*.(I - A^*)^{-1}.V \quad (10)$$

Where: k* is diagonal matrix with elements in diagonal is ki

Assumption μ is fixed, so, relations (9) can deploy:

$$(X(t_n)\ .\ X^{-1}(t_0)) - I_x = \mu[(I - A^*(t_n))^{-1}.\ (I - A^*(t_0) - I\ ] + \alpha.\partial K + \beta\partial L \quad (11)$$

The factor that changes the output in the relationship (9) and (11) in addition to the factor of capital and labor is the change in technical norms through intermediate input matrix. The extended Ghosh inverse matrix is considered to be the matrix of the economy's sensitivity to the other side of the coin while the Leontief inverse matrix is like another side of the coin.

Compare equations (8) and (11) we have:

$M = \mu\ [(I - A^*(t_n))^{-1}.\ (I - A^*(t_0) - I]$

M is equivalent to the concept of total factor productivity.

In the next section of the paper we will use data from Vietnam's I-O tables to calculate aggregate factor productivity under this approach

[1]Estimating from enterprise survey of Vietnam general statistics office.

3. Experimental Results: The case of Vietnam

In this research used the input – output tables in 2000, 2007 and 2012 with non-competitive import type

The total factor productivity of Vietnam has tended to increase in the recent period as some other calculations of the General Statistics Office of Vietnam. But deep analysis into the calculation data, we discovered a rather interesting paradox.

The factor that increases production in the Ghosh model is due to the economic inefficiency. In the Ghosh relation, it is shown that if the consumption of 2.33 dong in 2000 created 1 unit of value added in 2007 2.63 dong of new consumption would create 1 unit of value added in 2012 it would have to be consumed 3,13 new dong created 1 dong of added value. Thus, it can be seen that the economic inefficiency is also an important factor in increasing output. Thus, Solow's conception that the remaining increase in non-capital output and labor is the total factor productivity when the higher the factor is, the more efficient the economy is.

Table-1. Calculation results of the factors contributing to Vietnam's economic growth based on input – output tables Times

	2000	**2007**	**2012**
Intermediate input coefficient (A*)	0.57	0.62	0.68
Value added coefficient (V=I-A*)	0.43	0.38	0.32
Output requirement	2.33	2.63	3.13
Change on sensitivity (Or total factor productivity see from Ghosh model)		0.132	0.188

Sources: Calculation from input – output table 2000, 2007 and 2012

4. Discussion

Calculation of TFP according to production function Cobb - Douglas assumes that the total factor productivity Ω is an independent factor with α and β.

However, in reality due to changes in scientific and technological advances, changing of the way of organizing production, the structure of using capital in production industries changes. In other words, when A* (t_n) changes compared to A* (t_0), α and β also change.

Is this a paradox of TFP in the current context of Vietnam? FDI flows move strongly among countries. Developing countries like Vietnam tend to focus on outsourcing in the manufacturing process, so the value added is not large. Or the trend of sending prices into input costs between tamarind company and FDI enterprises artificially increases the intermediate cost factor. As a result, the aggregate factor productivity increases but not because of the improvement of intra national productivity because growth is due to FDI? Although TFP is higher, it is not due to more efficient use of production factors

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