ANALYSIS OF FACTORS DETERMINING ECONOMIC GROWTH

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Abstract

In this article the authors aim to study and find ways to highlight the fact that the factors that determine economic growth must follow a cycle of permanent improvement. In this respect, the factors of capital, labor and resources are explained in turn, with interpretations that lead to the idea that these factors must be given the necessary attention in order for them to remain in close correlation and the investments to be thus directed in this sense of ensuring adequate proportions.

The methodology used is that of using appropriate statistical indicators, economic notions and concepts that highlight economic factors and reveal the influence that each of these factors has and the cumulative effect on which the programming of economic evolution in a country must be based.

Technology starts from the need to understand concrete situations so that, in the end, the relationships materialized in statistical-econometric models are the ones that can determine the way of structuring investments to meet the purpose we have, that of correlated development of the economy to ensure macro stability. The imbalance that may occur in the factors of production may cause destabilization and, in this way, reduce the results obtained.

Keywords: *capital, labor force, resources, developments, factors, correlations.*

JEL classification: *C10, E10*

Introduction

In *the article Analysis of the factors that determine economic growth*, we started from the fact that these increases in production must be based on the insurance of factors of production. In this way, we have explained the criteria underlying the growth of the economy based on the growth of factors of production.

We took turns looking at increasing capital through advanced technology, which must be the basis of the changes that ensure the improvement of the production structure within a country.

Labor is the second factor that needs to be looked at from two points of view, quantitatively and qualitatively. Quantitatively, in the sense that it must respond to the occupation of the places created by the introduction of advanced technologies but, at the same time, qualitatively that it must correspond to the level of knowledge of the employees, the performance and the qualities that the technology used has.

The marginal product of labor is a variant of the analysis of quantitative growth to ensure an efficient occupation of the places created by the machines introduced in this activity.

The analysis, with slight examples, ensures the possibility of understanding how this problem of the correlation of the capital factor with the labor factor is absolutely necessary in order to be able to make the most efficient use of the financial and material resources available to the economy of a country.

I invoked in the article some equations that reveal how this increase can be ensured, this supply of investments for the quantitative and qualitative increase of capital, but also of labor.

An important problem of the workforce is its improvement, when changing the workplace, by acquiring knowledge that ensures consistency between the quality of the human capital used and the knowledge, skills of the staff used.

The key equation of growth accounting is that which identifies and allows the measurement of the three sources of increase in the amount of capital, of change in the amount of work, and of modification in the total productivity of the factors used.

The total productivity of factors is not directly observable, but it is measured indirectly, meaning that we have also identified the mathematical equation that would be the basis of such a possibility of measurement, which is absolutely necessary for the organization of production in the best conditions.

The sources of growth are different from one country to another, and that is why, for the clarification of this theory, we considered the established data, in a way arbitrary, but taking into account the theoretical criteria, which are able to ensure this possibility of growth.

A few words about the Solow residue. He explains that we cannot always reach the full optimization of these resources and that is why, over a period of time, the increase of each factor is different because it will highlight and analyze the structure of each one and the conditions in which it was affected.

Of course, the budgets of the States, the budget of the European Union and of other economic organizations, are important, in the sense that they must provide the source of investment that will ensure, firstly, increased research, innovation, development and then the production, on the basis of invention, of new technologies that will ensure that production is increased from one period of time to another.

Also, when demand is low, we must bear in mind that the level of production is closely in line with market demand, that prices are affordable, ensuring the movement of cutting-edge technology in places where a large amount of production of goods and services is produced.

Literature review

A mixture of factors that determine that economic recovery starts from the production function of Cobb Douglas (the need to capitalize on the three factors of production: capital, labor and resources). Thus, the analysis, from the economic and statistical point of view, can be carried out on the basis of a system of well-founded methodological and expressive indicators, correlated ensuring a thorough interpretation of the economic evolution. Due to its importance, the economic evolution was analyzed and interpreted by a number of authors, specialists in this field. Thus, Anghelache, C. and Anghel, M.G(2016) have given space and importance to presenting the essential aspects of economic growth, the emphasis being placed on the system of statistical indicators usable in this field. Anghelache, C. and Capanu, I. (2000) in the paper *Economic indicators used for micro and macroeconomic analysis*, deal extensively with the presentation and analysis of indicators that have an effect on economic growth. Anghelache, C (2008) publishes *the Treaty on Theoretical and Economic Statistics* in which it deals extensively with all aspects of the variables influencing economic development and the system of indicators used. Also, Anghelache, C., Mitrut, C. and Voineagu, V (2013) publish an extensive paper in which the aspects regarding the factors that determine the economic growth are complexly addressed. A similar theme is addressed in their work by Biji, E.M. and others (2012). Dormbusch, R. Fischer, S. and Startz, S. (2007) make consistent references to the factors that determine economic growth, the way of analysis and interpretation, as well as the system of usable statistical-economic indicators. Heiberger, R.M. and Holland, B. published in 2004 an extensive paper in which he pays attention to these elements, and Isaic-Maniu, A., Mitrut, C. and Voineagu, V. (2003) dealt with these aspects in a statistical work, focusing on macroeconomic aspects.

Methodology, resources, results and discussions

Let's say a country's real GDP has grown by an average of about 3% per year over the past 50 years. What explains this growth? We have linked the production of the economy to the factors of production (capital and labor) and to the production technology. Here we develop a technique called growth accounting that divides production growth into three different sources: capital increases, labor increases and advances in technology. This breakdown gives us a measure of the rate of technological change.

First, we will examine how increases in factors of production contribute to increases in output. To do this, we start by assuming that there is no technological change, so the production function that reports the output of Y to the capital K and the work L is constant over time:

$$Y=F(K, L).$$

In this case, the value of production changes only because of the volume of capital or changes in labor.

First, we will consider capital changes. If the amount of capital increases by ΔK units, how much does the quantity of production increase? To answer this question, we must start from the definition of MPK's marginal capital product, given by the relationship:

$$MPK = F(K + 1, L) – F(K, L).$$

The marginal product of capital tells us how much production increases when we increase capital by 1 unit. Therefore, when capital increases by ΔK units, production increases by approximately MPK x ΔK.

For example, suppose that the marginal product of capital is 1/5, that is, an additional unit of capital increases the amount of production produced by one fifth of a unit. If we increase the amount of capital by 10 units, we can calculate the amount of additional output as follows:

$$\Delta Y = MPK \times \Delta K = \frac{1/5 \text{ unități de output}}{\text{unitate de capital}} \cdot 10 \text{ units of capital} = 2 \text{ units of output}$$

By increasing the capital by 10 units, we get another 2 units of products. Thus, we use the marginal product of capital to convert capital changes into changes in production.

Let's now consider the changes in the workforce. When the amount of work increases with ΔL units, how much does production increase? We answer this question just as we answered the question about capital. The

marginal product of MPL labor tells us how much production changes when the labor force increases by 1 unit, that is:

$$MPL=F(K, L+1)-F(K, L).$$

Therefore, when the amount of work increases with ΔL units, the output increases by approximately MPL x ΔL.

For example, suppose that the marginal product of labor is 2, that is, an additional unit of labor increases the amount of production produced by 2 units. If we increase the amount of work by 10 units, we can calculate the amount of additional production as follows:

$$\Delta Y = 5\ MPL\ 3\ \Delta L = \frac{2\ \text{unități de ieșire}}{\text{unitate de muncă}} \cdot 10\ \text{unități de muncă} = 20\ \text{de unități de ieșire}$$

By increasing the workforce by 10 units, we get another 20 production units. Thus, we use the marginal product of labor to turn changes in labor into changes in production.

Let's consider where both factors of production change. Suppose that the amount of capital increases by ΔK and the amount of labor increases by ΔL. The increase in production comes from two sources: more capital and more work. We can divide the growth into the two sources using the marginal products of the two inputs:

$$\Delta Y = (MPK \times \Delta K) + (MPL \times \Delta L).$$

The first term in parentheses is the increase in output resulting from growth in capital, and the second term among parentheses is the increase in production resulting from the growth of the labor force. This equation shows us how to attribute the output factor to each increase.

We will convert this last equation into a form that is easier to interpret and apply to the available data. First, with some algebraic rearrangement, the equation becomes:

$$\frac{\Delta Y}{Y} = \frac{MPK \times K}{Y} + \frac{\Delta K}{K} + \frac{MPL \times L}{Y} \cdot \frac{\Delta L}{L}$$

This form of the equation links the rate of growth of production, ΔY/Y, with the rate of capital growth, ΔK/K, and the growth rate of labor, ΔL/L.

Next, we will establish a way to measure the terms in parentheses of the last equation. We have predicted that the marginal product of capital

is equal to the actual rental price. Therefore, MPK x K is the total return on capital, and (MPK x K)/Y is the production share of the capital influence. Similarly, the marginal product of labor is equal to the real wage. Therefore, MPL x L is the total increase under the influence of labor, and (MPL x L)/Y is the share of work in the realization of production. On the assumption that the production function has constant yields at scale, Euler's theorem tells us that these two stocks sum up to 1. In this case, we can write:

$$\frac{\Delta Y}{Y} = \frac{\alpha \Delta K}{K} + \frac{(1 - \alpha) \Delta L}{L}$$

where α is the share of the capital and (1 - α) is the share of the work.

This last equation gives us a simple formula to show how changes in inputs lead to changes in output, highlighting in particular, that we must weigh the growth rates of inputs with the parameters of factors.

In the analysis of the sources of growth, we assumed that the production function does not change over time. In practice, technological progress improves the production function. For any given amount of inputs, we can produce more production today than we have achieved in the past. We will expand the analysis to allow highlighting the effect of technological progress. Thus, we include the effects of changing technology by writing production that works as:

$$Y = AF (K, L)$$

where A is a measure of the current level of technology, called a total productivity factor.

Production is now growing not only on account of increases in capital and labor force, but also due to increases in total factor productivity. If the total factor productivity increases by one percentage point and if the inputs are unchanged, then production increases by one percentage point. So, the change in the level of technology adds another term to the equation of accounting for economic growth, namely:

$$\frac{\Delta Y}{Y} = \frac{\alpha \Delta K}{K} + \frac{(1 - \alpha) \Delta L}{L} + \frac{\Delta A}{A}$$

In other words: Increase output = capital contribution + labor contribution + total increase in productivity factor.

This is the key equation of growth accounting, which identifies and allows the measurement of the three sources of growth: changes in the amount

of capital, changes in the amount of labor and changes in the total productivity of factors.

Since the total productivity of the factors is not directly observable, it is measured indirectly. We have data on increasing production, capital and labor. We also have data on the share of capital in production. From these data and from the growth accounting equation, we can calculate the increase in the total productivity of factors to ensure that everything comes together:

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \frac{\alpha \Delta K}{K} - \frac{(1-\alpha)\Delta L}{L}$$

where ΔA/A is the output change that does not result directly from input changes.

Thus, the increase in the total productivity of factors is calculated as residual, the amount of increase in production that remains after we have accounted for determinants of growth that we can measure directly. The size of ΔA/A is sometimes called residual Solow, after Robert Solow, who showed how to make the calculation.

Total factor productivity can change for a number of reasons. Changes most often occur due to the increased knowledge of production methods, so the residual Solow is commonly used as a measure of technological progress. Other factors, such as education and government regulations, can affect the total productivity factor. For example, if higher public spending increases the quality of education, then workers can become more productive and production can increase, which implies higher total factor productivity. Also, if government regulations require firms to acquire capital to reduce pollution or increase the safety of workers, then the stock of capital can increase without any increase in measured output, which implies a lower total productivity of factors, the total productivity factor captures anything changes in the relationship between the measured inputs and the measured output.

For the clarification of this theory we will consider arbitrarily established data.

Suppose that production in the non-agricultural business sector increased on average by 3.5 percent per year over a given period. Of these 3.5 percent, 1.3 percent is attributable to capital stock increases, 1.0 percent to labor force growth and 1.2 percent to total factor productivity growth. These data show that increases in capital, labor force and productivity have almost equally contributed to economic growth. Of course, over a time frame, the increase in each factor is different, which will also stand out in the structural analysis of the influence of factors on economic growth. Accumulated over

many years, even a small change in the growth rate of a factor has an obvious effect on economic well-being.

When Robert Solow presented his famous waste, his goal was to shed light on the forces driving technological progress and long-term economic growth. Subsequently, economist Edward Prescott analyzed the Solow residual as a measure of technological change over shorter periods of time. He concludes that fluctuations in technology are a major source of short-term changes in economic activity.

Please note that the Solow residue fluctuates substantially. If Prescott's interpretation is correct, then we can draw conclusions that from these short-term fluctuations, the technology has been successively improved. Please note that the Solow residue moves simultaneously with the production. Thus, in years when production is falling, the technology has to get worse. In Prescott's view, it implies that recessions are driven by adverse shocks to technology. The assumption that technological shocks are the driving force behind short-term economic fluctuations and the complementary assumption that monetary policy has no role in explaining these fluctuations, is the foundation of the approach to real business cycle theory.

Many economists believe that the Solow residue does not accurately represent changes in technology over short periods of time. The standard explanation for the cyclical behavior of the Solow residue is that it results from two measurements (calculations) at agreed intervals of time.

Summing up, we can appreciate, first of all, that during recessions, firms can continue to hire workers they do not need so that they have these workers at hand when the economy recovers.

This phenomenon, called labor hoarding, means that labor supply is overestimated in recession because hoarded workers probably do not work as hard as under normal conditions. As a result, the Solow residue is more cyclical than the available production due to the technology. In a recession, productivity, as measured by the Solow residue, falls even if technology has not changed, but because workers are hoarded, waiting for the end of the recession.

Secondly, when demand is low, firms can produce goods demanded in the market. In times of recession, workers can carry out other complementary work that does not lead to increased production.

Economists can interpret the cyclical behavior of the Solow residue in various ways. Some economists point to low productivity in recessions as evidence of adverse technological shocks. Others believe that the measured productivity is low in recessions, because the workers do not work hard as usual and because more of their production is not measured (materialized in goods).

The increase in production and the Solow residue, which some are economists interpret as a measure of technological shocks, fluctuates depending on the economy's production of goods and services.

Conclusions

The elements contained in this article refer to the factors that determine economic growth lead to some conclusions that micro- or macroeconomic managers must take into account in directing production. First, the factors of production, as described by Solow or Clark-Douglas in his production function, are essential elements to which attention must be paid in investment plans, so that the correlation that must exist between the three factors is ensured by the investment rates allocated to each of them.

Secondly, it is the cutting-edge technology that can ensure economic growth in the sense that new raw materials, new inventions and scientific discoveries raise new qualitative standards that we must follow in creating capital of a higher quality level so that in the process of economic improvement we can use digitization, robotization, the possibilities of superior processing of resources, the possibilities of adequacy and replacement of some resources with others, so that the economy maintains its correlations and proportions that ensure the macro-stability of each country.

Of course, this process of economic evolution, from time to time, as it is happening today, is disturbed by moments of economic and financial crisis, by resources, by energy, by health crises and so on.

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