SOME CONSIDERATIONS ON THE INFLUENCE OF TECHNOLOGY AND POLITICAL STRATEGY ON ECONOMIC GROWTH

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Abstract

In this article I started from the desire to highlight that the development of the industry at the current rate of research and development is an acute requirement to be able to develop a modern industry. Romania, in the process of transition to the free market and to privatization, was practically left without any field of industrial activity, or agriculture, or construction or others, which would be defining and lead to the possibility that Romania, representative commercial companies from Romania, to be involved in intra- and extra-European projects and objectives. In this direction, in this article I started from the idea of highlighting the role of technology in economic growth. In one sentence it can be said that there is no doubt that the new technology based on innovations, inventions and research and development is the basis for the development of the industry and the economy in general. But I have exemplified by showing how this technology must be assimilated. It is delicate that in Romania the large commercial companies, including the multinationals, do not have research departments in Romania, which would satisfy the acute need of the demand of economic agents specialized in this field. We used an appropriate methodology, through comparative study, the use of indicators and indices or dynamic series to highlight the role of technology. At the same time, political and economic strategies must be based on this strategy of technological development, so that the proposed measures are those that bring increases in production and income. We have also used

other possibilities such as the Solow model which highlights the issue of the role of technology. In this article I used the data I had and processed some models that can be used to define these strategies.
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Introduction

In this article I started by starting from the Solow model, which assumes that it is a general and realistic model that can highlight the task of moving from theory to empirical. What does this mean? That by mastering these model and other models of domestic and international econometricians we can design economic growth models that are also based on technology and economic strategies.

One by one, I presented these aspects that I doubled with some examples, precisely to highlight the appreciations that I presented in the article.

Technological Progress and Growth the Solow model shows technological progress increasing the labor force and the rate of improvement in the growth of the correlation between the factors of production.

The stock of capital and labor resources lead to increased levels of production, which can provide a larger harvest. Thus, we also referred to the introduction of technological progress, which modifies the criterion for the Golden Rule.

The Golden Rule level of capital is defined as the equilibrium state that maximizes consumption per effective worker. That is, following this argument, we can show that steady state consumption per worker is given by the Solow relationship, which shows an increase from one time period to another.

Technological progress causes the values of many variables to increase along with the equilibrium state. This property, also called balanced growth, does an essential thing in that it describes long-term accumulated data for economists, who can orient their thinking toward using such modes of analysis.

I also referred to convergence, in the sense that this convergence is actually the idea that the evolution of the factors of production are closely correlated and converge towards each other so that the efficiency of the complex use of the factors of production is productive.

Then, we also referred to the fact that there are economic-financial strategies that must be established through models closely related to technological growth and this based on innovation, innovation and development research.

Literature review

Akçomaka, I.S., ter Weel, B. (2009), refers to the fact that social capital together with innovation are the factors with direct influence on economic growth. Anghelache, C. and others (2018) in their paper refer to the role of technology science and innovation in the economic evolution of each state. Barndorff-Neilsen, O. et al. (2008), are concerned with the measure of variation in equity prices in the presence of noise. Barbosa, N., Faria, A.P. (2011) emphasizes the fact that innovation is an important element supporting the development of a country's economy through the results resulting from research and development with immediate application in the business environment. Berg-Yuen, P., Medova, E.A. (2004) analyzed fundamental elements of economic capital. Onetti, A. et al. (2012) emphasize the fact that business must be based on certain and future results of research and innovation. Pinto, H. (2009) refers to the fact that innovation diversity must be an important factor in the evolution of an economy.

Data, Results and Discussion

The theory and desire for economic growth is specific to each state. It is the work of theoretical growth to explain such disparate results. These are the reasons why some nations fail while others succeed in promoting long-term economic growth, but as Robert Lucas suggests, the consequences for human well-being are truly staggering.

Starting from the basic version of the Solow model, we consider four new tasks. The first task is to make the Solow model more general and realistic. Now we can add the third source of growth, namely changes in technology. The Solow model does not explain technological progress, but instead considers it exogenous and shows how it interacts with other variables in the process of economic growth.

The second task is to move from the theory to the empirical. In recent decades, a large literature has examined the predictions of the Solow model and other economic growth models. It seems the glass is both half full and half empty. The Solow model can shed a lot of light on international growth experiences, but it is still a long way off.

It is important to examine how a nation's public policies can influence the level and increase in the standard of living of its citizens. Five aspects need to be clarified:

- Should society save more or less?

• How can politics influence the saving rate?

• Are there certain types of investment that the policy should specifically encourage?

• What institutions ensure that the resources of the economy are used as best as possible?

• How can politics increase the rate of technological progress?

The Solow growth model provides the theoretical framework in which we consider these policy issues.

Models help us understand the world by simplifying it. Therefore, after completing an analysis of a model, it is important to consider whether we have oversimplified the situation. So far, the Solow model has assumed an unchanging relationship between inputs of capital and labor and the output of goods and services.

However, the model can be modified to include exogenous technological progress, which over time expands society's production capabilities. To incorporate technological progress, we must return to the production function that considers total capital K and total labor L with total output Y. Until now, the production function was:

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

Now we write the production function as:

$$Y = F(K, W \times E),$$

where E is a new (and somewhat abstract) variable called labor efficiency.

Labor efficiency is meant to reflect society's knowledge of production. Thus, as available technology improves, labor efficiency increases and each hour of labor contributes more to the production of goods and services. For example, labor efficiency increased when assembly line production turned to manufacturing and increased again when computerization was introduced. Labor efficiency also increases when there are improvements in the health, education or skills of the workforce.

The term L x E can be interpreted as measuring the actual number of workers.

It takes into account the number of effective workers L and the efficiency of each worker E. In other words, L measures the number of workers in the workforce, as L x E measures both the workers and the technology that the typical worker comes equipped with. This new production function states that output Y depends on the input of capital K and effective workers L x E.

The essence of this approach to modelling technological progress is that increases in labor efficiency E are analogous to increases in labor force

L. Suppose that an advance in production methods causes labor efficiency E to double between 1980 and 2015. This means that one worker in 2015 is actually as productive as two workers in 1980. That is, even if the actual number of workers (L) remains the same from 1980 to 2015, the effective number of workers (L x E) doubles, and the economy benefits from increased production of goods and services.

The simplest interpretation of technological progress is that it causes the efficiency of labor E to increase at a constant rate g. For example, if g = 0.02, then each unit of labor becomes 2 percent more efficient each year, and output increases as if the labor force had increased by 2 percent more than it actually did.

This form of technological progress is called labor growth, and g is called the labor-increasing rate of technological progress. Since the labor force L increases at the rate n, and the efficiency of each unit of labor E increases at the rate g, the effective number of workers L x E increases at the rate n + g.

Since technological progress is modelled here as an increase in the labor force, it fits the model in much the same way as population growth. Technological progress does not cause the effective number of workers to increase, but that each worker actually brings in more units of labor over time, and this causes the effective number of workers to increase. Thus, the analytical tools for studying the Solow model with population growth are easily adapted to the study of the Solow model with labor-increasing technological progress.

Before adding technological progress, we analysed the economy in terms of quantities per worker. We can generalize this approach by analysing the economy in terms of quantities per effective worker.

We consider k + K/(L x E) to represent capital per effective worker and y = Y/(L x E) to represent output per effective worker. With these notations, we can again write y = f(k).

The analysis of the economy continues as we did when we examined population growth. The equation showing the evolution of k over time becomes

$$\Delta k = sf(k) - (\partial + n - g)k.$$

The change in the capital stock is equal to the investment sf(k) minus the break-even investment $(\partial + n + g)k$. Now, however, because k + K/(L x E), the break-even investment includes three terms. To keep k constant, ∂k is needed to replace depreciating capital, nk is needed to provide capital for new workers, and gk is needed to provide capital for new efficient workers created by technological progress.

The inclusion of technological progress does not substantially alter the steady state analysis. There is a level of k, denoted k*, at which capital per effective worker and output per effective worker are constant. This state represents the long-run equilibrium of the economy.

Technological progress that increases the labor force at rate g enters the analysis of the Solow growth model in the same way as population growth at rate n. Now that k is defined as the amount of capital per effective worker, increases in the effective number of workers due to progress technological tend to decrease k. At steady state, investment sf(k) exactly compensates for reductions in k attributable to depreciation, population growth, and technological progress. Capital per effective worker k is constant in equilibrium. Since y = f(k), output per effective worker is also constant. These quantities per effective worker are constant in the steady state.

From this information, we can deduce what happens to the variables that are not expressed in units per actual worker. For example, if we consider output per real worker Y/L = y x E, since y is constant in the steady state and E is increasing at rate g, output per worker must also be increasing at rate g constantly.

Similarly, the total output of the economy is Y = y x (E x L). Because y is constant at steady state, E increases at rate g, and L increases at rate n, total output increases at rate n + g at steady state.

With the addition of technological progress, the model can finally explain the sustained increases in living standards that we observe. We have shown that technological progress can lead to a sustained increase in output per worker. In contrast, a high saving rate leads to a high growth rate only until equilibrium is reached. Once the economy is in steady state, the growth rate of output per worker depends only on the rate of technological progress. According to the Solow model, only technological progress can explain the sustained growth and steady rise in living standards.

The introduction of technological progress also changes the criterion for the Golden Rule. The golden rule level of capital is now defined as the equilibrium state that maximizes consumption per effective worker. Following the same arguments, we used, we can show that steady state consumption per effective worker is:

$c^* = f(k^*) - (d + n + g)k^*$.

Steady-state consumption is maximized if:

$MPK = \partial + n + g$,

or

$MPK – \partial = n + g$.

That is, at the level of the golden rule of capital, the net marginal product of capital, MPK - ∂, equals the growth rate of total output, n + g. Because economies experience both population growth and technological progress, we must use this criterion to assess whether they have more or less capital than would be the golden rule steady state.

According to the Solow model, technological progress causes increases in many steady-state variables. This property, called balanced growth, is good at describing long-term economic development.

If we consider the first output per worker Y/L and the capital stock per worker K/L then, according to the Solow model, in the steady state both variables increase at g, the rate of technological progress. Technological progress also affects factor prices. In the steady state, the real wage increases at the rate of technological progress. However, the real price of capital is constant over time. Over the past 50 years, the real wage has increased by about 2% per year. It grew at about the same rate as real GDP per worker. However, the price of capital (measured as real income from capital divided by share capital) remained about the same.

Countries have huge variations in standards. The poor countries of the world have average levels of income per person that are less than one-tenth of the average levels in the rich countries of the world.

These income differences are reflected in almost every measure of quality of life. Much research has been devoted to the question of whether economies move toward each other over time. In particular, the economies of poor countries grow faster than the economies of rich countries. If they do, then the economies of the poor countries of the world will tend to catch up with the economies of the rich countries. This recovery process is called convergence. If convergence does not occur, then it is likely that countries remain poor.

The Solow model makes predictions about when convergence should occur. According to the model, it depends on whether two economies will converge. On the one hand, suppose that two economies that happen by historical accident start with different capital stocks, but they have the same equilibrium state, as determined by saving rates, population growth rates, and efficiency work. We should expect the two economies to converge. The poorer economy with less capital will naturally grow faster to reach equilibrium. On the other hand, if two economies have different stability, perhaps because the economies have different saving rates, then convergence should not be expected. Instead, each economy will approach its own equilibrium state. Experience is consistent with this analysis. Economies with similar cultures and policies converge toward each other at a rate of about 2 percent per year. That is, the gap between the rich and the poor, savings, closing by about 2 percent each year. However, these differences slowly disappeared over time. This convergence can be explained with the Solow model under the assumption that those state economies that had different starting points are approaching a common one, towards a balanced state.

In international data, a more complex picture emerges. When researchers examine only data on income per person, they find little evidence of convergence: countries that start out poor do not grow faster on average than countries that start out rich. This finding suggests that different countries have different equilibrium states. If statistical techniques are used to control for some of the determinants of the steady state, such as savings rates, population growth rates, and human capital accumulation, the data show convergence to be at a rate of about 2 percent per year . In other words, the world's economies exhibit conditional convergence: they appear to be converging to their own equilibrium states, which in turn are determined by variables such as saving, population growth, and human capital. From an accounting point of view, international differences in income per person can be attributed either to differences between factors of production, such as the amounts of physical and human capital, or to differences in the efficiency with which economies use their factors of production. That is, a worker in a poor country may be poor because he lacks the tools and skills, or because the tools and skills are not used to their full potential. To describe this problem in terms of the Solow Model, the question is whether the large gap between rich and poor is explained by differences in capital accumulation (including human capital) or differences in the production function.

Much research has attempted to estimate the relative importance of these two sources of income disparities. The exact answer varies from study to study, but both factor accumulation and production efficiency are important. A common finding is that they are positively correlated. Nations with high levels of physical and human capital tend to use these factors efficiently.

There are several ways to interpret this positive correlation. One hypothesis is that an efficient economy can encourage capital accumulation. For example, a person in a well-functioning economy may have greater resources and incentives and accumulate human capital. Another hypothesis is that accumulated capital can induce greater efficiency. If there are positive externalities to physical and human capital, then countries will emerge that save and invest more to have better production functions. Thus, higher production efficiency can lead to higher factor accumulation or vice versa.

A final hypothesis is that both factor accumulation and production efficiency are determined by a common third variable. The third common variable is the quality of the nation's institutions, including the government's policymaking process. Policies that do not control high inflation, excessive budget deficits, market interference and corruption often go hand in hand.

We should not be surprised that economies with these ratings accumulate less capital and fail to use the capital they have as efficiently as they could.

We used the Solow model to discover the theoretical relationships between the various sources of economic growth and presented some of them. We can use theoretical considerations and evidence to guide our thinking about economic policy. According to the Solow growth model, how much a nation saves and invests is a determinant of the standard of living of its citizens.

As we have seen, the saving rate determines the equilibrium levels of capital. A certain saving rate produces the golden rule equilibrium, which maximizes consumption per worker and thus economic welfare. To decide whether the economy is above or below the Golden Rule level, the equilibrium state, we must compare the marginal product of capital net of depreciation ($MPK - \delta$) with the growth rate of total output ($n + g$), as we have shown at the Golden Rule equilibrium, $MPK - \delta = n + g$. If the economy is operating with less capital than in the Golden Rule equilibrium, diminishing marginal product tells us that $MPK - \delta < n + g$. In this case, the increase in the saving rate will cause capital accumulation to increase and the economy to grow, and ultimately lead to a steady state of higher consumption. If the economy has more capital than in the Golden Rule it holds that $MPK - \delta = n + g$. Capital accumulation is excessive, and reducing the saving rate will lead to higher consumption both immediately and in the long run.

To make this comparison for a real economy we need an estimate of the growth rate of output ($n + g$) and an estimate of the net marginal product of capital ($MPK - \delta$). Real GDP grows by an average of 3 percent per year, so $n + g = 0.03$. We can estimate the net marginal product of capital with the following three elements:

- The social capital is approximately 2.5 times the GDP of a year.
- Capital depreciation is approximately 10 percent of GDP.
- Capital income is approximately 30 percent of GDP.

Using model notation, we can write these aspects to be:

$k = 2.5y$;

$\delta k = 0.1y$;

$MPK \times k = 0{,}3y$.

We solve for the depreciation rate δ by dividing equation 2 by equation 1:

$\delta k/k = (0{,}1 \text{ years})/(2{,}5 \text{ years})$

$\delta = 0{,}04$.

And we solve for the marginal product of capital MPK by dividing equation 3 by equation 1:

$(MPK \times k)/k = (0{,}3 \text{ years})/(2{,}5 \text{ years})$

$MPK = 0{,}12$.

Thus, approximately 4 percent of the share capital depreciates each year, and the marginal product of capital is approximately 12 percent per year. The net marginal product of capital, MPK – δ, is about 8 percent per year.

We can see that the return on capital (MPK – δ = 8 percent per year) is well above the average growth rate of the economy (n + g = 3 percent per year). This fact, along with the previous analysis, indicates that capital is well below the Golden Rule level. When calculations similar to the above are made for any economy, the results are similar. The possibility of excessive saving and capital accumulation beyond the Golden Rule level is theoretically intriguing, but does not appear to be a problem for real economies. In practice, economists are more often concerned with underserving.

Conclusions

From the data presented in this article, through careful study, a number of important and promising conclusions for future economic growth can be drawn. Macroeconomics, like microeconomics, cannot develop only on declarative bases, they must be based on, subordinated to models that are tangential to this concern that we have from one period of time to another.

It follows that the Solow model, and those of other researchers who investigated, highlighted the need to ensure the net marginal product of capital, which is given by a mathematical function that clearly states what it is about.

Studies for research and economic development are essential. Therefore, the possibility of excessive saving and capital accumulation beyond the level of the Golden Rule must be applied, being interesting from a theoretical point of view, but which must be well analysed in the perspective of the real incomes we discuss in economics.

In practice, economists are more often concerned with insufficient saving than with finding the forms in which this saving can become really effective in the interest of the entire mass of employees, labor capital in other words.

The calculations show that to move the economy toward the Golden Rule as a steady state, policy makers should adopt policies to encourage individual and national saving.

A simple accounting situation shows that larger national savings means larger public savings, means private saving, and a combination of the two, which can lead to harmonious development that ensures increased economic development.

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