GROWTH RATES, QUALITY OF ECONOMIC GROWTH AND CONVERGENCE OF GROWTH RATES

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ABSTRACT: *The aim of this analysis is to examine methodological possibilities for defining the interdependence of the key categories of production theory. The ultimate goal of this paper is to define relationships pointing to the interdependence of growth rates. Due to the general interdependence, each specifically observed growth rate reflects the relevant characteristics of current development processes, but also reflects on the development conditions and the opportunities of achieving a satisfactory pace of growth in the future. The pace of growth can increase significantly to the detriment of its quality. Low quality growth eventually causes a slowing of economic dynamics, proving that the temporary acceleration has been achieved at the expense of the future and long-term growth rate. Without a simultaneous increase in the efficient use of resources, all growth rates of endogenous factors of production (capital) converge to the arithmetic mean of the growth rates of exogenous production factors.*

KEY WORDS: *growth rates, interdependence, convergence, growth quality, quality.*

JEL CLASSIFICATIONS: *C18, D24, O12.*

1. INTRODUCTION

The efficiency of economic development is most often observed through the level and changes in the pace of growth. However, if changes in its pace are introduced into the analysis, the entire procedure is relativized, and the obtained estimates are ambiguous.

It should be emphasised that each particularly observed rate reflects relevant characteristics of the current development processes, but it also reflects on the conditions of development and opportunities of reaching a satisfactory growth rate in the future. In other words, the same growth rate may be assessed differently, depending on whether it

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has been preceded by high or low growth rates. If a development process has previously prepared the ground for acceleration of growth in the current period, then relatively high growth rates cannot be interpreted as good result of current economic policies. The situation is reversed if unfavourable development opportunities have been created in a previous period.

The degree to which a certain growth rate is interpreted as successful depends in a very complex way on the entire configuration of growth rates recorded in the previous period. In certain period, a set of institutional policies may give good results, simultaneously containing (as a tendency or possibility) elements that could reduce development performance. Such a set of institutional policies enables the achievement of high growth rates, but contains a potential for creating new policies, which will significantly reduce these rates. This interdependence is especially true for underdeveloped and developing countries.

Successful development in one a period is not independent of development trends and performance in the future. This concerns ″the phenomenon of time interdependence of the growth rates achieved in successive intervals of the observed period.″ Thus, due to general interdependence, each particularly observed growth rate reflects relevant characteristics of development processes in the past and affects the conditions of development and pace of growth in the future (Denison, et al., 1972).

Growth quality analysis is particularly important in the conditions of rapid economic expansion when positive conclusions are easily drawn, but a high growth rate does not guarantee its quality. Economic growth analysis is long-term in its nature. When observing shorter periods, the time interdependence of growth rates must be kept in mind. Low-quality growth is manifested as a limiting factor for the increase in production in the future. However, if one economy achieves rapid growth in the long run, it is reasonable to assume that the growth is of a good quality.

2. PRODUCTION FACTORS AND DISTRIBUTION OF NATIONAL INCOME

In the case of linearly homogenous production functions, the second direct partial derivatives can be expressed through their second mixed partial derivatives. By differentiating a linearly homogenous production function: $tY = f(tK, tL)$, we obtain:

$$Y = K \cdot f_K(K, L) + L \cdot f_L(K, L),$$

whose linear differential by K and L gives:

$$K \cdot f_{KK} + L \cdot f_{LK} = 0 \text{ and}$$
$$K \cdot f_{KL} + L \cdot f_{LL} = 0,$$

from which the correlation between mixed and direct partial derivatives can be expressed as:

$$f_{KL} = f_{LK} = -\frac{K}{L} \cdot f_{KK} = -\frac{L}{K} \cdot f_{LL}$$

Labour productivity (p = $\frac{Y}{L}$) can be expressed by including capital equipment (m = $\frac{K}{L}$), if the equation is divided by L_t:

$$p_t = A \cdot m_t^{\alpha}$$

which is a *function of labour productivity*.

The marginal product of the factors K and L can also be expressed through the productivity function. Given that:

$$Y = L \cdot f\left(\frac{K}{L}\right)$$

and the marginal product of factor K is defined as the partial derivative by this argument. Then:

$$\frac{\partial Y}{\partial K} = L \cdot f'\left(\frac{K}{L}\right)\frac{d}{dK}\left(\frac{K}{L}\right) = L \cdot f'\left(\frac{K}{L}\right)\frac{1}{L} = f'(m).$$

This means that the first partial derivative of function K equals the first derivative by argument $\left(\frac{K}{L}\right)$.

The first partial derivative of production by the second argument L is then:

$$\frac{\partial Y}{\partial L} = \frac{\partial}{\partial L}\left[L \cdot f\left(\frac{K}{L}\right)\right] = f\left(\frac{K}{L}\right) + L \cdot f'\left(\frac{K}{L}\right)\frac{d}{dL}\left(\frac{K}{L}\right) = f\left(\frac{K}{L}\right) - L \cdot f'\left(\frac{K}{L}\right)\left(\frac{K}{L^2}\right) = f\left(\frac{K}{L}\right) - \frac{K}{L}f'\left(\frac{K}{L}\right) = f(m) - m \cdot f'(m)$$

Further analysis yields:

$$K \cdot \frac{\partial Y}{\partial K} + L \cdot \frac{\partial Y}{\partial L} = K \cdot f'\left(\frac{K}{L}\right) + L \cdot f\left(\frac{K}{L}\right) - L \cdot \frac{K}{L}f'\left(\frac{K}{L}\right) = L \cdot f\left(\frac{K}{L}\right)$$

i.e.: $K \cdot \frac{\partial Y}{\partial K} + L \cdot \frac{\partial L}{\partial K} = Y$, which represents Euler's theorem.

Variable Y can also be interpreted as the national income of an economy as a whole (Gilium & Klaus, 2004). Then coefficients α and (1-α) become shares of factors in the functional distribution of national income:

$$\varphi_{YK} = \frac{\partial f}{\partial K} \cdot \frac{K}{f} = \alpha \cdot A \cdot K^{\alpha-1}L^{1-\alpha}\frac{K}{A \cdot K^{\alpha} \cdot L^{1-\alpha}} = \alpha \qquad (1)$$

$$\varphi_{YL} = \frac{\partial f}{\partial L}\frac{L}{f} = (1-\alpha) \cdot A \cdot K^{\alpha} \cdot L^{-\alpha}\frac{L}{A \cdot K^{\alpha} \cdot L^{1-\alpha}} = 1-\alpha \qquad (2)$$

At the same time, prices of factor utilization are equal to their marginal products, so that (Allen, 1962; Hall & Lieberman, 2001):

$$\frac{\partial Y}{\partial K} = z \quad \text{and} \quad \frac{\partial Y}{\partial L} = w \qquad (3)$$

where *z* and *w* are prices of the utilization of factors K and L.

Let $K \cdot f_K$ represent the mass of income earned on capital, and $L \cdot f_L$ the share of income that belongs to the labour factor. *Share of capital and labour* in the national income (φ_K, φ_L) is (Salvatore, 2003):

$$\varphi_K = \frac{\partial Y}{\partial K} \cdot \frac{K}{Y} = \frac{K \cdot f_K}{Y} = \frac{z \cdot K}{Y}$$

$$\varphi_L = \frac{\partial Y}{\partial L} \cdot \frac{L}{Y} = \frac{L \cdot f_L}{Y} = \frac{w \cdot L}{Y} \tag{4}$$

The law of diminishing returns is manifested as a decrease in marginal products as the result of an increase in the value of this factor when the other factor remains unchanged (Brown, 2008). The measure of the pace of the effect of the law of diminishing returns is the coefficient of elasticity of the marginal product relative to the factor itself (λ_{LL}, λ_{KK}):

$$\lambda_{LL} = \frac{-f_{LL} \cdot L}{f_L} \qquad \lambda_{KK} = \frac{-f_{KK} \cdot K}{f_K} \tag{5}$$

It can be seen from relationships (5) that the relationship of the share of factors in the distribution of national income is equal to the reciprocal value of the ratio of the appropriate elasticity coefficients:

$$\mu = \frac{\varphi L}{\varphi K} = \frac{L \cdot f_L}{K \cdot f_K} = \frac{f_L}{f_K} \cdot \left(-\frac{f_{KL}}{f_{LL}}\right) = \frac{f_L}{f_{LL} \cdot f_K} \cdot \frac{K \cdot f_{KK}}{L} = \frac{\lambda_{KK}}{\lambda_{LL}}$$

The cross-elasticity coefficients are then:

$$\lambda_{LK} = \frac{f_{LK} \cdot K}{f_L} = \frac{K}{f_L}\left(-\frac{L \cdot f_{LL}}{K}\right) = -\frac{L \cdot f_{LL}}{f_L} = \lambda_{LL} \tag{6}$$

$$\lambda_{KL} = \frac{f_{KL} \cdot L}{f_K} = \frac{L}{f_K}\left(-\frac{K \cdot f_{KK}}{L}\right) = -\frac{K \cdot f_{KK}}{f_K} = \lambda_{KK}$$

3. TWO-FACTOR PRODUCTION FUNCTION AND THE RATE OF FACTOR SUBSTITUTION

The *rate of substitution for the production factor* is the relationship among marginal products of inputs. It shows the conditions under which inputs are substituted in production (how many times the value of an input must be multiplied to compensate for the decrease that would result from a decrease in the value of another input). *The marginal rate of substitution* for the production factors of any degree of homogeneity depends on this relationship rather than the absolute value of the inputs (Arrow, et al., 1961):

$$\mathrm{S} = \frac{f_1(x_1,x_2)}{f_2(x_1,x_2)}$$

which means that the initial combination of production inputs requires the absolute value of the gradient of isoquant (f_1/f_2), as determined by the ratio of inputs, to remain constant under any proportional change thereof.

Marginal product functions can also be used to calculate the *marginal rate of substitution*:

$$S = \frac{f_K}{f_L} = \frac{z}{w} = \frac{\alpha \cdot A \cdot K^{\alpha-1} \cdot L^{1-\alpha}}{(1-\alpha) \cdot A \cdot K^{\alpha} \cdot L^{-\alpha}} = \frac{\alpha}{1-\alpha} \cdot \frac{L}{K} \tag{7}$$

If the *marginal rate of substitution* diminishes (Silberberg & Suen, 2001) the value of other inputs will sharply increase, which is necessary to compensate for the reduction in the first input. This means that inputs are difficult to replace. It is therefore desirable to construct an indicator of the pace at which the rate of substitution changes based on this interdependence. This indicator is the *coefficient of elasticity of substitution.* Given that the rate of substitution depends on the ratio quantity of production inputs, the *coefficient of elasticity of substitution* should be defined to include both the substitution rate and the K/L ratio:

$$\sigma = \frac{d(K/L)/(K/L)}{ds/s} \tag{8}$$

Therefore, the *coefficient of elasticity of substitution* is defined (McEachern, 2000) as the quotient of the relative increase in the ratio quantity of production inputs and the relative increase in the marginal rate of substitution, and it will be even higher if the inputs can more easily be substituted (if the inputs are easy to substitute, the marginal rate of substitution increases slowly, so that the denominator is relatively low and the coefficient σ is relatively high). At the same time, this means that production can easily be increased through the increase of a single factor. Because the law of diminishing returns will not have a significant impact, it is possible to achieve relatively high growth rates with an uneven rate of increase in the available amounts of production factors.

Because the Cobb-Douglas function is linearly homogenous, the *coefficient of elasticity of substitution* can also be calculated as (Kumar, 2019):

$$\sigma = \frac{f_L \cdot f_K}{Y \cdot f_{LK}} \tag{9}$$

It is also necessary to express the second mixed partial derivative:

$$f_{LK} = \alpha(1-\alpha) \cdot A \cdot K^{\alpha-1} \cdot L^{-\alpha}$$

The substitution produces:

$$\sigma = \frac{\alpha \cdot A \cdot K^{\alpha-1} \cdot L^{1-\alpha}(1-\alpha) \cdot A \cdot K^{\alpha} \cdot L^{-\alpha}}{A \cdot K^{\alpha} \cdot L^{1-\alpha} \cdot \alpha \cdot (1-\alpha) \cdot A \cdot K^{\alpha-1} \cdot L^{-\alpha}} = \frac{\alpha(1-\alpha) \cdot A^2 \cdot K^{2\alpha-1} \cdot L^{1-2\alpha}}{\alpha(1-\alpha) \cdot A^2 \cdot K^{2\alpha-1} \cdot L^{1-2\alpha}} = 1$$

The value of *the coefficient of elasticity of substitution* equals 1 regardless of the value of the arguments of the production function, which indicates constant and unvaried distribution.

If ***k*** is the *capital coefficient* and ***n*** is the *labour coefficient*, then the *coefficient of elasticity of substitution* **σ** can be expressed as:

$$\sigma = \frac{d(^k/_n)/(^k/_n)}{ds/s} \tag{10}$$

Given that: $s = \frac{f_L}{f_K} = \frac{w}{z}$ (factor price ratio) the *rate of substitution* as a function of ***n*** and ***k*** is:

$$\frac{w}{z} = g\left(\frac{n}{k}\right)$$

Substituting function ***g*** into the ratio of the share of two factors in the distribution of national income produces:

$$\mu = \frac{\varphi_L}{\varphi_K} = \frac{w \cdot L}{z \cdot K} = \frac{n}{k} \cdot g\left(\frac{n}{k}\right)$$

Given that:

$$d\mu = d\left(\frac{\varphi_L}{\varphi_K}\right) = \frac{\varphi_K \cdot d\varphi_L - \varphi_L \cdot d\varphi_K}{(\varphi_K)^2} = \frac{\varphi_L}{\varphi_K}\left(\frac{d\varphi_L}{\varphi_L} - \frac{d\varphi_K}{\varphi_K}\right)$$

$$d\left(^n/_k\right) = d\left(\frac{L}{K}\right) = \frac{K \cdot dL - L \cdot dL}{K^2} = \frac{L}{K}\left(\frac{dL}{L} - \frac{dK}{K}\right),$$

is then:

$$\frac{d\mu}{d\left(^n/_k\right)} = \frac{w}{z}\left[\frac{r(\varphi_L) - r(\varphi_K)}{r_L - r_K}\right]$$

where ***r(φ_L), r(φ_K), r_L*** and ***r_K*** are *growth rates of appropriate values*, and at the same time:

$$\frac{\varphi_L/\varphi_K}{L/K} = \frac{w}{z}\,.$$

Comparing the ratios obtained, it follows that:

$$\frac{r(\varphi_L)-r(\varphi_K)}{r_L-r_K} = 1 - \frac{1}{\sigma}\,, \qquad \text{that is:} \quad \sigma = \frac{r_K-r_L}{r_w-r_z}\,. \tag{11}$$

4. GROWTH RATES AND A TWO-FACTOR PRODUCTION FUNCTION

Growth rates can be expressed from the production function (Domar, 1946), taking into consideration that all variable functions of time are:

$$Y(t)= f[K(t), L(t)] .$$

Differentiating by time *t*, we get:

$$\frac{dY}{dt} = \frac{\partial f}{\partial K} \cdot \frac{dK}{dt} + \frac{\partial f}{\partial L} \cdot \frac{dL}{dt}$$

and dividing the equation by Y, the growth rate $\boldsymbol{r_Y}$ is:

$$r_Y = \frac{f_K \cdot K}{Y} \cdot r_K + \frac{f_L \cdot L}{Y} \cdot r_L \qquad (12)$$

Given that: $\frac{f_K \cdot K}{Y} = \varphi_K$ and $\frac{f_L \cdot L}{Y} = \varphi_L$, then:

$$r_Y = \varphi_K \cdot r_K + \varphi_L \cdot r_L$$

and in a linearly homogenous production function:

$$r_Y = \varphi_L \cdot r_L + (1-\varphi_L) \cdot r_K . \qquad (13)$$

so, besides an increase in the pace of production factor growth, the growth rate is also influenced by the change in the share of coefficient φ_L over time, and it depends on the *elasticity of substitution* (Lewis, 2019). The rate of change in growth rate r_Y is:

$$\frac{dr_Y}{dt} = (r_L - r_K) \frac{d\varphi_L}{dt}$$

which means that it is necessary to determine the change in input share coefficient φ_L over time (Frank& Bernanke, 2001; Landsburg, 2002). Given that: $\frac{f_L \cdot L}{Y} = \varphi_L$, this value can also be expressed as the function of the rate of substitution: $\left(s = \frac{f_L}{f_K}\right)$ and capital equipment of labour ($c = \frac{K}{L}$):

$$\varphi_L = \frac{f_L \cdot L}{Y} = \frac{\left(f_L/_{f_K}\right) \cdot K \cdot f_K}{Y \cdot \left(K/_L\right)} = \frac{s \cdot (1 - \varphi_L)}{c}$$

from which: $\ln \varphi_L = \ln s + \ln (1- \varphi_L) - \ln c.$

Differentiating by time:

$$\frac{dln\, \varphi_L}{dt} = \frac{dln\, s}{dln\, c} \cdot \frac{dln\, c}{dt} + \frac{dln\,(1-\varphi_L)}{dt} - \frac{dln\, c}{dt} = \frac{1}{\sigma}(r_K - r_L) - \frac{1}{1-\varphi_L}\frac{d\varphi_L}{dt} - (r_K - r_L) \qquad (14)$$

Given that: $\frac{dln\, \varphi_L}{dt} = \frac{1}{\varphi_L} \cdot \frac{d\varphi_L}{dt}$, we get:

$$\frac{d\varphi_L}{dt} = \varphi_L(1-\varphi_L)\frac{1-\sigma}{\sigma}(r_K - r_L). \tag{15}$$

Given that: $\frac{dr_Y}{dt} = (r_L - r_K)\frac{d\varphi_L}{dt}$, the substitution produces:

$$\frac{dr_Y}{dt} = \varphi_L(1-\varphi_L)\frac{\sigma-1}{\sigma}(r_L - r_K)^2 \tag{16}$$

which means that the growth rate r_Y will not be constant for given and constant growth rates of production factors only if the coefficient of elasticity of substitution differs from 1.

5. INTERDEPENDENCE AND CONVERGENCE OF GROWTH RATES

Extensive growth has mechanisms for its own curtailment, which are based on the depletion of exogenous sources of growth. Once the sources are depleted, the growth will slow, with a tendency towards economic stagnation (Hulten & Isaksson, 2007; Thirlwall, 2008). In this way, the aspect of the interdependence of individual components of extensive growth, which eventually lead to its slowdown, becomes apparent. This interdependence appears in the sphere of purely material relations. This means that systems incapable of generating growth in efficiency (global productivity) may achieve only lower capital growth rates and due to convergence lower output growth rates.

As the result of convergence (Derviş, 2012), in the long run, the growth rate of the national product equals the growth rate of capital. Because of this, the *average capital coefficient* ($\bar{k}$*)* takes a constant value. In the short run, these rates may differ from the *marginal capital coefficient (k).* This can be proven in a simple way.

If the investments I(t) equal accumulation S(t) and if: S(t)=s·Y(t), then:

$$r_K = \frac{I(t)}{K(t)} = \frac{s \cdot Y(t)}{K(t)} = \frac{s}{\bar{k}(t)} \tag{17}$$

$$r_Y = \frac{\dot{Y}(t)}{Y(t)} = \frac{\dot{Y}(t)}{I(t)} \cdot \frac{I(t)}{Y(t)} = \frac{s}{k(t)} \tag{18}$$

If the accumulation rate (s) is given and constant, the capital growth rate equals the quotient of *accumulation rate* and *average capital coefficient* $\bar{k}$ (equation 17). At the same time, the growth rate of national income equals the quotient of the same rate and the *marginal capital coefficient k* (equation 18). By comparing these two equations, the following is possible:

$$\begin{array}{lll} r_K > r_Y & & \bar{k}(t) < k(t) \\ r_K = r_Y & \text{and} & \bar{k}(t) = k(t) \\ r_K < r_Y & & \bar{k}(t) > k(t) \end{array} \tag{19}$$

If the *marginal capital coefficient* ***k*** is higher than the *average* $\bar{k}$ $[k > \bar{k}]$, this results in an increase of the *average capital coefficient* $\bar{k}$.

Proof 1: If **k** > $\bar{k}$, then (taking into consideration equations 17 and 18) the growth rate of the national product r_Y is less than the growth rate of capital r_K [$r_Y < r_K$]. Since the average capital coefficient is $\bar{k} = K(t)/Y(t)$, and the numerator grows faster than the denominator, $\bar{k}$ is therefore increasing.

Proof 2: Since r_K=s·(Y(t)/K(t)), if [$r_Y > r_K$] this means that the denominator grows faster than the numerator, and r_K must decrease approaching r_Y. In a similar way, the convergence of the rate r_K towards the rate r_Y occurs when [$r_Y < r_K$], with a constant accumulation rate (s).

Conclusion 1: With a constant accumulation rate (s), the growth rate of capital (r_K) cannot remain higher (nor lower) in the long run than the growth rate of the national product (r_Y).

Further, it is necessary to show the declining tendency of the rate r_K when [$r_Y > r_K$] in the conditions when the *accumulation rate* is variable:

Proof 3: If: $r_K = \frac{s(t)\cdot Y(t)}{K(t)}$, then: $r(r_K) = r_s + (r_Y - r_K)$ (20)

When [$r_Y > r_K$] in the expression $r(r_K)$ a negative component $(r_Y - r_K) < 0$ will appear with the declining tendency r_K. This decline may be partially compensated by growth of the accumulation rate (r_s>0). However, this compensation cannot be complete, since the definition limit for the rate *s* is 1. The effect of the relation r_s>0 will eventually prevail and $(r_Y - r_K)$<0. This negates the effect of the rate r_s>0, and the rate $r(r_K)$ <0. Therefore,

Conclusion 2: The growth rate of capital will approach from above the growth rate of the national product. In the conditions when [$r_K < r_Y$], this cannot be permanently compensated by reduction of the accumulation rate r_s<0.

Proof 4: If [$r_K < r_Y$], then $(r_Y - r_K)$>0. This can be compensated by a reduction of the rate *s* (r_s<0). However, since the accumulation rate (*s*) has zero as its definition limit, this means that eventually the convergence $r_K \rightarrow r_Y$ will appear.

Thus, the convergence $r_K \rightarrow r_Y$ has been proven in cases of constant and variable accumulation rate (*s*).

From the *long-term* point of view, the only relevant case is that of a constant rate *s*, since its potential increase may only be temporary (Dani, 2011; Doppelhofer, et al, 2000). With a constant rate *s*, it is possible for r_K to rise, partially compensating for decline in the growth rate of employment and global productivity. This compensatory growth may be only temporary.

Proof 5: If r_K=s·(Y(t)/K(t)), the increase in growth rate of capital $r(r_K)$>0 implies that $r_Y > r_K$. Bearing in mind the expressions (1) and (2), this means that $k(t) < \bar{k}(t)$, and also a decline of $\bar{k}$. The declining *average capital coefficient* $\bar{k}$ will start to approach *k*, since the latter cannot be constantly declining. This means that the difference between them will decline [$(\bar{k} - k) \rightarrow 0$]. This further means that *the growth rate of the capital growth rate* $r(r_K)$, while remaining a positive value, will become gradually lower, that is its growth rate is negative. Thus, the acceleration phenomenon gradually disappears and the growth rate r_K tends towards a constant value.

The empirical results of some studies are in accordance with these postulates (Madžar, 1981; Dosi, et al., 1988; Deepak, 1995; Kogan, et al.,2015). Namely, intensifying investment with the aim of compensating depressing effects of other factors by capital growth is limited in range and depletes relatively quickly. Experience shows that, in economies that have followed a strategy of extensive growth, *the average capital coefficient* grew. Therefore, the *marginal capital coefficient* was higher than the *average* one (Denison & Poullier, 2016), and the capital growth rate (r_K) higher than the growth rate of the national product (r_Y). This is precisely the reason why the capital growth rate was declining. A decreasing (r_K) puts pressure on reduction of the growth rate (r_Y).

Growth of *the average capital coefficient* $\bar{k}$ implies $r_K > r_Y$. Since $r(r_K)=r_s + r_Y$, then r_K and r_s, as a rule, equal zero. If, in order to mitigate the slowdown in growth, a strategy of increasing the accumulation rate is applied, this means that $r(r_K)<0$, i.e. the capital growth rate r_K will decrease. The rate of decrease depends on whether the gap between $\bar{k}$ and k narrows. In other words, while the average capital coefficient $\bar{k}$ grows, the marginal one is higher than the average, and must also grow eventually, which implies the effect of lowering of the rate r_Y.

A typical reaction in developing economies has been to compensate the decrease in efficiency, manifested through growth of the *average capital coefficient*, with an increase in the accumulation rate. This may temporarily delay and partially mitigate the observed effect, but cannot prevent it while the relation between national product and capital is deteriorating (Y/K – productivity or capital efficiency) (Denison, 1984). Certain management interventions may mitigate, but not reverse fundamental and exogenously determined trends. These are mechanisms that cannot achieve a permanent increase in economic efficiency.

Convergence of the rates r_K and r_Y may be achieved in several ways. It may be achieved through high or low growth rates, then the system can quickly decrease to low equilibrium rates or approach them slowly and gradually. If in the long-run there is an unavoidable decrease in the capital growth rate, as the consequence of decreasing and low efficiency (technical progress), in the short run there is an additional mechanism whereby the causal relation goes in the opposite direction. A slowdown in capital growth, caused by inadequate technical progress (efficiency), contains a short-term feedback in which the slowdown in capital growth adversely affects the rate of technical progress.

6. CONCLUSION

In the theory of production, what is of primary interest is the way in which the total product varies with the variation of production inputs. Results show that the growth rate is the weighted arithmetic mean of the growth rate of marginal production and the share of factors in income distribution. In addition, for given and constant growth rates of the production factor, the growth rate of GDP $\boldsymbol{r_Y}$ will not be constant only if the coefficient of elasticity of substitution differs from 1.

"The growth rate is a necessary but insufficient indicator of economic growth in the initial stages of development". The pace of growth may significantly increase to the detriment of its quality. Poor quality growth will eventually cause a slowdown of economic dynamics, which proves that the temporary acceleration was achieved at the detriment of future and long-term growth rates.

Of course, insisting on the qualitative aspect of growth is not aimed at questioning the great importance of high growth rates, especially in countries with low levels of development. The first task of quantitative analysis of the sources of growth is to identify the factors upon which the pace of production increase depends. It is necessary to select indicators that express the level and dynamics of certain factors of economic growth. Disregarding quality is directly related to costs. Apart from the decrease in social welfare, which is hard to measure, low quality also implies higher current costs and other types of cost. This especially refers to the quality of investment goods, where savings achieved at the expense of quality (in a negative sense) are more than compensated with higher operating costs. Low-quality raw materials and inputs also imply higher costs, since production is more difficult, production delays longer and more frequent, with possible technical complications.

The strategy of forced quantitative increase cannot permanently replace a lack of motivation and creativity and an increase in economic efficiency based on them. Even with stagnant efficiency, it is not possible to maintain a desired and, for market economies, typical pace of growth.

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