MARGINAL EFFICIENCY OF PRODUCTION FUNDS: A METHODOLOGICAL PERSPECTIVE

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Abstract: *In this study, the effect and the efficiency of investments in addition to operation is presented both graphically and analytically. The author suggests a method for calculating the recovery period. In author's view, investments must be focused mainly on creation and modernization of production funds in the agri-food sector/industry.*
Keywords: *Effect, investments, efficiency, production funds, capital, production function, physical depreciation of capital.*

It is difficult that all factors of economic growth be enumerated and classified in order of their importance. We may name three factors with a direct impact on economic growth: labour, production funds and technical progress. Leaving aside technical progress, GDP noted Y is the result of the action of two main factors: labour force (L) and production funds (K). Each combination of the two factors provides a specific amount of production (Y) that may be noted as a function $Y = F(K, L)$, in which $K \geq 0$; $L \geq 0$, is called a production function. The increase of the amount of production funds by ΔK contributed to the increase of production by ΔY, the volume of labour force L remaining constant. The evolution may be interpreted graphically (Fig. 1)

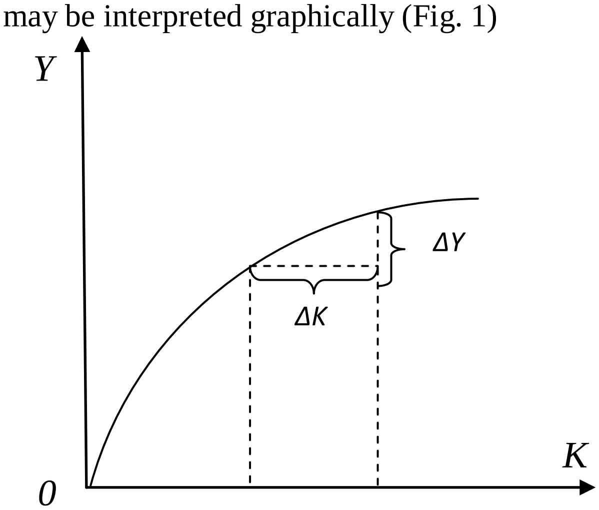

Figure 1 Production volume growth by ΔY as a result of production funds growth by ΔK

The relation $\frac{\Delta Y}{\Delta K}$ shows how many units of production growth are there per each growth unit of production funds. Let us take the limit of this relation:

$$\lim_{\Delta K \to 0} \frac{\Delta Y}{\Delta K} = \frac{\partial Y}{\partial K} \text{ called marginal efficiency pf production funds}$$

If, for example, the production function is known $Y = F(K, L)$, then $\frac{\partial Y}{\partial K}$ may be called the expected efficiency of production funds. It is natural that the expected efficiency in various economic operations be different. In this case, the expected efficiency turns into „test” identifying the economic sectors, operations, where production funds generate the highest expected efficiency. The highest expected efficiency makes it possible to identify the shortest period for recovering production funds. If, for example, hypothetically, production funds are not subject to renovations, then they lose over time their value, they become physically depreciated. In formal language, the speed of production funds depreciation $\left(\frac{dK}{dt}\right)$ is directly dependent on the volume of operational production funds ($K(t)$) or

$$\frac{dK(t)}{dt} = -AK(t), \qquad (1)$$

where A – is the coefficient of proportionality. The equation (1) is a separable first order differential equation. Let us separate the variables:

$\frac{dK}{K} = -Adt$, we take the integration on both sides and obtain

$$\int \frac{dK}{K} = -A \int dt \;\; or \; ln|K| = -At + c \; from\, where\; K = e^{-At} * e^{c}$$

In the initial period $t = 0$, the volume of production funds is $K(0) = K_0$. We calculate the value of constant e^c:

$$K_0 = e^{A*0} * e^{c};\; e^{c} = K_0$$

so, $K = K_0 e^{-At} = \frac{K_0}{e^{At}}$ – is the evolution of physical depreciation of production funds that may be interpreted graphically (Fig. 2).

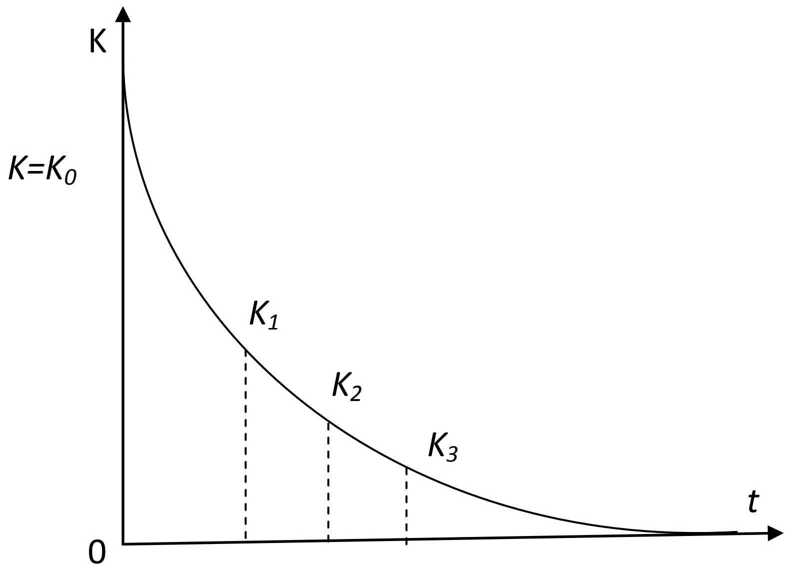

Figure 2 Evolution of physical depreciation of production funds

The depreciation of production funds leads also to the decrease of production volume $Y(t)$. We assume that in the initial period $t \approx 0$, investments have been made in the amount I. Production funds are $(K_0 + I_0)$. Similarly, we calculate the evolution of physical depreciation of the volume of production funds $(K_0 + I_0)e^{-At}$. Up to the increase of production funds by I units, the production function is $Y = F(K_0 e^{-At}, L)$, after the increase, it is $\bar{Y} = F\left((K_0 + I_0)e^{-At}, L\right)$. We calculate the balance, the effect generated by investments I_o:

$$\Delta Y = \bar{Y} - Y = F\left((K_0 + I_0)e^{-At}, L\right) - F(K_0 e^{-At}, L).$$

In a time interval $(0, \infty)$, the effect is:

$$\text{Effect} \cong \int_0^\infty \left(\bar{Y}(t) - Y(t)\right)dt = \int_0^\infty \left(F\left((K_0 + I_0)e^{-At}, L\right) - F(K_0 e^{-At}, L)\right)dt.$$

The effect of making the investments I_o may be interpreted graphically (Fig. 3)

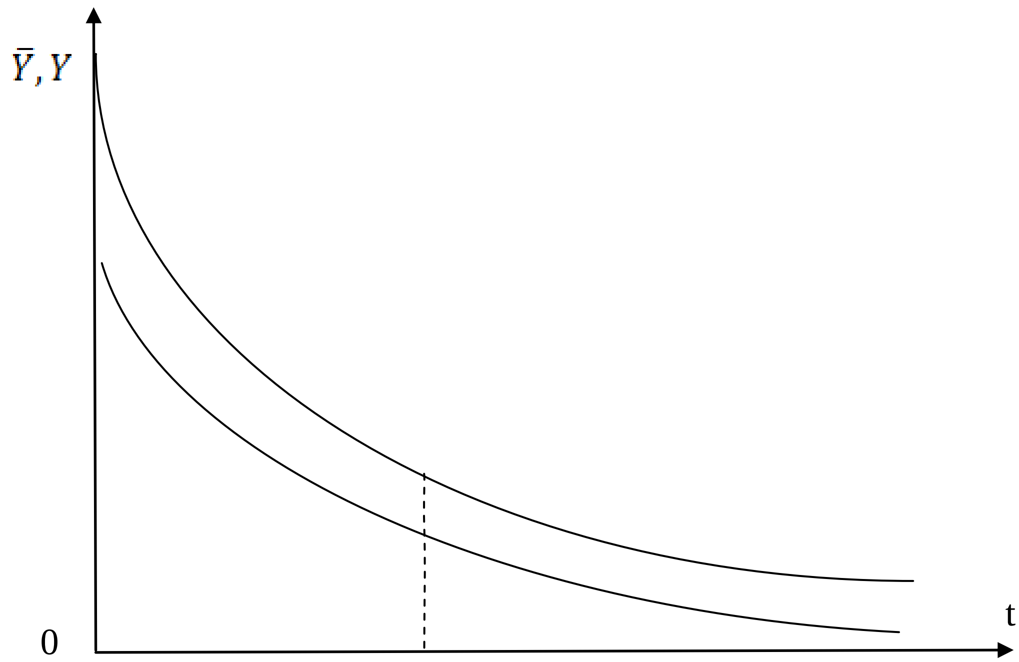

Figure 3 The effect of investments I_o

The effect of making investments I_o in fig. 3 is the surface between the two curves. The relation $\frac{Efectul}{I_0 e^{-At}} = e$ is the efficiency of investments I_o or how many effect units are there per each unit of investments I_o. In this context, the period of investment recovery I_o is the time interval (*0*, *T*), in which the integral effect becomes equal to investment costs I_o. The definition may be presented formally, as follows

$$\int_0^T \left(F\left((K_0 + I_0)e^{-At}, L\right) - F\left(K_0 e^{-At}, L\right)\right) dt = I_0$$

Let us examine the effect of investments I_o for the Cobb-Douglas function $Y = A, K^\alpha L^\beta$, where α, β stand for elasticity of production funds (*K*), labour (*L*)[2]. We assume 0<α<1. We calculate the effect of investments I_o for the Cobb-Douglas function in the time *t*:

$$E(t) = \bar{Y}(t) - Y(t) = A_1(K_0 + I_0)^\alpha e^{-\alpha At} L^\beta - A_1 K_0^\alpha e^{-\alpha At} L^\beta = A_1 K_0^\alpha L^\beta \left(\left(1 + \frac{I_0}{K_0}\right)^\alpha - 1\right) e^{-\alpha At}$$

$$= Y_0 \left(\left(1 + \frac{I_0}{K_0}\right)^\alpha - 1\right) e^{-\alpha At}$$

In the period (0,∞):

$$Effect = \int_0^\infty Y_0\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)e^{-\alpha At} = Y_0\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)\int_0^\infty e^{-\alpha At}\,dt$$

$$= Y_0\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)\left(-\frac{1}{\alpha A}e^{-\alpha At}\,\Big|_0^\infty\right) = \frac{Y_0}{\alpha A}\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)$$

$$Efficience = \frac{Efectul}{I_0 e^{-At}} = \frac{Y}{\alpha A L_0 e^{-At}}\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)$$

Let us analyse the evolution of the effect $E(t) = Y_0\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)e^{-\alpha At}$;

$$\frac{\partial E(t)}{\partial t} = Y_0\left(\left(1+\frac{I_0}{K_0}\right)^\alpha - 1\right)(-At * e^{-\alpha At}) < 0$$

The decrease of the effect interpreted also in fig. 3 may be explained by physical depreciation of productive funds, whose efficiency is decreasing.

CONCLUSIONS

According to data of the National Bank of Republic of Moldova at end of 2016, the foreign direct investments in national economy amounted 3,58 billion US dollars, an increase of 3,3% compared to 2015. Being mostly from the EU, main economic operations that benefitted from foreign capital remained processing industry, followed by financial operations. Main measures taken to attract private investments in Republic of Moldova were provided for in the commitment and roadmap of the Economic Council on investment policies. Among main goals of the commitment were the consolidation and modernization of the legal framework related to investments and implementation of international practices in the field and a constructive dialogue with the business community. In this regard, it is important that businesses, academic community entered into various partnerships, contributed with methodological recommendations, orientation of investments mainly towards creating production funds in the agri-food sector and rural areas. Investments targeted at various sectors may generate various economic and social effects. These are important for all economic sectors and analysis should be made as to identify their effects and efficiency. Approaches and methodological interpretations should be carried out for each sector. The investments represent a common effort for all options, although their effect will be different. Consequently, the efficiency will also vary. The BNS data show that the high percentage in the structure of GDP of retail and wholesale trade (20%), followed by industry (16%), communications (7,5%). We believe that considering this trend changes are needed. The most important economic challenge faced by the Republic of Moldova is the modernization of its agri-food industry. All measures, including investments, should be channelled to this area.

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