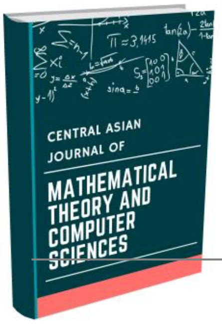

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THE SIMPLEST MATHEMATICAL MODELS OF ECONOMIC PROCESSES

Primov Tulkin Islamovich

Senior lecturer Tashkent Institute of chemistry and technology, Shahrisabz branch

tprimov_197070@mail.ru

Abstract

Mathematical modeling, mathematical model of an object, systems of units of measurement, principles of variation, elements of the system, physical, biological or social phenomena and their descriptive properties.

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Processes and phenomena in different areas of the world around us are often represented by the same or "similar" equations [1]. Therefore, the mathematical models developed for certain phenomena are relatively easy to apply in processes in another broad field. When the real income of the country is received in relation to the average time, it often grows. There are periods when it falls (periods of recession), but there is an increase in the interval of a long time. Economic growth is an important problem of macroeconomics - a branch of economic theory, in which the problems of the economy are studied: economic growth, recession, inflation, unemployment, etc.

Let's consider the dynamics of a separate economy in a long period of time, where its voluntary t - Time state is represented by a set of the following sizes: D(t) - the volume of the final product (income), C(t) - the non - production Consumer Fund, S(t) – the aggregate fund, y(t) – the volume of labor resources (here-the number of workers), X(t) - the volume of The final product is used for full consumption and for savings, i.e., in this case, the fund (aggregate) of the Fund C is the given Part C of the final product, therefore

$$S = sD, C = (1-s)D \qquad (1)$$

There is $s = const, 0 < s < 1$. The depreciation of capital resources is proportional to their size, and investments under the payment of the fund (aggregate) fund [2] are used to compensate for the depreciation of capital and for the growth of capital:

$$S = \delta X + \frac{dX}{dt}, \qquad (2)$$

There is $\delta = const, 0 < \delta < 1$.

The number of handlers, the capital and the volume of the final product are interconnected and it is determined by the function of f(x) production:

$$D = yf(x) \qquad (3)$$

There is $x = \frac{X}{y}$ - capital provision of the labor force $x \geq 0,\ f(0) = 0,\ f'(x) > 0$.

Without it, taking into account the formulas (1) and (3), the equation (2) $syf(x) = \delta X + \frac{dX}{dt}$,

is written as,

$$\frac{1}{y}\frac{dX}{dt} = sf(x) - \delta x \qquad (4)$$

The following that

$$X = xy \qquad (5)$$

taking into account

$$\frac{dX}{dt} = x\frac{dy}{dt} + y\frac{dx}{dt}$$

we form an equality, so the Equation (4) can be written as: $\frac{dx}{dt} = -\frac{x}{y}\frac{dy}{dt} + sf(x) - \delta x$ (6)

In addition, the number of handlers increases exponentially with relative speed [3], assuming: $\frac{dy}{dt} = \varepsilon y$ (7)

Without it, the equation (6) can be written in the final way as follows: $\frac{dx}{dt} = sf(x) - (\delta + \varepsilon)x$ (8)

Giving initial values

$$x(0) = x_0,\ y(0) = y_0 \qquad (9)$$

and (7) - (9) solutions to Cauchy issues

$x(t), y(t) = y_0 e^{\varepsilon t}$ having found, we determine the volume of capital resources according to Formula (5), income according to Formula (3) and consumption and savings fund according to Formula (1). Let's take a look at the following simple case in which the production function is linear:

$$f(x) = mx,\ m = const > 0 \qquad (10)$$

Without it, equation (8) comes to the following view: $\frac{dx}{dt} = (sm - \delta - \varepsilon)x$ (11)

that is, it will be the same as the equation of the Maltus Model (1). Therefore, the cited economic model will have the same disadvantages as the biological model of Maltus [4]. Another production function – the Cobb – Douglas function [35] – is widely used in economic growth theory:

$$f(x) = mx^{\alpha},\ m = const > 0,\ 0 < \alpha = const < 1 \qquad (12)$$

For this function, the equation (8) is written like the Bernoulli equation: $\frac{dx}{dt} = smx^{\alpha} - (\delta + \varepsilon)x$ (13)

Equilibrium point

$$x_* = \left(\frac{sm}{\varepsilon + \delta}\right)^{\frac{1}{(1-\alpha)}} > 0 \qquad (14)$$

For $t \to \infty$ will be $x(t) \to x_*$. By this property (13), (9) calculated the limit at for actual solutions of the issues [5], you can make sure:

$$x(t) = [x_*^{1-\alpha} + (x_0^{1-\alpha} - x_*^{1-\alpha})e^{-(\delta+\varepsilon)(1-\alpha)t}]^{\frac{1}{(1-\alpha)}} \qquad (15)$$

Since the number of workers y (t) increases over time (3) from the formula equilibrium state of capital supply at the end product production comes an increase, the Consumption Fund and the savings fund increase ((1) See formula), the volume of capital resources also increases (5), that is, economic growth occurs, even if labor productivity does not change at all. (14) as can be seen from the formula [6], capital provision is the fixed rate of the savings fund to s and the coefficient of production function to m is inversely proportional to the number of workers and depreciation deductions to inversely proportional. and, considering the parameters invariant, we find the maximum possible value of the Fund(1), (3), (12) support formulas $C(s) = \frac{C}{y} = \frac{(1-s)D}{y} = \frac{(1-s)yf(x_*)}{y} = (1-s)mx_*^{\alpha}$

We will find. So,

$$\frac{\partial c}{\partial s} = -mx_*^{\alpha} + (1-s)mdx_*^{\alpha-1}\frac{\partial x_*}{\partial s}$$

14) taking into account the expression,

$s = \alpha$ $\frac{\partial c}{\partial s} = 0$ we come to the conclusion that it is. Thus, the highest standard of living of workers is achieved when there is a savings norm. The considered model of economic growth is not capable of explaining many phenomena observed in the economy, therefore it needs improvement, just like mathematical models that represent the development of biological species applied in the initial stages, which were later improved in the models created by Lotka – Vol'terr, Kolmogorov and others. (13) the fact that the economic model has disadvantages leads to the creation of a group of models of economic growth that are used in the management of the modern economy.

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