# ELEMENTS OF THE NEOCLASSICAL GROWTH THEORY*

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**Abstract**
*One of the relevant components of the contemporary economic science is the economic growth theory, the economic background of the time leading to new guidelines of the research. The neoclassical growth theory - the core of modern analysis - explains how the capital accumulation and technological changes affect the economy, significant for the analysis of the economic growth process being the Solow's neoclassical growth model. The paper brief describes the elements of the economic growth model developed by Solow, both for the situation when it allows the explanation of extensive growth and that wherein the growth is of intensive nature, as a result of the intervention of exogenous technical progress – a determinant of factors productivity growth. It is highlighted the importance of the exogenous neoclassical model, proposed by Solow, who showed the determinant role of the technical progress in the economic growth phenomenon.*

**Keywords**
neoclassical theory; growth; Solow's model; technical progress

**JEL Classification**
E10; E13; O11; O47

## 1. Introduction

In the evolution of an economy, the main objective of development is the economic growth achievement, a basic factor in providing the long-term economic success of a nation and a premise of the efforts to eradicate poverty.

In this sense, the economic literature has shown a continuous concern on the questions of growth and its determinants, the developed theories and models aiming the research of possibilities for steady growth, finding the ways in which the future work can be predicted based on the current experience data, identifing the ways that can lead to a continuous growth.

The growth theories and models have evolved over time, correlated with the dynamics of economic reality, the used factors and instruments of economic analysis, being appropriate for the stages of development (the classical theory, the Keynesian and Neo-Keynesian theory, the neoclassical theory, the new theory of growth – the endogenous growth theory).

## 2. The neoclassical growth theory – the Solow's model

In the second half of the last century, the theory of economic growth has become a component of the contemporary economic science, the new orientation of researchers being generated by the economic context of the era.

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The neoclassical growth theory - the core of modern analysis - explains how the capital accumulation and technological changes affect the economy.
It is noted a number of characteristic features of the theory:

- perfect competition on the market of goods and production factors;
- taking into consideration of two factors, the labor force and capital;
- the yields are constant throughout the factors;
- decreasing marginal yields on each of the two factors;
- the growth of economic rate correlated with the population growth rate.

Meaningful for the analysis of economic growth process is the neoclassical model of Solow (1956). For Solow, the production level depends both on the quantity and on the factors productivity – the labor and the capital – alongside which, in the production function, he incorporated a third factor – the technical progress, whose role was considered exogenous.
The model shows how in the absence of tehnological progress, there is the risk of economic growth cease, as a result of incomes decrease.

## 2.1.Basic elements of the model:

The agregate production function of the neoclassical model is of the form (Aghion, P.; Howitt, P.,1998):

$$Y = F(K,L) \text{ where:}$$

Y – the production;
K – the amount of capital;
L – the amount of labour force
The function allows explaining **the extensive growth** depending on:

- the capital increase by investments in capacity;
- the workforce growth by demographic effect.

Starting from the function: Y = F(K,L), it is considered:
» *On a constant offer of workforce*, the production function shall be expressed as a **function of capital Y = F(K)** and shows: what is the volume of output Y produced with a given stock of aggregate capital, K, at a given level of knowledge (Aghion, P.; Howitt, P.,1998);
Characteristic for the accumulation of capital: the revenues are decreasing - the marginal product of capital is decreasing (in the capital stock): the growth can be generated only by the capital increase.
The equation of neoclassical theory of growth highlights how the rate of the capital stock change at any time is determined by the volume of the existing capital at that time.

$$K = sF(K) – \delta K, \text{ where:}$$

s – the constant saving of population;
$\delta K$ - the rate of capital diminishing
In the absence of population growth and of technological changes, the economic growth is limited due to capital decrease.
When the capital stock reach the stationary level $Y^* = F(K^*)$ - the rate of the output growth ceases; the economic growth is of temporary nature.
The saving rate growth, ***s*** , temporarily increases the rate of capital accumulation, but has no long-term effect on the growth rate which falls back toward 0; it is the consequence of the capital depreciation rate increase ($\delta$) which reduces its level and of the output on long-term, accelerating the depreciation swift.
»When the aggregate output stream *depends on the capital and labor force*, in the scale production function Y = F (K, L): the output per person is y = Y/L and depends on the stock of capital per person k = K/L (Aghion, P.; Howitt, P.,1998).

Using the Cobb-Douglas function $Y = L^{1-\alpha} K^{\alpha}$ and $0 < \alpha < 1$, the production function per capita could be written $y=f(k)=K^{\alpha}$.
Considering:
The population growth - ***L*** - with a constant exponential rate per year - ***n***
The capital increase - ***K*** – determined by the saving rate per person ***sy*** and the capital decrease due to: the depreciation per person with the depreciation rate ***δK*** and the population growth which causes a decrease with the rate ***nk,*** the net rate of capital increase results from the equation:

$$K = sk^{\alpha} - (n+\delta)k$$, wherein:

s - the savings rate
n – the rate of population growth
δ – the rate of capital depreciation

For a more speedy growth of population, the trend is of reducing the amount of capital per person - similar to depreciation - because of the increase of the number of people which attend the income achievement. As such, the rate of capital depreciation has to be compensated with a rate of population growth. But also it is needed an upper limit of capital per person. When the population savings compensate the decrease of capital (generated by depreciation and population growth) it is reached the stationary value - $k*$ - expressed by $sk^{\alpha} = (n+\delta)k$. On the long run, the capital stock converges to the stationary value $k*$ and the output per capita will converge to the corresponding stationary value, $y^* = f(k^*)$.
The output and the capital grow dependent on the rate of population growth, but on the long-term, the growth (expressed in the output per person) will stop.
The economic growth is of extensive nature, the share of growth being given by the quantitative extent of production factors (the labor and respectively, the capital).

## 2.2. The exogenous technological element

The Solow's neoclassical model showed the difficulty that it provided a perspective of gradually diminishing of per capita economic growth and progress cease, in the absence of innovation in technology; having reached the stationary steady state, the economy ceases growth.
Solow has exceeded this limit, by introducing, along with labor and capital, a third factor - technical progress. Considered an **exogenous factor**, the technical progress increases the productive efficacy of the other two factors, offsetting the revenues diminishing and explaining the growth of the output per capita over time (Diemer, A.).
The model assumes the existence of a parameter of productivity – ***A*** - in the aggregate production function, which increases with a constant exponential rate ***g***, its exogenous value reflecting the progress in science.
For the aggregate production function in the form $Y = (AL)^{1-\alpha}, K^{\alpha}$ (Aghion, P.; Howitt, P.,1998) wherein:
A - the productivity
L - the labor force
K - the capital
α - the constant - $0 < \alpha < 1$

» the technological progress equivalent with the increase of labour force supply AL, increases with the rate of population growth ***n,*** plus the rate of productivity ***g***, so the growth rate is ***n + g***;
» the capital stock growth rate is given by the saving minus the depreciation ***sy-δk,*** wherein:

s - the savings rate;
y – the output/capita;
δ – the rate of capital depreciation.

The distinction from the previous situation **(a)** occurs at the rate of population growth from ***n*** to ***n + g***; the capital per capita - ***k*** (as shown above) moves toward the stationary state. The output and capital per person grow dependent on the exogenous rate of technical progress ***g***.
Along with the accumulation of capital, the downward trend of the ratio output/capital is attenuated by the technical progress. The revenues diminishing and the technical progress mutually attenuate, and the ratio output/capital is constant, so that the economy reaches the stationary state moment.
The reached stationary state maxim point of increase is determined by the rate of savings ***s*,** the rate of depreciation ***δ***, the rate of population growth ***n***, but the parameter that affects the rate of growth is the exogenous rate of technological progress ***g***.
The long-term growth is achieved through the intervention of the exogenous technical progress which influences the effect of the "work" factor , this increasing at a constant rate. So, **the stationary state moves over time, under the influence of exogenous technical progress**, different from the past situation, wherein the growth tended to convergence, to stationary state (Amable, B., 2002).
The technical progress determines the growth of the Total Factor Productivity, leading to their qualitative and not only quantitative growth, which confers growth an **intensive** character.
The elements that distinguish the two forms of growth (extensive and intensive) of the neoclassical model should be noted in the figure below (**Figure** 1):

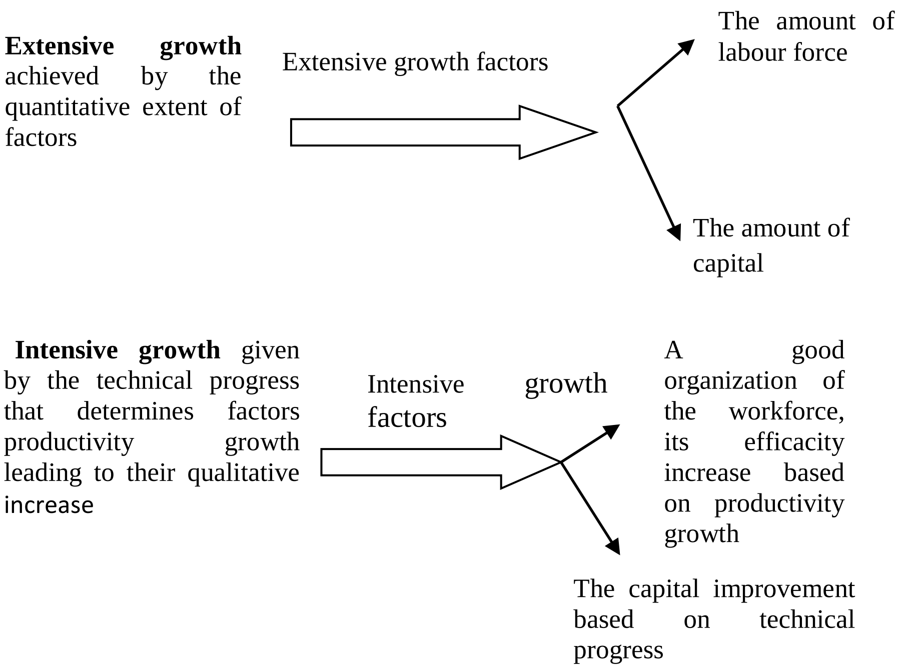


**Figure 1 Elements that distinguish the two forms of growth**
Source: Adaptation from Quelles sont les Sources de la Croissance Économique?, http://www.cours-seko.fr/resources/ECONOMIE/CROISSANCE/COURS-croissance-1.pdf

## 3. Conclusions

The Solow's model does not explain the long-term growth, but only the possibility to avoid the stagnation of production per capita, as a result of a technical progress generated by positive external effects.

The increase due to exogenous technical progress can not be considered a self-sustained and cumulative phenomenon, due to the exogenous nature of the progress, considered to be achieved outside the economic sphere and due to a deacreaseing marginal productivity of each factor.

Noting the role of technical progress, as a factor of economic growth, the neoclassical *exogenous* model, proposed by Solow, represents a critical moment in the economic growth theory, the knowledge of which is necessary to understand the further contribution of the endogenous growth in the economic growth theory.

The works that followed Solow's theory focused on answering the long-term growth question, complementing and enriching the model. In the '80s - '90s period, the Romer's works outlined the new theory of growth - the endogenous growth theory – at the origin of which, there is the emergence of theories of research and development, the technological innovations diffusion.

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