ANALYSIS THE FACTORS THAT DETERMINE DYNAMIC OF MACEDONIAN ECONOMY (MODELS OF NEW THEORY OF GROWTH)

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Abstract:

The progress of growth theory as a part of economic development, including scientific progress of new theory of growth and new institutional economy have created opportunities to analysis of many complex issues related with dynamic of growth process that previously scientists were unable to analyzed.

The main aim of our paper is analyzing the factors that determine economic growth in context of new theory of growth and new institutional economy. In this regard, the paper is based on understanding the mechanic of economic growth, including the influence of institutional quality. The models of new theory of growth try to explain the growth process through analysis of technological procures-technological improvements. The main purpose of these models is to find out answer of the question: why some country is rich than another, or why some country have more dynamic growth process than another?

Our research is focus on two models: R&D growth model that explain the difference in economic performance among countries through differences in innovation process and R&D activities. The country which have more R&D account high level of growth rate, compare with another. The second model that is object of our analysis is model of growth based of institutions.

***Keywords**:* economic growth, models of growth, R&D activities, physical and human capital, institution and quality of institutions.

Jell classification: F40

R&D – based growth model

The production of final goods

A representative firm produces final output in the amount Y_t according to the Cobb-Dougles production function:

$$Y_t = K_t^{\alpha}(A_t L_{Yt})^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{1}$$

The production of new technology

The representative firm in the R&D sector takes the stock of technology as given at any point in time, just like the firm in the final goods sector does.

The production function of the individual firm is:

$$a_t = \bar{\rho} A_t^{\phi} L_{At}, \qquad \bar{\rho} > 0. \tag{2}$$

In equilibrium, $a_t = A_{t+1} - A_t$, therefore the aggregate production function for new technology is:

$$A_{t+1} - A_t = \bar{\rho} A_t^{\phi} L_{At} \tag{3}$$

The complete model

Our model consists of the six equations. The first two are the aggregate production functions of final goods and services (output) and production function of technology (via) by R&D activities. The third one is an equation that describes how capital accumulates.

$$Y_t = K_t^{\alpha}(A_t L_{Yt})^{1-\alpha} \tag{4}$$

$$A_{t+1} - A_t = \bar{\rho} A_t^{\phi} L_{At} \qquad A_0 \text{ given} \tag{5}$$

The capital accumulation equation is given by

$$K_{t+1} - K_t = sY_t + \delta K_t \qquad K_o \text{ given} \tag{6}$$

According to this equation, the change in the capital stock, $K_{t+1} - K_t$, is equal to the amount of gross investment, sY_t, less the amount of depreciation that occurs during the production process, δK_t.

$$L_{t+1} = (1+n)L_t \Rightarrow n = L_{t+t} - L_t \qquad L_o \text{ given} \tag{7}$$

This equation assuming that the labor force, L_t, grows at a fixed exogenous rate, n, where $n > -1$.

$$L_{Yt} + L_{At} = L_t \tag{8}$$

Equation (8) shows that the sum of labor inputs in the two sectors (production of final goods sector and R&D sector) has to be equal to the total amount of labor available.

The last equation assumes that in all periods a given and exogenous fraction, s_R, of all labor is used in the R&D sector, where $0 < s_R < 1$.

$$L_{At} = s_R L_t \qquad (9)$$

Because our model does not have broad microeconomics foundation, we will have to treat the R&D share as exogenous and our research will focus on consequences, rather than the causes, of its size. In this regard, we will try to analysis R&D shares *via* so-called GERD indicator (gross expenditure on research and development) as a percentage of GDP in some OECD counties.

Literature review of Institution and growth

The growth theory tries to explain the dynamic of growth process and the enormous differences of income per capita and economic performance among countries. From historical perspective, some group of countries have accomplished very high rate of growth and economic performance compared with other countries which face with economic problems (slowly dynamic of growth process). There are many explanations about this fact, basically, three theories analyze the factors which determinate cross-country differences in income levels and growth rate. First, the neoclassical theory of economic growth, based on work of Solow (1956), Lucas (1988), and others, focuses on the inputs of physical and human capital as a main resource of growth process, and late, Romer (1990) focus on technology advances through R&D activities (activities that create new ideas in economy) as a engine of growth. Second, the geographic/location theory explain that the geographic location of country (access to market) and the climate condition are very important for income level and economic performance. The theoretical and empirical research present the strong causality between the geographic location and the income level, the geographic/location theory explain only the income level differences among countries. In other side, the most important question for economist is the engine of growth, and in this direction the growth theory tries to explain the factors which determent the rate of growth.

Third, the institutional approach emphasizes the importance of creating an institutional environment and institutions that support and encourage the main foundation of market economy (e.g. protection of property rights, rule of law, enforcement of contracts, and voluntary exchange of market-determined price. Institutions refer to rules, regulations, laws and policies that affect economic incentives such as incentives to invest in technology, physical capital and human capital. In this regard, the good institution framework is necessary for high level investment. Investors do not prefer to risk their capital when the protection of property rights is poorly, there are weak in rule of law and enforcement of contracts, and other illegal activities in market foundation economy.

The theoretical explanations for growth that we introduced above are not inconsistent each other and all might play important role, but institutions are the major fundamental cause of economic growth and cross-country differences in economic performance.

Theoretical model of institutions, capital and economic growth

To develop the growth model with institutions, we start our analysis with aggregate production function which describes how the inputs (physical and human capital, labor and technology) are combined to produce output.[1]

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{1-\alpha-\beta}{}_2 \qquad (1)$$

where Y is output, the parameter A represent the level of technology in economy, K is physical capital, H is human capital, and L is labor. We should make distinction between human capital and labor. The labor force is amount of people who are able to work, in the other side, human capital is the knowledge, skills and abilities of people who are or who may be involved in production process.

The equation of production function can write in per capita form:

[1] The production function is characterize with constant return, $\alpha + \beta \leq 1$.

[2] The equation (1) we can write in this terms: $Y_t = K_t^{\alpha} H_t^{\beta} (A_t L_t^{1-\alpha-\beta})$.

$$\frac{Y_t}{L_t} = \frac{K_t^{\alpha}}{L_t}\frac{H_t^{\beta}}{L_t}\frac{A_t L_t^{1-\alpha-\beta}}{L_t} \tag{2}$$

$$y_t = A_t k_t^{\alpha} h^{\beta} \tag{3}$$

Traditional macroeconomic growth models do not include the influence of institutional quality as a factor of economic growth. These models implicitly assume an underlying set of good institutions. The fact that institutions have important role in growth process, the economists try to implement the institutional quality in growth models.

$$A_t = A_0 k_t^{\delta_1 (In - In^*)} h_t^{\delta_2 (In - In^*)} \tag{4}$$

where A_0 represents the basic level of technology, In^* represents the best quality institutions, these ideal institutions are assumed in the traditional growth model, and In is the country's current level of institutional quality. The mathematical statement $(In - In^*)$ measures the degree to which the country's institutions fall short of the best conditions. The traditional growth model assume that economies function close to best-quality institutions, $In = In^*$, thus, these growth model reduce the influence of quality institutions.

Substituting the equation (3) into equation of production function per worker, we get:

$$y_t = A_0 k_t^{\delta_1 (In - In^*)} h_t^{\delta_2 (In - In^*)} k_t^{\alpha} h_t^{\beta} \tag{5}$$

Rewriting this equation we get:

$$y_t = A_0 k_t^{\alpha + \delta_1 (In - In^*)} h_t^{\beta + \delta_2 (In - In^*)} \tag{6}$$

To study the dynamic of output per capita, we will use a simple *mathematical trick* that economists often used in the study of growth.[3] The mathematical trick is to "take logs and then derivatives".

[3] Mathematical notes: The theory of growth uses some properties of natural logarithms. One of that properties is: The statement regarding the timing of the logarithms of a variable, gives the growth rate of that variable:

If $y(t) = \log x(t)$, than, $\frac{dy}{dt} = \frac{dy}{dx}\frac{dx}{dt} = \frac{1}{x}\Delta x = \frac{\Delta x}{x}$.

If we take logs of equation (6), we obtain:

$$\log y_t = \log A_0 + \left[\alpha + \delta_1(In - In^*)\right]\log k_t + \left[\beta + \delta_2(In - In^*)\right]\log h_t \quad (6)$$

Derivatives regarding time t, we obtain following form:

$$\frac{d\log y_t}{dt} = \frac{d\log A_0}{dt} + \left[\alpha + \delta_1(In - In^*)\right]\frac{d\log k_t}{dt} + \left[\beta + \delta_2(In - In^*)\right]\frac{d\log h_t}{dt} \quad (7)$$

As we can see, the equation (8), show the growth rate of output per capita:

$$\frac{\Delta y_t}{y_t} = \frac{\Delta A_0}{A_0} + \left[\alpha + \delta_1(In - In^*)\right]\frac{\Delta k_t}{k_t} + \left[\beta + \delta_2(In - In^*)\right]\frac{\Delta h_t}{h_t} \quad [4] \quad (8)$$

Rewriting equation (8) we get following form of growth rate of output per capita:

$$\frac{\Delta y_t}{y_t} = \frac{\Delta A_0}{A_0} + \left[(\alpha - \delta_1 In^*) + \delta_1 In\right]\frac{\Delta k_t}{k_t} + \left[(\beta - \delta_2 In^*) + \delta_2 In\right]\frac{\Delta h_t}{h_t} \quad (9)$$

If we assume that: $\varphi_1 = (\alpha - \delta_1 In^*)$; $\varphi_2 = (\beta - \delta_2 In^*)$ and $\alpha_0 = \Delta A_0$, and adding an error term ε_t, we get final equation of growth rate of output per capita:

$$\frac{\Delta y_t}{y_y} = \alpha_0 + \varphi_1\frac{\Delta k_t}{k_t} + \delta_1 In\frac{\Delta k_t}{k_t} + \varphi_2\frac{\Delta h_t}{h_t} + \delta_2 In\frac{\Delta h_t}{h_t} + \varepsilon_t \quad (10)$$

The final basic equation that we got in our theoretical model can use to test the impact of institution on the growth by the influence of institution's quality on the productivity of physical and human capital. In addition, we explain the coefficient estimates for $\varphi_1, \varphi_2, \delta_1, \delta_2$. The coefficient φ_1 and φ_2 measure the return to physical and human capital investments (the productivity of capital investments) in a country with the worst possible institutional quality, while coefficient δ_1 and δ_2 showing an increasing return to these capital investments as the country's institutional quality improves to the ideal level for economy based of market foundations.

[4] Where symbol, Δ, denotes changes of parameters.

The economic growth in Republic of Macedonia

The theoretical growth models show us that dynamic growth process in the long run is based on many factors, especially, R&D and quality of institutions. The empirical and theoretical investigation tells that Macedonian economy is faced with rather low quality of institutions and low value of innovation.

Uses mathematical and statistical methods we can determine the relative contribution of individual factors of production that causes increase of economic growth rate – growth of real gross domestic product (GDP). The average rate of economic growth in previous few years in Republic of Macedonia is about 4%. From empirical investigation of Macedonian economy we can conclude that about 60% of economic growth is based on TFP[5] – total factor productivity, about 30% of human capital and only 10% of physical capital.[6] The analysis presents that theoretical research is match with empirical investigation.

In this regard, the country has to increase the spending of R&D activities as a source of technological improvements, to produce more human capital via quality education, and to improve the quality of institutions (economic, political and financial institutions). Those economic policies will cause to increase factors productivity and economic performance.

[5] TFP is parameter that economists call Solow residual. TFP are included technological improvements, improvements of institution's quality, management organization, enterprenuanship and other indicators.

[6] The results are based on author's empirical investigation.

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