# Basic Endogenous Economic Growth Model (Ak Model) - Evidence For Danube Region Of Bulgaria

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**Abstract:** The economic development of Bulgaria characterizes with regional imbalances. They come from historically shaped differences in the development of social processes (social, economic, governance) in the regions. The imbalances are formed about GDP per capita, the age and educational structure of the population, the level of employment (unemployment), the income per capita and distribution of investments.Due to it, the main objective of regional economic policy is overcoming of the imbalances. The current development need to ensure equal good living conditions in all parts of the country.

The main theory for economic development nowadays is the research of Solow. According his theory, main factors for economic growth are: capital(K), labour force (L) and technology. The simplest version of this endogenous growth model is AK model. According this model, the production function is assumed to be linear with single factor of growth - capital stock or investments. The model assumes that the population is constant.

The Danube region, object of this research, includes 11 districts in the North Bulgaria. They are part of 3 economic regions. These districts are lower developed; some of them are poorest regions in EU. The GDP of Danube region is 16.09% of GDP of Bulgaria in 2017. The average income per capita in the region is 9249.70 BGN by 14280 BGN average for the country in 2017.

The research by the creation of mathematical model calculates the impact of single growth factor - foreign and local investments – in the region in short and long term. It will define their influence on the growth and in perspective it could use their increasing for advancing development of Danube region compared with other in the country.

**Key Words:** economic growth, factors of economic growth, regional development.

## 1. INTRODUCTION

The economic development of Bulgaria's characterizes by strong regional imbalances. They come from historically shaped differences in the development of social processes (social, economic, governance) in the regions. The imbalances are formed about GDP per capita, the age and educational structure of the population, the level of employment (unemployment), the income per capita and distribution of investments.Due to it, the main objective of regional economic policy is overcoming of the imbalances. The current development needs to ensure equal good living conditions in all parts of the country.

As known, the economic growth defines as an increase of Gross Domestic Product (GDP) in a country for one year. The increasing of aggregate supply will allow better to meet the needs of citizens. According to its economic characteristics, the economic growth could be extensive or intensive.  The current conditions of globalization of the economy, liberalization of market, capital and labor force' movement require the search of instruments for realizing intensive type of economic growth.

The Danube region in Bulgaria includes 11 Bulgarian administrative units (NUTS level 3) as part of 3 planning regions (NUTS level 2) - the districts of Vidin, Vratsa, Montana, Lovech, Pleven, as part of the North-West planning region; districts VelikoTurnovo, Gabrovo, Ruse, Razgrad, Silistra as part of the North Central Region; Dobrich District, belonging to the North-East Planning Region. Vidin, Vraza and Montana are the slowest-growing administrative units and the poorest regions, both nationally and within the EU. The region covers almost half of the country's territory. But GDP produced in the Danube region in 2017 represents 16.09% of the country's GDP. The average GDP per capita for 2017 is BGN 9249.70, compared to the national average - BGN 14280, which is 64.77%. Due to it, research tries to find the impact of main factor for advancing development of Danube region in Bulgaria compared with others in the country.

## 2. BASIC ENDOGENOUS ECONOMIC GROWTH MODEL (AK MODEL)

The main neoclassical growth model was developed by Solow1. This model uses a production function as follows:

$$Y = F (K) + F (L) + F (A)$$

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[1] Camba-Mendes G, G. Kapetonios, F. Papailias, M. Weale (2015). Forecasting the industrial production growth for euro area countries. ECB. Working paper 1773

Where

Y –aggregate supply or Gross domestic product (GDP)

K - capital or investment

L - labor force

A - the measure of the level of technology.

## 2.1 Basic Endogenous Economic Growth Model (AK Model) - theoretical approach

Rebelo (1991) [2]provided the simplest version of the endogenous growth model, the AK model. It is characterized by the following production function:

Y = AK

where

Y - GDP,

A - constant ensuring the proportionality of income or GDP relative to capital

K - the capital stock or investment.

This model belongs to the first generation of endogenous growth models (Acemoglu, 2009[3]). The accumulated capital along with risk of projects determine the volume of investments(Rebelo, 1991; Jones, 2002[4]).The production function is assumed to be linear with its single factor of growth - capital stock or investment. The population is considered to be constant (Rebelo, 1991) and therefore the population growth rate is zero. The endogenous nature of the model is based on the result that the economic policy of the government has an impact on household saving patterns and, therefore, on the accumulated capital and the investments in the country.The assumption of a production function rejects the possibility of exogenous technological change suggested by the Solow model and leads to the conclusion that the rate of technological growth should be equal to 0 (Rebelo,King 1990[5]) The main characteristic of the AK model is the constant return on scale, confirms by the production function and, in particular, the

constant return on the accumulated capital. Rebelo, King (1990) explains the existence of constant return on scale by the lack of such scarce resources as land in the process of creation of capital stock. Based on these assumptions, the production function becomes proportional and linear with the capital.

The constant return on capital accumulation guarantees a constant addition to the total output equal to A per unit of additional capital (Jones, 2002). By the AK model accumulated capital sets volume of investments. In this way, an economic policy geared toward increasing of investments through savings will have long-term effects on the growth of a country's income and will lead to significant differences in income between countries (Rebelo, 1991). This is the main conclusion of the AK model. But this model is an initial version of factor analysis of growth.

## 2.2 Model for Danube region

It creates mathematical model[6,7] to calculate the impact of main factor of growth – investments.

$$GDP = ß0 + ß1 x1 + ß2x21 + ß3x22+ei,t \quad (1)$$

where

GDP – Gross Domestic Product annually for the region

$x_1$ – direct foreign investment annually for the region

$x_2$ – direct local investment annually for the region

Second part of the research calculates the change of GDP per 1 BGN direct foreign, respectively local, investments. It will show the efficiency of 1 BGN foreign or local investments.

$$E = \frac{\Delta GDP}{\Delta DI} \quad (2)$$

where

[2] Rebelo, Sergio T.(1991). Long-Run Policy Analysis and Long-Run Growth. Journal of Political Economy. 99(3).500–521.

[3] Acemogly, D. (2009). Introduction to Modern Economic Growth. Princeton University Press, ISBN 9780691132921

[4] Jones, Charles (2002). Sources of U.S. Economic Growth in a World of Ideas, American Economic Review. 92 (1).220-236

[5] Rebelo, Sergio T ,Robert King(1990). Public Policy and Economic Growth: Developing Neoclassical Implications. Journal of Political Economy, 98(5).126-150

[6] Assenova, K. (2019). Current stage and perspectives for the advancing development of Danube region - Factors of growth. Journal Knowledge. 34(2).119-125

[7] Assenova, K. (2020), What adds more to the economic growth in Danube region – foreign or local direct investment?. Journal Knowledge, (forthcoming)

GDP – Gross Domestic Product annually for the region

$\Delta DI$ – direct foreign or local investments annually for the region

## 2.3. LIMITATIONS OF THE RESEARCH

- Because the different way to be made the data by National statistic – with or not accumulation, monthly, quarterly or annually, chronologically presented – the different variables are recalculated to be mathematically compatible;

- The research recognizes as the single factor capital.

- Foreign direct investment delivers to the economy more innovative technology and techniques, new approach to education and management of human resources.

- Local direct investment depends on accumulated capital in the country. Its volume is a result from local decisions.

- It is very difficult to distinguish the impact of factors' variables on the changes of GDP or such are the result from automatic adjustment and due to it, the research suggests as a reason for changes only the influence of independent variable.

## 2.4. VARIABLES

- GDP annually in current prices. It used current prices, because in this case it possible to account different stage of economic cycle.

- GDP is measured by final expenditure.

- Foreign direct investments in EURO, recalculated in BGN by fix currency rate 1.9558 in Bulgaria.

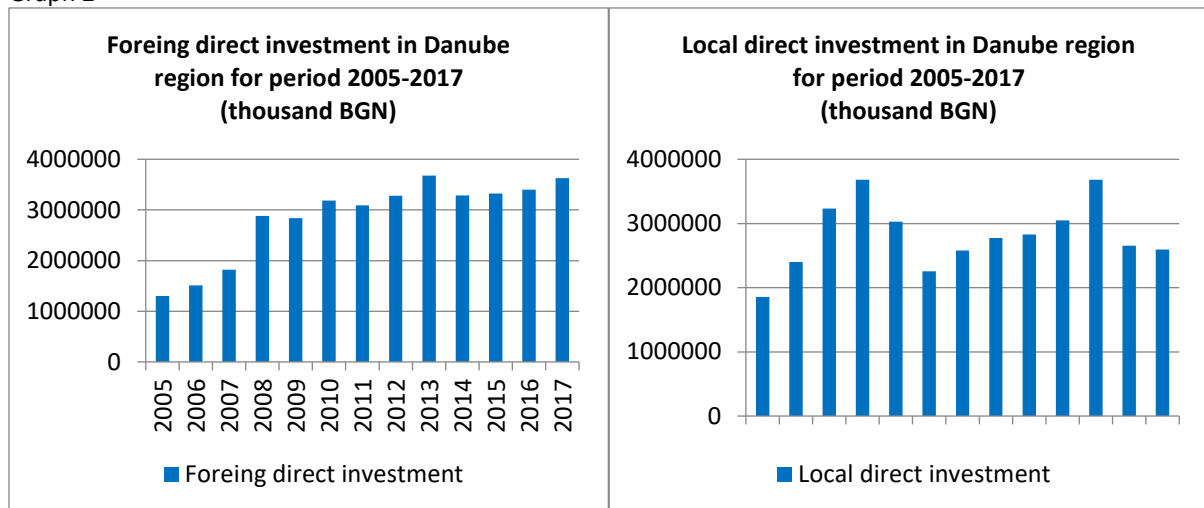- Local direct investments.

## 3. DATA ANALYZE

Graph 1
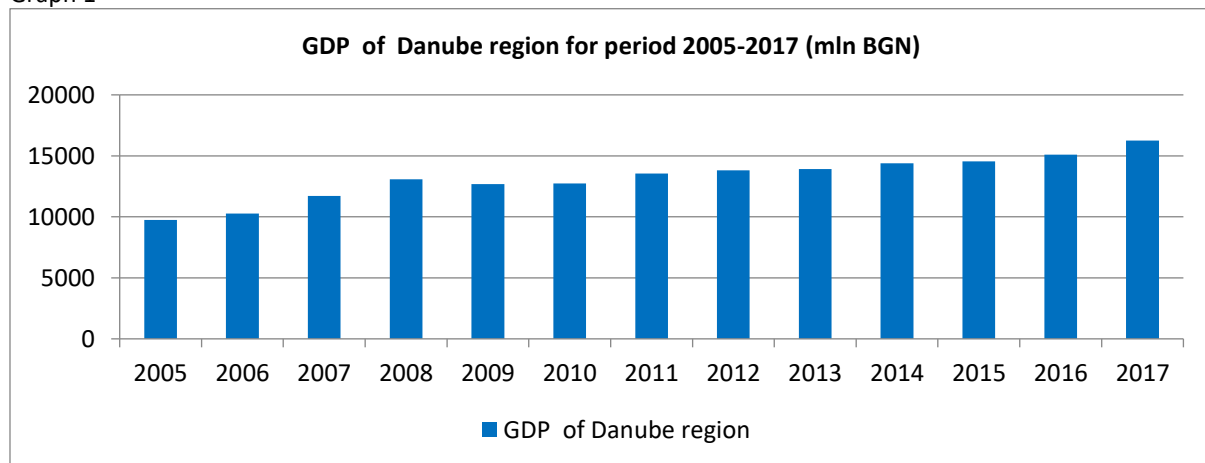


Source: BG National statistic

The foreign direct investments rise with strong rate during the period 2005-2008 – respectively with 15.83 %, 20.36 % and 58.48%. Between years 2009 - 2011 there are two years with negative rate. The biggest decrease of foreign direct investments is in 2014 with minus 10.59 %. Last three years of research period they increase with small pace from 1 to 6.70 %.

The local direct investments increase strongly during the same period as foreign. It is between 2005-2008 – respectively with 29.16%, 34.78% and 13.92%. In next two years they reduce sharply with minus 17.85% and minus 25.91 %. Between 2012 and 2015 local direct investments raise from 2% to 14%. The biggest negative change is in 2016 when
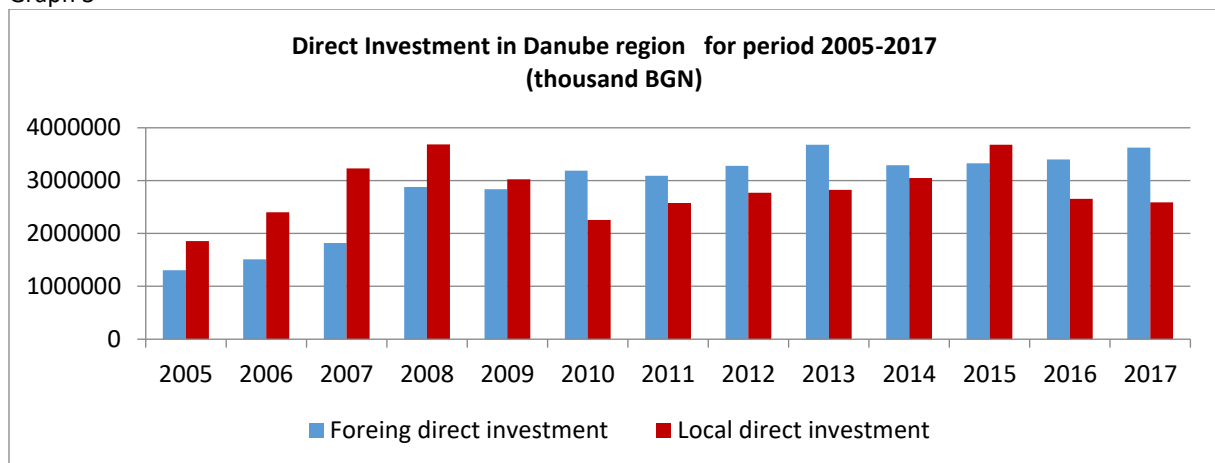
they reduce with minus 27.90 % and this tendency continues in 2017.

Graph 2

**Foreing direct investment in Danube region for period 2005-2017 (thousand BGN)**

**Local direct investment in Danube region for period 2005-2017 (thousand BGN)**

Source: BG National statistic

Graph 3

**Direct Investment in Danube region for period 2005-2017 (thousand BGN)**

Source: BG National statistic

## 3. Results

By the testing of model it calculated following results:

On Tab. 1 Model Summary is given the coefficient of determination of the single factorial regression model. As expected, the coefficient is $R^2 = 0,855$, which means almost a functional link. Also, the coefficient is statistically significant (Table 2, Sig. $< \alpha = 0,05$ ).

Table 1

| | | Model Summary | | |
|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1 | ,925[a] | ,855 | ,826 | 765,34565 |
| a. Predictors: (Constant), LDI, FDI | | | | |

Table 2

| | | ANOVA[b] | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 34519367,201 | 2 | 17259683,600 | 29,466 | ,000[a] |
| | Residual | 5857539,568 | 10 | 585753,957 | | |
| | Total | 40376906,769 | 12 | | | |
| a. Predictors: (Constant), LDI, FDI | | | | | | |

b. Dependent Variable: GDP

In the Table 3. Coefficients - are defined the standardized coefficients for the single factorial regression model for main factor of economic growth.

Table 3

| Coefficients[a] | | | | | |
|---|---|---|---|---|---|
| Model | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| | B | Std. Error | Beta | | |
| 1 (Constant) | 6519,530 | 1278,597 | | 5,099 | ,000 |
| FDI | ,002 | ,000 | ,895 | 7,030 | ,000 |
| LDI | ,000 | ,000 | ,081 | ,639 | ,537 |

a. Dependent Variable: GDP

The statistical analysis shows the coefficient of determination for direct foreign and local investments is significant. The economic analysis notes strongest impact of investments in the region on the aggregate supply, measured with GDP. The investments have two effects: direct-increasing of the aggregate demand and there for aggregate supply for current year and indirect - additional multiple effects on the aggregate demand and the GDP in next several years[8]. The capital expenditure, because long duration of each stage of their turnover, retains the impact on the aggregate demand and therefore on the GDP for long period of time. The impact in the current year is stronger, indicating these costs immediately produce a high demand for goods and services. As known from the theory, as a result - income increases and employment reduces not only in sectors, where the capital spending made, but in others[9]. It leads to an increase of aggregate demand, not only through investment (I), but also indirectly through the consumer spending (C).The correlation coefficient for foreign direct investments, calculated for the region is very strong and probably shows they add to GDP, because better management, nowadays technology and techniques. The higher income paid in foreign companies adds to multiply effect of these investments through consumption. The correlation coefficient for local direct investment is lower compared with such for foreign direct investments and shows worse organization compared with international companies and small add to the result – GDP.

On next stage of the research is calculated the efficiency of direct investments – foreign and local. On the Graph below shows the changes of GDP by 1 BGN foreign or local direct investments.

Graph 4
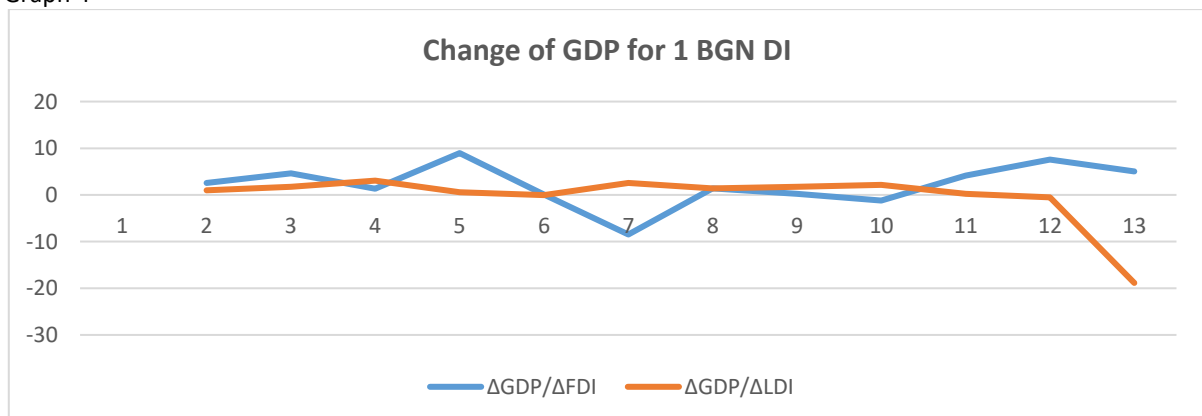


Source: BG National statistic and own calculations

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[8] Borensztein E., De Gregorio J. and Lee J. (1998). "How does Foreign Direct Investment affect Economic Growth?". Journal of International Economics. 45.115-135.

[9] Assenova S. (2020). Indicators, influencing on the optimization of run in public passenger transport, Journal Knowledge.(forthcoming)

## CONCLUSION

The economic development of Bulgaria's characterizes by strong regional imbalances. As a result, it found different usage of the factors of growth and the conditions of business. It causes lower productivity, different level of income, of public services, quality of life and, as a result, welfarein different point of the country. The well - being is main goal of every economic policy.

Regional differences comes from historically shaped differences in the development of social processes (social, economic, managerial) in individual regions. In this way, imbalances are observed about GDP per capita, distribution of investments, the age and educational structure of the population, the level of employment (unemployment), income per capita. For this reason, the main objective of regional economic policy is overcoming the imbalances and realizes advancing development in order to make equally good living conditions in all parts of the country.

It creates model with single factor of economic growth - investments. The economic analysis notes strongest impact of foreign direct investments in Danube region on the aggregate supply, measured with GDP. It due to better management, nowadays technique and technology. The local direct investments have weak effect on GDP. The aggregate supply rises when they reduce sharply, because increasing of productivity of labour. The investments have two effects: direct-increasing the aggregate demand and there for aggregate supply for current year and indirect - additional multiple effect on the aggregate demand though consumer expenditure. The calculated results requires to increase foreign and improve the efficiency of local direct investments in the future. It will provide advancing development of Danube region compared with others in the country.

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