Trakia Journal of Sciences, Vol. 11, Suppl. 1, pp 301-307, 2013

Available online at:
http://www.uni-sz.bg

ISSN 1313-7069 (print)
ISSN 1313-3551 (online)

MODELLING OF THE DEPENDENCE BETWEEN GDP AND THE INVESTMENT IN THE CONTEMPORARY BULGARIAN ECONOMY

M. Ruseva*

Department of Finance, Faculty of Economic and Social Sciences, University of Plovdiv, Plovdiv, Bulgaria

ABSTRACT
The modelling of the dependence between GDP and the investments is an important scientific and practical task. The pattern of investment multiplier establishing correlation between GDP and fixed capital has been widely used in macroeconomic research in practice to the countercyclical regulation of the economy, planning and forecasting. The purpose of present report is to assess the investment multiplier in the contemporary Bulgarian economy. To realize the desired goal objective method regression analysis and the dynamics study theory of the reality phenomena are used.

Key words: investment multiplier, regression model, time series

INTRODUCTION

The development of the economy of each country is assessed using a variety of macroeconomic indicators. The main purpose which is placed in this report is to attempt an experimental evaluation of the impact of the investments on GDP of Bulgaria by applying the concept of the multiplier.

The first part of the paper clarifies the nature of the investments as a part of the expenditure forming the aggregate demand in the economy and presents a brief overview of the theoretical concepts of the multiplier, explained the John M. Keynes "General Theory of Employment, Interest and Money "in 1936 year.

In the second part the correlation between investments and GDP in Bulgaria is empirically investigated, specific opportunities for stimulating investment activity are outlined. The level and the composition of aggregate expenditure are revealed. The effects of investment activities, their impact on aggregate demand (GDP) of the country are presented. The dependence research between GDP and investments in the modern Bulgarian economy is based on data obtained by applying the cost approach for the period 1997 - 2012.

The choice of data pattern and a model to a large extent determines the analysis results. For this reason, in the present empirical study statistics for investments in the country, published by the National Statistical Institute (NSI), are used. Consistently the growth rates and growth rates of income (GDP) and investments are calculated.

In the economic theory, a great number of opinions on the role of investments to in relation to income (GDP) of a country are present. The first most popular ideas about the role of investment opportunities and their impact on GDP are associated with the name of John M. Keynes. As he transfers the analysis to a macro-level, Keynes displays the correlation between investment growth and the growth of income in a short period. Unlike the neoclassical economic theory, which emphasizes as key growth the indicators for technical and industrial change,

***Correspondence to**: *Margarita Ruseva, Department of Finance, Faculty of Economic and Social Sciences, University of Plovdiv, Plovdiv 4000, Bulgaria, 24 Tsar Asen Str., GSM: +359 887 105 380, E-mail: ruseva_margarita@abv.bg*

Keynesian explanation is aimed to emphasize the role of demand. Regardless of the criticisms made on the model of Keynes, in many cases, this model gives good results for the behaviour of economic agents in terms of investments, but also for planning and forecasting of its parameters.

Nature of the investments as a key element in the aggregate demand

The investments are one of the main variables of the aggregate demand. They are characterized by large fluctuations because of the unpredictability of the factors influencing them. The investments are reflected in the creation of new real capital in the economy, through which opportunities for increased employment and greater production of goods are extended. General economic investments are defined as the expenses for purchasing new and replacement of depreciated capital equipment (gross accumulation of fixed capital). As a whole gross domestic investment represent firms expenditure incurred within the national economy for capital goods or fixed assets and inventories necessary for recovery (maintenance), expansion and modernization of real capital in the national economy.

A part of the costs for investment are called basic or fixed investments, as they are used for increasing and renewing production facilities, as well as their future potential. The second part of the investment cost is designed to complete the inventory of raw materials, semi-finished and finished products. General investment spending by companies or investment demand is determined by a number of factors. The real interest rate and the expected or actual rate of net profit prevail among them.

The concept of the multiplier

The multiplier is one of the main tools for establishing the correlation between income, investment, consumption and employment developed by Keynes in his General Theory. Ever since the advent the concept of the multiplier, the opinion of the economists to the multiplier is ambiguous. A group of them say that Keynesian multiplier is a new paradigm in economic theory (Blaug, Benassy, Pasinetti, and Trevithick). But at the same time, there are economists who have doubts about the multiplier (Robertson). Another group of economists poses serious suspicions regarding the validity of the multiplier (Ahiakpor, Hazlitt, and Stoddard). There are authors who consider the multiplier as a dynamic process (Goodwin, Hansen, and Pasinetti), and V. Chick claims that Keynes' multiplier has two features: equilibrium and dynamics. There are numerous arguments against the concept of the Keynesian multiplier, such as: the effect of the multiplier is very static (Schumpeter, Robinson), unrealistic, and it is characterized by instability. The followers of Keynes attempt to "improve" the theory of the multiplier as one of their main arguments is that the multiplier is based on a solid mathematical basis (Minsky).

Regardless the critical remarks Keynesian model allows to study as changes in investment as well as the ensuing changes in the level aggregate output and employment. Precisely the effect of changing investments in the economy causes the formation of a multiplier effect. Based on this principle, it is possible to determine how the magnitude of the level of aggregate production is altered under the influence of an amendment to the investments. The multiplier is displayed as a numerical coefficient of the relationship between the change in aggregate production and investments change. The multiplier is a summary of a concept that can be applied equally to the various elements of the aggregate demand. In the language of symbols the coefficient of the multiplier is presented using the following expression:

$$k = \frac{\Delta Y}{\Delta I} \qquad (1)$$

In fact the coefficient multiplier K is directly proportional to the marginal propensity to consume and marginal inverse propensity to save. In this aspect of the analysis the multiplier coefficient can take positive and negative values. There are the following features derived from the theory:

1) The coefficient of the multiplier is positive when the growth in income outpaced the growth in investments.

$$\begin{cases} \Delta Y = Y_2 - Y_1 > 0 \Rightarrow k = \frac{\Delta Y}{\Delta I} > \\ \Delta I = I_2 - I_1 > 0 \end{cases} \qquad (2)$$

2) The coefficient of the multiplier is positive when the reduction in income outstrips the reduction in investments.

$$\begin{cases} \Delta Y = Y_2 - Y_1 > 0 \\ \Delta I = I_2 - I_1 < 0 \end{cases} \Rightarrow k = \frac{\Delta Y}{\Delta I} > 0 \quad (3)$$

3) The coefficient of the multiplier is negative when the income growth lagged behind the growth in investments.

$$\begin{cases} \Delta Y = Y_2 - Y_1 > 0 \\ \Delta I = I_2 - I_1 < 0 \end{cases} \Rightarrow k = \frac{\Delta Y}{\Delta I} < 0 \quad (4)$$

4) The coefficient of the multiplier is negative when the reduction of the income lagged behind the fall in investments.

$$\begin{cases} \Delta Y = Y_2 - Y_1 < 0 \\ \Delta I = I_2 - I_1 > 0 \end{cases} \Rightarrow k = \frac{\Delta Y}{\Delta I} < 0 \quad (5)$$

5) The coefficient of the multiplier can't be defined when the increase in investments is equal to the increase in income.

$$\begin{cases} \Delta Y = Y_2 - Y_1 > 0 \\ \Delta I = I_2 - I_1 = 0 \end{cases} \Rightarrow \lim_{\Delta I \to 0} k = \frac{\Delta Y}{\Delta I} = +\infty \quad (6)$$

6) The coefficient of the multiplier can't also be defined as the reduction of investments is equal to the reduction in income.

$$\begin{cases} \Delta Y = Y_2 - Y_1 \\ \Delta I = I_2 - I_1 = 0 \end{cases} \Leftrightarrow \lim_{\Delta I \to 0} k = \frac{\Delta Y}{\Delta I} = -\infty \quad (7)$$

The multiplier is derived, based on certain assumptions that do not apply in pure form for the modern economy. In accordance with the established constraints, it is necessary to bear in in mind that this coefficient can be used to predict the economic system in three ways:

1. For fixing the amount of the expected rate of earning growth with limited investments.

2. To determine the necessary investment growth that ensures limited income growth (GDP).

3. To determine the effect which the reduction of the amount of investment will have on the income.

The concept of the multiplier, presented in this pure form, is only valid provided that the period for which income growth is provided, investment efficiency remains the same as it was in the preceding period. A similar hypothesis is correct only at relatively short intervals, so that the model of the multiplier is suitable only for short-term predictions. The focus is put on the fact that the described model of the multiplier does not take one very important feature of investment - namely the lagged effect of their action. In this context reasoning three groups of factors that determine the change in the value of the multiplier can be distinguished.

The first group of factors includes the cost of new investments. They are termed impulsive factors.

The second group of factors include consumer spending and bear the name distribution factors. The effect of the distribution is determined by the ratio between the marginal propensity to consume and marginal propensity to save.

The third group of factors can be explained by the effect of the productivity of investments, which can't be equated with the multiplication factor. This is because the latter characterizes the increase in the income, which corresponds to a unit increment in the investments in economy.

After the reasoning with regard to the concept of the multiplier it can be said that the full increase in income (respectively GDP), caused by the initial increase in the investments, is represented by the expression:

$$Y = \Delta I + c_1 \Delta I + c_1^2 \Delta I + c_1^3 \Delta I + \cdots + c_1^n \Delta I = \frac{1}{1 - c_1} \Delta I \,, \quad (8)$$

where $c_1 = \frac{\Delta C}{\Delta Y}$, and ΔS is the symbol, marking the change in the consumption.

By means of the rule (8) the so-called "booster effect" on investment income, respectively (GDP) is presented. That effect can be both positive and negative. It can be explained that the initial investments trigger a chain of events that generates additional user costs. The positive reinforcing effect is associated with relatively small changes in government spending and their impact on the income and the employment. The negative enhancement effect has been associated with changes in the investments which are insignificant, but these changes are smaller than the changes in GDP and cause economic instability.

Correlation between investments and GDP in Bulgaria in the period 1997 - 2012

Empirical survey of GDP and the investments in Bulgaria is based on economic and statistical analysis. It is essential the use of the operating system of statistical indicators for investments and quality they represent a summary. GDP by expenditure approach is calculated as the sum of individual consumption (including final consumption expenditure of households, final consumption expenditure of non-profit institutions serving households, final government expenditure of individual consumption), collective consumption (final cost of the government for collective consumption, which satisfy the needs of society as a whole), gross fixed capital formation (investments made in fixed assets), changes in inventories and trade balance of goods and services (the difference between exports and imports of goods and services). The flows of products and services in the economic system of Bulgaria are structured based on national classifications consistent with the following classification standards:

European System of National Accounts 95 (ESNNA 95);

• Classification of Individual Consumption by Purpose;

• Classification of the Government Functions;

• Nomenclature of industrial production (PRODPROM - 2001), developed on the basis of the nomenclature of industrial products of the European Union (PRODCOM);

• Combined Nomenclature for import and export of goods.

As mentioned above, the forthcoming analysis will be based on data for real GDP per year for the period 1997 - 2012 inclusive, as well as data on investment costs in fixed capital for the same period. Seen from Table 1 is that, as a share of GDP, the investments increased from 11.35% in 1997 to 33.6% in 2008 and then again decreased to reach 21.4% of GDP in 2012. The trends in changes in GDP and gross fixed capital formation are presented using **Fig. 1**, where the dynamics of aggregate demand and the investment activity in the selected period of analysis are outlined.

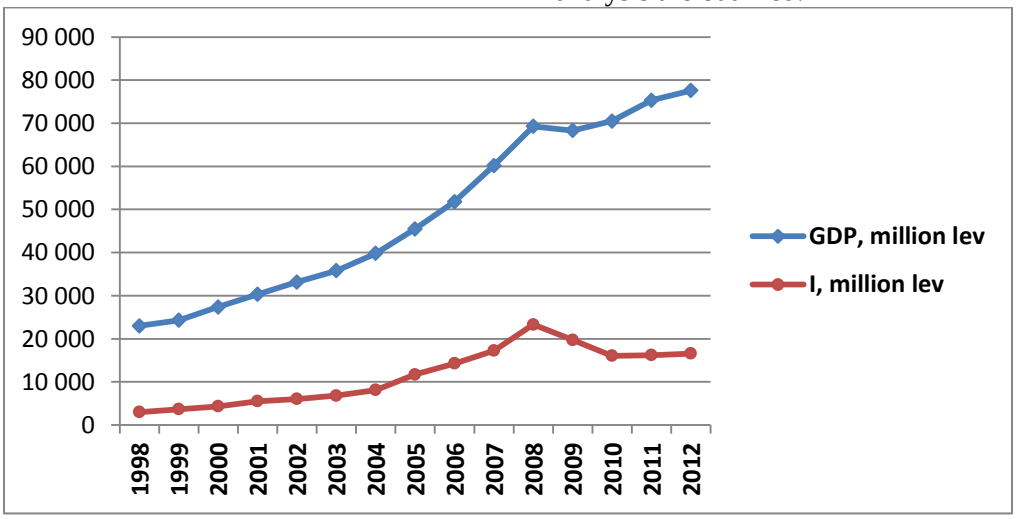

Fig. 1. Dynamics of the investments and GDP in the period 1997 – 2012

It should be noted that by 2008, both GDP and gross fixed capital marked an increase in absolute terms. Fluctuations in both indices occurred during the period 2009 - 2012, when the investments decreased to a much greater pace than GDP. Particular interest is the fact that the absolute changes in investment activity during the period 2010 – 2012 lead to large changes in aggregate demand and those changes are surprising. It is curious what happened in 2011 - namely, an increase in investment of 148 million lev is obsereved, which, if we stick to the concept of the multiplier is accompanied by an increase in GDP by 4797 million lev. The calculated value of the investment multiplier in this calendar year is 32.44, which is practically unreal.

Table 1. *Growth rates at constant and chain basis of investments and GDP in Bulgaria; investment multiplier during the period 2007 – 2012*

Year	Gross fixed capital formation, million lev	GDP, million lev	Relative share of investment in GDP%	Growth rate of GDP at constant base year 1997 = 100%	Growth rate of GDP at chain base%	Growth rate of Inv. at constant base year 1997 = 100%	Growth rate of Inv. at chain base%	Amendment of Inv. in absolute amount	Amendment of GDP in absolute amount	investment multiplier
1997	1919	16 909	11,35	100	-	-	-	-	-	-
1998	3 006	22 992	13,07	135,98	135,98	156,65	156,65	1 087	6 083	5,595
1999	3 654	24 309	15,03	143,77	105,73	190,42	121,55	648	1 318	2,034
2000	4 325	27 399	15,78	162,04	112,71	225,36	118,35	670	3 089	4,607
2001	5 537	30 299	18,27	179,19	110,59	288,52	128,03	1 212	2 900	2,393
2002	6 060	33 189	18,26	196,28	109,54	315,81	109,46	524	2 890	5,518
2003	6 807	35 812	19,01	211,8	107,9	354,7	112,31	746	2 623	3,515
2004	8 109	39 824	20,36	235,52	111,2	422,56	119,13	1 302	4 012	3,081
2005	11 711	45 484	25,75	269	114,21	610,28	144,43	3 602	5 660	1,571
2006	14 297	51 783	27,61	306,25	113,85	745,05	122,08	2 586	6 299	2,436
2007	17 264	60 185	28,68	355,94	116,22	899,63	120,75	2 966	8 402	2,832
2008	23 283	69 295	33,6	409,82	115,14	1 213,27	134,86	6 019	9 110	1,514
2009	19 724	68 322	28,87	404,06	98,6	1 027,84	84,72	-3 558	-973	0,274
2010	16 077	70 511	22,8	417,01	103,2	837,8	81,51	-3 647	2 190	-0,600
2011	16 225	75 308	21,55	445,38	106,8	845,5	100,92	148	4 797	32,444
2012	16 600	77 582	21,4	458,83	103,02	865,03	102,31	375	2 274	6,068

Fig. 2 shows the values of the multiplier for the entire time period from 1997 to 2012. The coefficient of the multiplier for the period of analysis takes positive values, with the exception of 2010, when the negative growth of the investments in fixed capital induced positive changes in GDP.

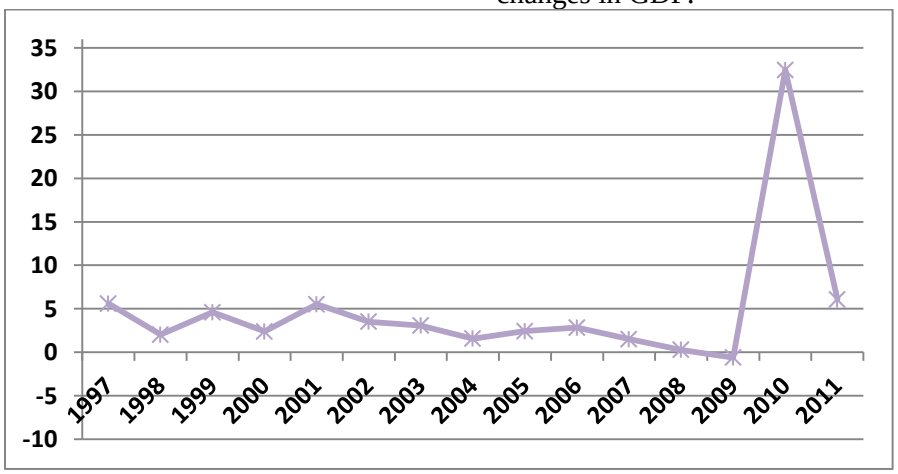

Fig. 2. Dynamical changes in the value of the investment multiplier in Bulgaria in the period 1997 – 2012

The correlation between the change of GDP and the investments is determined by the marginal propensity to invest (MPI). In order to define the strength and direction of influence of the investments on total demand, initially it is necessary to determine a model of the type: Y = f (I), and to construct an appropriate regression model explicitly. The resulting correlation between GDP and gross fixed capital formation is presented in **Fig. 3**, taking into account the following features:

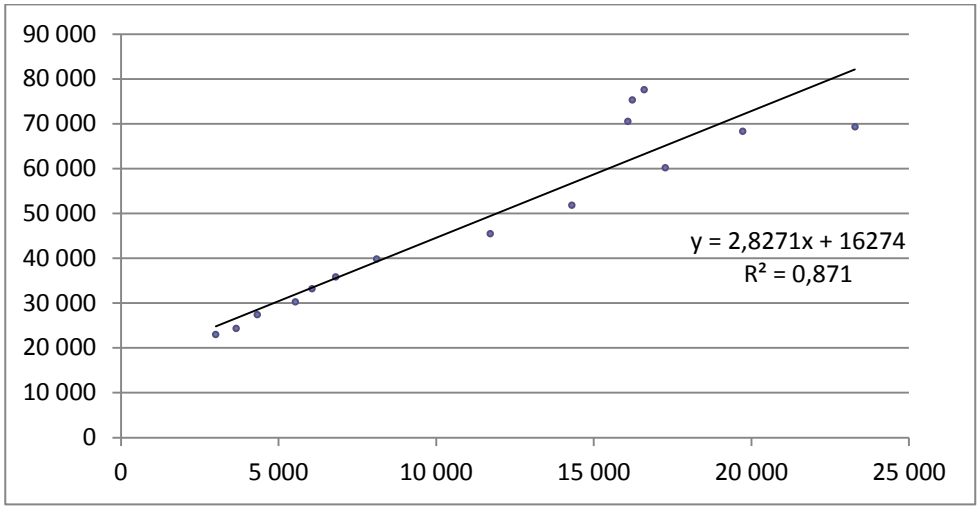

Fig. 3. Correlation between investments and GDP in Bulgaria during the period 1997 – 2012

1) The eventual presence of autocorrelation in the statistical series does not affect the value of the parameters of the constructed regression model. For this reason the use of the regression analysis with respect to the dynamic statistical series does not require any pre-verification to be performed in the autocorrelation output time series.
2) Therefore, the study of the relationship between fixed investment and GDP in the period 1997 - 2012 is made on the basis of the output dynamic statistical series.
3) After verifying of the adequacy of a series of models, it was established that the most appropriate in this case, is the linear model, in which statistical significance of the parameters is outlined.

The application of this method of regression analysis in dynamics requires residuals around the regression line to be random. In the present case it is not so, which means that there is autocorrelation between the output series. After a series of computing procedures a new regression model, based on the corrected values, is created. By this way, the correlation between the investments and GDP in Bulgaria in the period 2007 - 2012, is presented by the expression:

$$\hat{Y} = 2{,}626\,\mathrm{x} + 11\,967 \qquad (9)$$

CONCLUSION

In conclusion, it is important to be summed up that the principle of the multiplier emphasizes an important economic phenomenon: that one of the indirect effects of the investment on total income, which increases by an amount greater than the original investment. But when applied to particular situation this analysis apparatus is the subject of a certain number of limitations. Regardless of which the multiplier principle emphasizes an important phenomenon, namely, that each investment has secondary effects causing increase in the total income, which is greater than the initial investment cost.

This report presents the values of the investment multiplier on the assumption that the changes in GDP to the other components of the aggregate expenditure as a synthetic measure of the return of the investments. Their magnitude indicates how many times more or less output is produced during the period 1997 - 2012, with one additional growth capital investments. The apparent sensitivity of the investments and their impact on the overall cost reflect in significant variations on the amount of investments by year and average for the period. The results of the comparison between the aggregated values and growth rates indicate that the summary value of the multiplier is positive. To each unit increase in investment limit correspond on the average 2.62 units additional increase production output.

Acknowledgements This paper was sponsored as a part of project SR13 FESS 001/20.03.2013 at the Scientific Research Fund of the University of Plovdiv "Paisii Hilendarski".

REFERENCES

1. Ahiakpor, James C. W., Classical Macroeconomics Some modern variations and distortions. London, Routledge, 2003.
2. Benassy, J-P., Ricardian equivalence and the intertemporal Keynesian multiplier. Economic Letters, V.94, Issue 1, pp. 118-123, 2007.
3. Blaug, M., Second Thoughts on the Keynesian Revolution in The Philosophy and Methodology of Economics.,1993.
4. Blaug, M.,Economic Theory in Retrospect. 5th Ed., Cambridge University Press, Cambridge, 2006
5. Chick, V., Macroeconomics after Keynes, A Reconsideration of the General Theory. The MIT Press, Cambridge, Massachusetts, 1993.
6. Davar, E., The Renewal Classical General Equilibrium Theory and Complete Input-Output System Models. Averbury, Aldershot, Sydney, 1994.
7. Davar, E., The Genuine Meaning of Keynes Multiplier, UK HET 2003 Conference, Leeds, 3-5 September, 2003.
8. Davar, E., Flaws of Modern Economic Theory: The Origins of the Contemporary Financial-Economic Crisis, Modern Economics, V.2, Num.1, 25-31, 2011.
9. Hansen, A. H., A Guide to Keynes, Mc Graw-Hill Book Company, New York Harcourt, G. C. and, 1953.
10. Goodwin, R. M., 'The Multiplier', in The New Economics, Ed. Harris, S. E., New York, Alferd A. Knopf, 1947.
11. Kahn, R., The Relation of Home Investment to Unemployment, Economic Journal, 41, June: 173-98, 1931.
12. Keynes, J. M., The General Theory of Employment Interest and Money. London, Macmillan, 1936
13. Klein, L. R., The Keynesian Revolution, London, Macmillan & Co LTD, 1952.
14. Minsky, H. P., John Maynard Keynes, New York, Columbia University Press,1975.
15. Pasinetti, L.I., Growth and Income Distribution Essays in Economic Theory, Cambridge University Press, London, 1974.
16. Patinkin, D., Keynes and the Multiplier", Manchester School, Vol. 46(3), September, 1978.
17. Robertson, D.H., Some notes on Mr Keynes General Theory of Employment, Quarterly Journal of Economics 51, November: 168-91, 1980.
18. Samuelson, P. A., The simple Mathematics of Income Determination", In Income, Employment and Public Policy: Essay in Honor of Alvin H Hansen, edited by L. A. Metzler et al. New York, 1948.
19. Trevithick, J. A. The Monetary Prerequisiedes for the Multiplier: An Adumbration of the Crowding-out Hypothesis, CJE, 18(1), 77-90.