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***Igor Kononenko,*** *DSc (Technical), Professor*
*e-mail: igorvkononenko@gmail.com*
***Anton Repin,*** *PhD Student*
*National Technical University "Kharkiv Polytechnic Institute"*

# THE REGULARITY OF THE COUNTRY'S GDP GROWTH RATE CHANGES INFLUENCE ON THE VOLUME OF GROSS FIXED CAPITAL FORMATION

The regularity of a country's GDP growth rate changes affecting capital investment volume into its economy for countries with a different economic state was proposed. One of the features of this regularity is as follows: there is an obvious increase of capital investment providing that GDP growth rate exceeds a certain threshold. Moreover, this increase occurs at any changes of the GDP growth rate of the above-threshold region. For the first time, this regularity was discovered in 2005 for the European transition economy countries. The objective of this work is to test the regularity of GDP's growth rate change influence on the volume of Gross fixed capital formation for countries with different levels of economic state within the period 1995 – 2013. To achieve the goal, the economic processes taking place in 35 countries around the world were analyzed. The verified result of the analyzed economies demonstrated a high rate of correspondence. On average, in 93.52 % of cases of the economies of the countries analyzed the capital formation was held according to the regularity. In 14 of the 35 countries, investment processes came up to it. Moreover, with the growth of the period considered compared to the previous study, the corresponding percentage rose from 90.7 to 93.52 despite the world crisis.

***Key words:*** regularity, GDP growth rate, impact, capital investment, 35 countries, economic state.

***Ігор Кононенко, Антон Рєпін. ЗАКОНОМІРНІСТЬ ВПЛИВУ ЗМІН ПРИРОСТУ ВВП КРАЇНИ НА ОБСЯГ КАПІТАЛЬНИХ ІНВЕСТИЦІЙ***

Запропоновано закономірність впливу змін приросту ВВП країни на обсяг капітальних інвестицій в її економіку для країн з різним економічним станом. Вперше ця закономірність була виявлена в 2005 р. для європейських країн з перехідною економікою. Мета статті: перевірити закономірність впливу змін приросту ВВП країни на обсяг капітальних інвестицій для країн з різним рівнем економічного розвитку в період 1995-2013 рр. Для досягнення мети були проаналізовані економічні процеси в 35 країнах світу. Результат перевірки закономірності на економіках проаналізованих країн показав високий відсоток відповідності.

***Ключові слова:*** закономірність, приріст ВВП, вплив, капітальні інвестиції, 35 країн, економічний стан.

***Игорь Кононенко, Антон Репин. ЗАКОНОМЕРНОСТЬ ВЛИЯНИЯ ИЗМЕНЕНИЙ ПРИРОСТА ВВП СТРАНЫ НА ОБЪЕМ КАПИТАЛЬНЫХ ИНВЕСТИЦИЙ***

Предложена закономерность влияния изменений прироста ВВП страны на объем капитальных инвестиций в ее экономику для стран с различным экономическим состоянием. Впервые эта закономерность была обнаружена в 2005 г. для европейских стран с переходной экономикой. Цель статьи: проверить закономерность влияния изменений прироста ВВП страны на объем капитальных инвестиций для стран с различным уровнем экономического развития в период 1995-2013. Для достижения цели были проанализированы экономические процессы в 35 странах мира. Результат проверки закономерности на экономиках проанализированных стран показал высокий процент соответствия.

***Ключевые слова:*** закономерность, прирост ВВП, влияние, капитальные инвестиции, 35 стран, экономическое состояние.

**Introduction.** An important factor for predicting the social-economic and scientific-technological development of the country is forecasting Gross fixed capital formation (GFCF). GFCF is the integral part of gross domestic product calculation, based on the use of the expendable approach. According to the World Bank[1], GFCF, previously referred to as a gross domestic fixed investment, includes land improvements, acquisition of a plant, machinery, and equipment; the construction of roads, railways etc., including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Net acquisitions of valuables are also considered as capital formation.

In its turn, this indicator is difficult to predict because it depends on numerous factors, including poorly formalized ones. One way of solving this problem is to find the relationship between the volume of GFCF and another macroeconomic indicator, which is easier to predict. The country's GDP is proposed to be used as the latter.

There are two hypotheses about the direction of causality between investment and growth. The first hypothesis is that increased investment leads to increased economic growth. The growth models of Solow (1956), Domar (1957), Harrod (1999) confirmed that increased investment may enhance economic growth. Tyler (1981) concluded that investment is the main determinant of growth rate. He came to this conclusion after investigating statistics of 55 developing countries. Positive influence between the rate of physical capital formation and the rate of a country's economic growth was reported in papers of Kormendi & Meguire (1985), Barro (1991), Levine & Renelt (1992). Adhikary (2011) investigated the linkage between foreign investment, trade openness, capital formation, and economic growth rates. He considered statistical data of Bangladesh development for a period 1986-2008. He showed that the volume of foreign direct investment and level of capital formation reveal significant positive effects on changes in real GDP.

Blomstrom et al. (1996) checked the second

[1]http://data.worldbank.org/indicator/NE.GDI.FTOT.CD (04.02.2015)

hypothesis that economic growth stimulates increased investment. They used Granger causality tests and indicated that the direction of causality runs from economic growth to investment. Mehrara & Musai (2013) showed that there is a long-run relationship between investment and GDP. They investigated statistics for the Middle East and North Africa (MENA) region countries for the period 1970-2010. Their results suggested that there is strong causality running from GDP to investment with no feedback effects from investment to GDP MENA region countries. This paper supported the point of view that high economic growth leads to higher investment.

In the paper (Arby & Batool, 2007) authors showed the presence of a two-way relationship between the volume of capital investment and GDP by means of econometric approaches, in particular, with the help of Granger causality test. In the paper (Voronkin, 2004) the author proposed a formula that relates the GDP to the country's investment. However, it can help to find a marginal share of investment in GDP in different countries.

We offer to analyze the dependence of the volume of capital investment and GDP growth from a different perspective. In this paper (Kononenko & Repin, 2005) authors have analyzed the economic processes in the countries with transition economy. The analysis of the data allowed to reveal and formulate the regularity of the country's GDP growth rate change influence on the volume of GFCF for the European transition economy countries (Kononenko & Repin, 2006a, 2006b). In these papers (Kononenko & Repin, 2007, 2010) the pattern has been tested in the countries with different levels of economic development. All in all, the economic processes taking place in 33 countries around the world were analyzed, among them 31 European countries, as well as the Japan and the United States. According to the classification of the World Bank[2] countries with a high level of Gross national income per capita (hereinafter HI), countries with upper-middle gross national income per capita (UMI), countries with lower-middle gross national income per capita ( LMI) were considered. In the group of HI, 24 countries were analyzed, 8 countries were analyzed in the group UMI, and one country was considered in LMI group. Period of research covered 1985-2006. In some cases, time limits were restricted due to the lack of reliable statistics for the entire range. The test yielded fairly good results. Thus, on average, in 90.7% of cases in the countries' economies analyzed this regularity was observed. In 10 of the 33 countries processes fully corresponded to it. Because after the survey, i.e. after 2006, the global economic crisis broke out, the following questions arose: How did the crisis affect the revealed trend? Did the regularity comply with the period of crisis validity and its aftermath?

**The purpose and background.** The objective of this work is to test the regularity of GDP's growth rate change influence on the volume of GFCF for countries with different levels of economic development over 1995 – 2013. To achieve the goal, we analyzed the economic processes taking place in 35 countries around the world. For this study, the countries provided with statistics data on the growth rate of GDP and GFCF by Eurostat agency[3] were selected. In some cases, time limits have been narrowed due to the lack of reliable statistics for the entire period.

Considering significant differences in the economic conditions of the countries, we divided them into groups according to the World Bank classification based on Gross national income (GNI) per capita[2]. In the group of HI the following countries were analyzed:Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States (in total 30 countries). In the UMI group, the following countries were analyzed: Bulgaria, Hungary, Macedonia, Romania, Turkey (5 countries).

**The regularity of the country's GDP growth rate changes influence on the volume of GFCF.** Prior to the proposed regularity description, it is necessary to define the so-called "threshold", which is often referred to hereinafter. Having analyzed the economic processes in the countries mentioned above in terms of the dependence of GFCF from GDP growth rate we came to the conclusion that it is possible to identify a threshold of GDP growth rate for each economy with high accuracy. It is important that if GDP growth rate for some year is higher than the threshold value, the change in investment for the same year is described by a certain algorithm, and if it is below the threshold a different algorithm can be used.

For more details, we will show it with the direct description of the regularity. There is a well-known notion of a "zero" threshold in the economy. If GDP growth rate is above zero the economy "works" with a plus if lower –with a minus. We discovered that another threshold value other than zero is always positive, which is defined for the economy of every country of the described range. Thus, the threshold value is the value of GDP growth rate, above and below which the investment in the economy is subject to different rules. Proceed directly to the regularity, the essence of which is as follows. First, there is the growth of capital investment in the economy if the GDP growth rate is above a certain threshold value which is different for each country. Moreover, investment growth is observed with increase and decrease of GDP growth rate, provided GDP growth changes occur in the above-threshold area.

Secondly, there is a decrease, or (rarely) stabilization of the volumes of capital investment into the economy in case a GDP growth rate falls if the reduction of GDP growth rate is observed in the area below the threshold.

Thirdly, there is a rise in investment or stabilization with an increasing GDP growth, if such an increase occurs in the area with positive values.

Fourthly, if the increase of GDP growth occurs in the area of negative growth values, this process is accompanied by an investment decrease.

[2]http://data.worldbank.org/about/country-and-lending-groups (04.02.2015)
[3]http://ec.europa.eu/eurostat (04.02.2015)

In the fifth place, if a GDP growth is in the area of positive values of growth after a period of GDP growth falling in the sub-threshold zone there is an investment reduction (which in rare cases may happen even a year after such a fall).The points at which GDP growth rate corresponds exactly to the value of the threshold behave either as sub-threshold or as above-threshold. The established regularity is to define the dependence of the volume of capital investment in the economy and GDP growth rate for the same year and with one year delay of capital investment indicator. In the latter case, the dependence of the investment volume in the year t and GDP growth rate in the previous year is considered.

Fig. 1 shows a graphical interpretation of the established regularity in general.

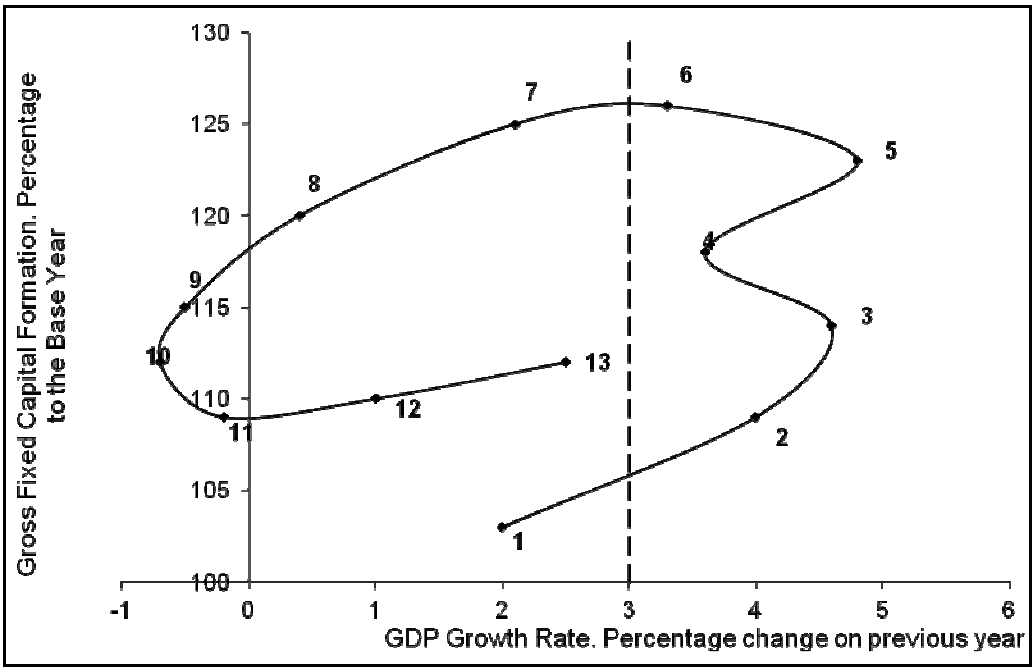


***Fig. 1. Graphical interpretation of the regularity***

The threshold value for the simulated economy makes up 3% of the GDP growth rate. The graph demonstrates all the elements of the regularity.

**The first section of the regularity.** The beginning of the period corresponds to point 1. GDP growth is in the sub-threshold area and makes up 2%. Further on, the country's economy develops more efficiently and, starting from point 2, is characterized by a steady increase of annual GDP growth values above the threshold of 3%. This is the first stage of the regularity, characterized by an increase of capital investment volumes. In addition, fluctuations in the value of GDP growth have no effect on this trend. This section of the regularity (points 2-6) was called in our investigation "the serpent". It was observed within the considered time interval in all the countries under analysis.

**The second section of the regularity.** It takes place in case of crossing the threshold in the reverse direction (points 6-7). In the segment 6-7-8 first growth termination (stabilization) is clearly observed, and then - falling investment while reducing GDP growth in the sub-threshold area. Segment 9-10 is in the area of negative GDP growth rate values and it is also characterized by a decline of investment.

**The third section of the regularity** is observed in segments 11-13, 1-2. It is characterized by an increase in investment under conditions of GDP growth when GDP growth rate occurs in the area of positive values.

**The fourth section** is observed in the segment 10-11 when an increase in GDP growth rate occurs in the area of negative values and it corresponds to the decline in capital investment.

**The fifth section** is illustrated by the segment 9-10, Fig. 2. In this case, after a period of falling of GDP growth rate in the sub-threshold area with an increase of GDP growth rate in the area of positive values an investment decline was observed and in rare cases, namely in Bulgaria (2011), Ireland (2011), Netherlands (2004), Poland (2003), Spain (2011) even one year after a fall. The years when a certain phenomenon was observed are marked by brackets. In general, the fifth section of the regularity was observed in 33 cases out of 61. In 28 cases after a period of GDP growth drop in the sub-threshold area, there was a third section of the regularity.

The fifth section was carried out in the following countries in the years indicated by brackets: Austria (2010), Belgium (2010), Bulgaria (2010, 2011, 2013), Croatia (2000), Cyprus (2010), Czech Republic (1999), Denmark (2010), Estonia (2010), France (2013), Germany (2004), Hungary (2010), Iceland (2013), Ireland (2011), Japan (2010), Lithuania (2000), Luxembourg (2010), Macedonia (2010), Malta (2013), Netherlands (2003, 2004, 2010), Norway (2000, 2010), Poland (2003, 2010), Portugal (2006, 2010), Slovakia (2000), Slovenia (2010), Spain (2011), USA (2002) (in total 33 cases).

The fifth section was not carried out for the following situations: the Czech Republic (2010), Denmark (2013), Estonia (2000), Finland (2010), Germany (2010),

Greece (2006), Hungary (2013), Iceland (2011), Italy (2004), Japan (2000, 2003), Latvia (1996, 2011), Lithuania (2010), Macedonia (2002), Malta (2005), Romania (2000, 2011), Slovakia (2010), Sweden (2010), Switzerland (2004, 2010, 2013), Turkey (2000, 2002, 2010), the United Kingdom (2010), the USA (2010) (in total 28 cases).

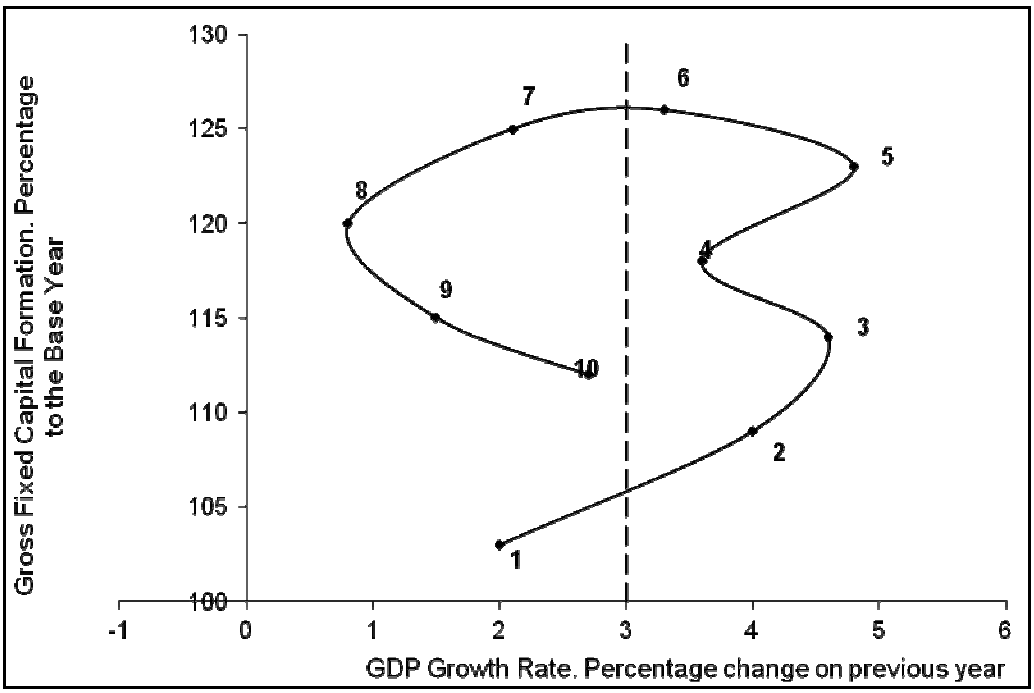


***Fig. 2. The Graphical interpretation of the regularity, fifth section***

Thus, in Fig. 1 and 2 the revealed regularity is demonstrated in the example of the conditional economy.

To provide the analysis of statistical data on the real economies it is advisable to introduce the following definitions for areas that describe economic processes. The area «NA (Negative Area)» is an area in which the values of GDP growth rate are negative.

The area «STA (Sub-Threshold Area)» is an area where the value of GDP growth rate is above zero but below the threshold (TL, Threshold Level). The area «OTA (Over-Threshold Area)» is an area where the value of GDP growth rate is above the threshold TL.

**Verification and illustration of the regularity on the example of economies around the world.** The testing results of the regularities on the statistical data defining the economic processes in 33 European countries, as well as the United States and Japan are demonstrated in Tables 1 and 2.

It is obvious from the tables that the regularity shows up in full 100 % for the 14 countries from the 35 considered; what's more, for 9 countries the regularity is manifested in more than 90% of facts. The average value of the relevance of the economic processes for the regularity proposed is 93.52% (for the countries considered). It is important that the accuracy of the regularity is almost independent of the rate of the nation's economic well-being.

The further manifestation of the regularity is shown by an example of the above-mentioned groups (HI, UMI).

In the group of HI, the most interesting countries from the point of view of the regularity demonstration are the United Kingdom and the United States. For these countries, during the analyzed period, the variations of the GDP growth rate in the three zones (OTA, STA, and NA) were observed. These variations allow us to demonstrate the regularity in full.

On all subsequent graphs the data are presented in the chronological order, i.e., one point at the beginning of the curve corresponds to the starting year of the period analyzed, and the other at the end of the curve corresponds for the last year.

Fig. 3 shows the dependence of the GFCF and GDP growth rate for the US economy.

In accordance with the graph, the threshold value of GDP growth rate for the US economy is about 1.8%. From 1995 to 2000, from 2003 to 2006 and from 2010 to 2013, GDP growth rate values were in the above-threshold area; this corresponds to the growth of GFCF regardless of changes in GDP growth rate. During these periods, there was "the serpent" specific for the first section of the regularity. In 2001, the value of GDP growth rate was below the threshold level and was accompanied by a decline in GFCF (the second section of the regularity). In 2002 there was a decline of GFCF after a period of fall in GDP growth rate in the sub-threshold area (the fifth section of the regularity). In 2007-2009, there was a decrease of GFCF with GDP growth rate decrease, which corresponds to the second section of the regularity. In this case, the point 2007 was exactly on the threshold and behaved like a sub- threshold point. In 2010, GDP growth rate in the area of positive values of growth corresponds to the growth of GFCF (third section of the regularity).

*Table 1*

***The results of the regularity verification for the analyzed economies***

| Num-ber | Country | Research period / Number of analyzed points | Number of points satisfying the Regularity | Number of points not satisfying the Regularity | Regularity satisfying, percentage of the total number of points |
|---|---|---|---|---|---|
| 1 | Austria | 1995-2012 / 17 | 15 | 2 | 88,24 |
| 2 | Belgium | 1996-2013 / 17 | 16 | 1 | 94,12 |
| 3 | Bulgaria | 1996-2013 / 17 | 15 | 2 | 88,24 |
| 4 | Croatia | 1996-2013 / 17 | 17 | 0 | 100 |
| 5 | Czech Rep. | 1995-2013 / 18 | 18 | 0 | 100 |
| 6 | Cyprus | 1996-2013 / 17 | 15 | 2 | 88,24 |
| 7 | Denmark | 1995-2013 / 18 | 15 | 3 | 83,33 |
| 8 | Estonia | 1995-2013 / 18 | 18 | 0 | 100 |
| 9 | Finland | 1995-2013 / 18 | 18 | 0 | 100 |
| 10 | France | 1995-2013 / 18 | 17 | 1 | 94,44 |
| 11 | Germany | 1995-2013 / 18 | 16 | 2 | 88,89 |
| 12 | Greece | 2000-2013 / 13 | 13 | 0 | 100,0 |
| 13 | Hungary | 1996-2013 / 17 | 14 | 3 | 82,24 |
| 14 | Iceland | 1995-2013 / 18 | 16 | 2 | 88,89 |
| 15 | Ireland | 1996-2012 / 16 | 16 | 0 | 100 |
| 16 | Italy | 1995-2013 / 18 | 18 | 0 | 100 |
| 17 | Japan | 1995-2013 / 18 | 16 | 2 | 88,89 |
| 18 | Latvia | 1995-2013 / 18 | 18 | 0 | 100 |
| 19 | Lithuania | 1996-2013 / 17 | 16 | 1 | 94,12 |
| 20 | Luxembourg | 1996-2012 / 16 | 13 | 3 | 81,25 |
| 21 | Macedonia | 1998-2010 / 12 | 10 | 2 | 83,33 |
| 22 | Malta | 2002-2013 / 11 | 10 | 1 | 90,91 |
| 23 | Netherlands | 1995-2012 / 17 | 16 | 1 | 94,12 |
| 24 | Norway | 1995-2013 / 18 | 15 | 3 | 83,33 |
| 25 | Poland | 1996-2013 / 17 | 17 | 0 | 100 |
| 26 | Portugal | 1996-2013 / 17 | 17 | 0 | 100 |
| 27 | Romania | 1995-2012 / 17 | 16 | 1 | 94,12 |
| 28 | Slovakia | 1995-2013 / 18 | 17 | 1 | 94,44 |
| 29 | Slovenia | 1995-2013 / 18 | 17 | 1 | 94,44 |
| 30 | Spain | 1995-2012 / 17 | 17 | 0 | 100 |
| 31 | Sweden | 1995-2013 / 18 | 15 | 3 | 83,33 |
| 32 | Switzerland | 1995-2013 / 18 | 18 | 0 | 100 |
| 33 | Turkey | 1995-2010 / 15 | 15 | 0 | 100 |
| 34 | United Kingdom | 1995-2012 /17 | 16 | 1 | 94,12 |
| 35 | United States | 1995-2013 / 18 | 18 | 0 | 100 |

*Table 2*

***The Summary of the regularity verification for the analyzed economies***

| Indicator | Value |
|---|---|
| Number of analyzed countries | 35 |
| Biggest research period | 1995-2013 |
| Lowest research period | 2002-2013 |
| Biggest Regularity satisfying, % | 100 |
| Lowest Regularity satisfying, % | 81,25 |
| Average percentage of Regularity satisfying, % | 93,52 |
| Number of countries, for which the regularity is satisfying: | |
| 80,1 – 85 % | 6 |
| 85,1 – 90 % | 6 |
| 90,1 – 95 % | 9 |
| 95,1 – 99,9 % | 0 |
| 100 % | 14 |

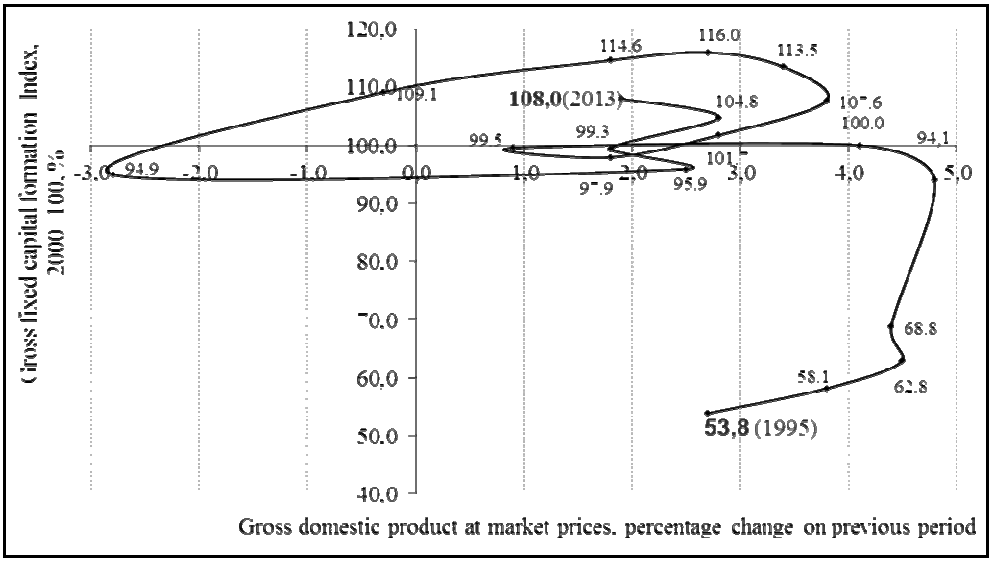


***Fig. 3. Graph of the Regularity between GFCF and GDP for the United States economy in 1995-2013***

Thus, the revealed regularity was totally observed for the US economy in the considered time interval.

Fig. 4 shows the dependence of the GFCF and GDP growth rate for the UK economy.

When GDP growth rate in the UK changed in the above-threshold area the increase of the volume of GFCF in comparison with 2000 (the first section of the regularity) was observed. The figure shows the typical "serpent". The threshold is between 2.2% and 2.3% of an annual GDP growth rate. In 2008 and 2009 there was a decline of GDP growth rate in the sub-threshold region (the second section of the regularity), respectively, the volume of GFCF also reduced. In 2009 there was the maximum negative GDP growth rate. In 2010, GDP growth rate in the region of positive values corresponded to the growth of GFCF (the third section of the regularity). The decrease in GDP growth rate in the sub-threshold area in 2011 was accompanied by a decrease in GFCF (second section of the regularity). Only the value for 2012 stands out a little against the revealed regularity because instead of falling GFCF there was a slight increase by 0.7%.

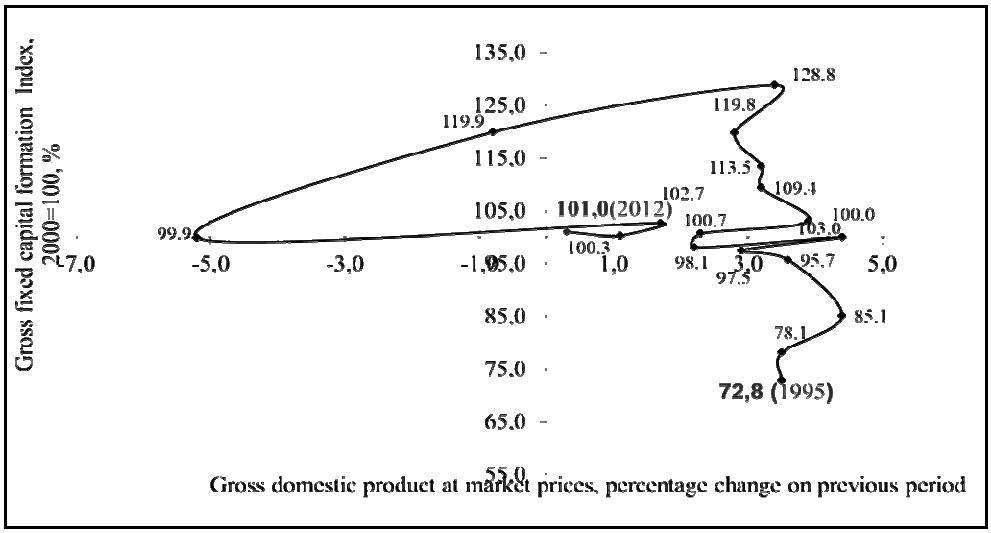


***Fig. 4. Graph of the Regularity between GFCF and GDP for the United Kingdom economy in 1995-2012***

Fig. 5 displays a graph of the dependence of the volume GFCF on the GDP growth rate for the German economy.

The threshold value for the German economy according to the data for the period under consideration is between 1.5% and 1.7% of GDP growth rate. In 1996, according to the second section of the regularity, the GFCF decrease with GDP growth rate decrease in the sub-threshold region was occurred. Further on, from 1997 to 2000, there was "the serpent" (the first section of the regularity). From 2001 to 2003, GDP growth rate decrease in the sub-threshold region corresponded to a decrease of GFCF (the second section of the regularity). In 2004, GDP growth rate in the area of positive values increase was accompanied by a decrease in GFCF (fifth section of the regularity). In 2005, instead of reduction

GFCF together with a decrease in GDP growth rate in the sub-threshold area, there was a slight increase by 0.78%. In 2006 and 2007 "the serpent" was observed again (the first section of the regularity). In 2008, instead of reducing GFCF together with a decrease in GDP growth rate in the sub-threshold region it rose by 1.26%. In 2009, the GFCF decrease in full accordance with the second section of the regularity took place. In 2010, 2011 there was "the serpent" (the first section of the regularity).

In 2012 and 2013, strictly in accordance with the second section of the regularity, the reducing GDP growth rate in the sub-threshold area was accompanied by a decrease of GFCF.

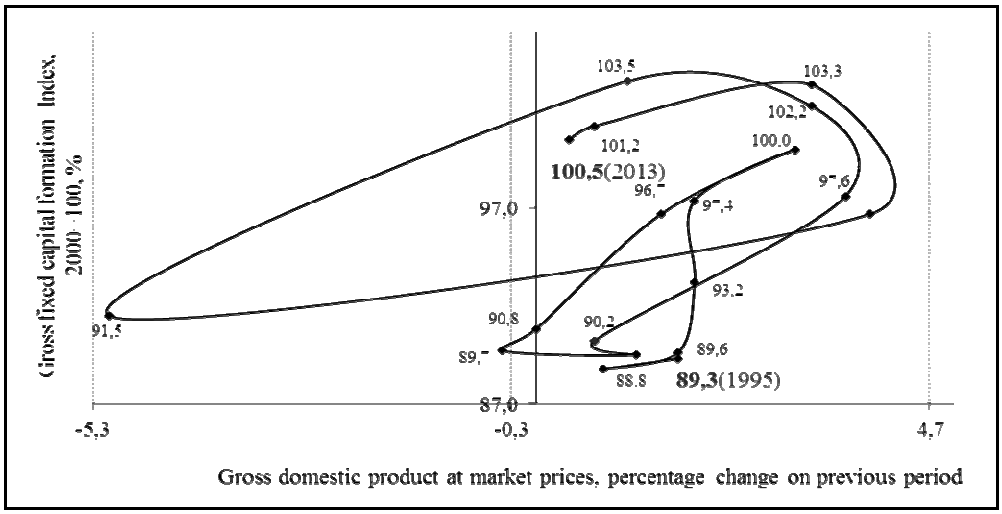


***Fig. 5. Graph of the Regularity between GFCF and GDP for the Germany economy in 1995-2013***

Fig. 6 demonstrates the dependence of the GFCF on the GDP growth rate for the Japanese economy.

The threshold for Japan in the considered time interval is between 0.4% and 1.3% of GDP growth rate. In 1995, 1996, there was "the serpent" (the first section of the regularity). In 1997, instead of GFCF growth in accordance with "the serpent," there was a very slight decrease of GFCF about 0.09 %. In 1998, a decrease of GDP growth rate in the sub-threshold area corresponded to a significant decrease of GFCF (second section of the regularity). In 1999, the fourth section of the regularity appeared. In 2000 there was an increase of GFCF, with increased GDP growth rate in the area of positive values (the third section of the regularity). In 2001 and 2002, according to the second section of the regularity a decline of GFCF was observed. From 2003 to 2007 the processes were accurately described by "the serpent" (the first section of the regularity). In 2008 and 2009, an abrupt decrease of GDP growth rate in the sub-threshold area corresponded to a decrease of GFCF (the second section of the regularity). In 2010, there was a significant increase in GDP growth rate excessing the threshold level. It happened after a period of falling GDP growth rate in the sub-threshold area. At the same time, there was a very slight decrease of GFCF (the fifth section of the regularity). The value of GFCF in 2011 was somewhat higher: 1.46% than in 2010, which does not correspond to the reduction of GDP growth rate in the sub-threshold area. This point is not in accordance with the revealed regularity.

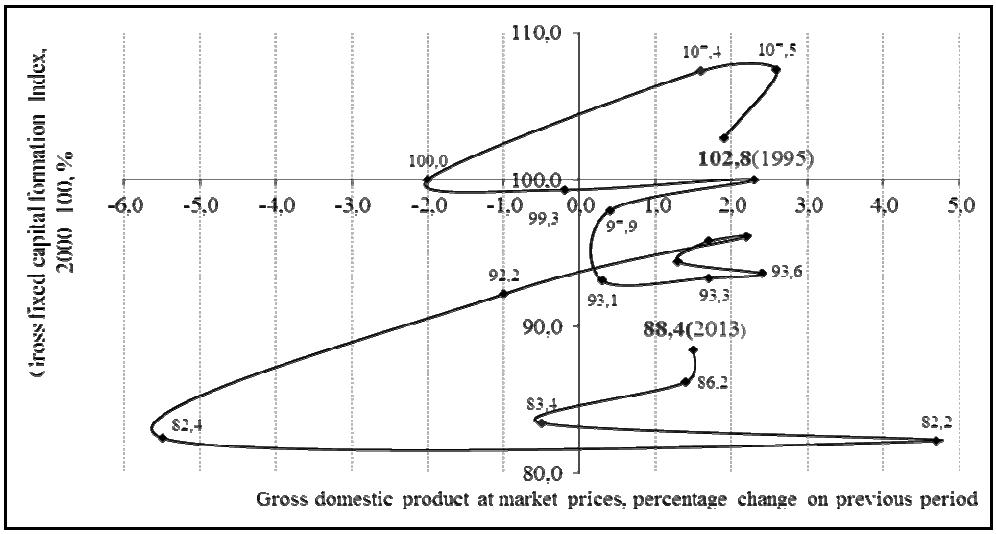


***Fig. 6. Graph of the Regularity between GFCF and GDP for the Japan economy in 1995-2013***

On average, for the group HI (30 countries) the regularity was shown in 94.17% of cases. For the 13 countries out of 30, the regularity was shown in 100% of cases.

Next, the regularity is considered by the example of one country from the group UMI, Bulgaria.

Fig. 7 demonstrates the dependence of the GFCF on GDP growth rate for the economy of this country.

The threshold value for the Bulgarian economy in the considered time interval is between 1.8% and 2% of GDP growth rate. In 1996, 1997 the processes fully corresponded to the fourth section of the regularity, i.e. an increase of GDP growth rate occurred in the area of negative values, which was accompanied by a decrease of GFCF. From 1998 to 2008, Bulgaria's economy developed rapidly in the above-threshold zone in strict accordance with "the serpent" of the first section of the regularity.

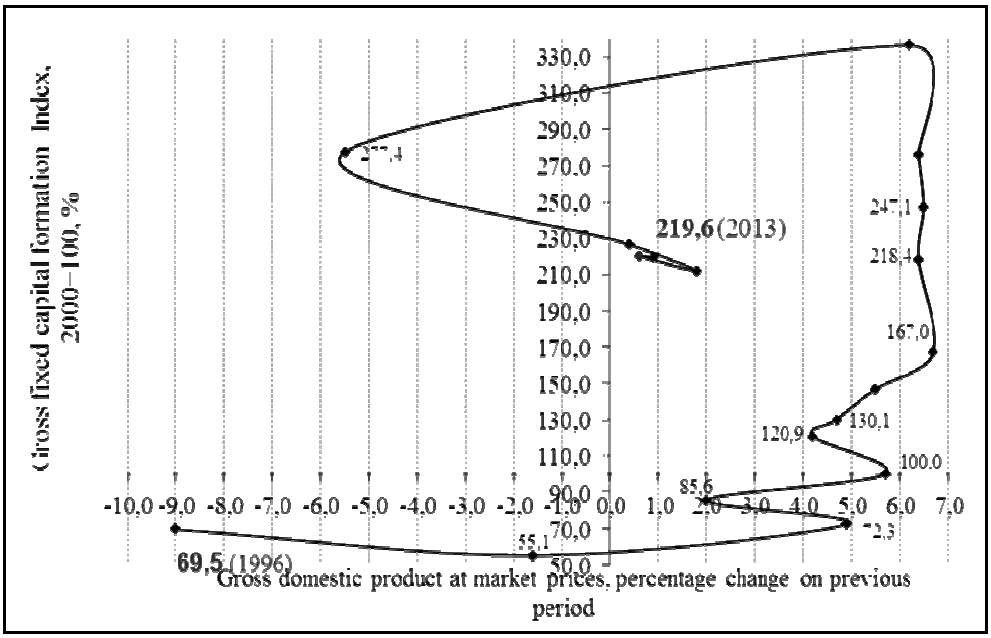


***Fig. 7. Graph of the Regularity between GFCF and GDP for the Bulgaria economy in 1996-2013***

In 2009 there was a sharp decrease of GDP growth rate, and it was deep in the zone of negative values. It was accompanied by a decrease of GFCF (second section of the regularity). After a period of GDP growth rate drop in the sub-threshold area in 2010 and 2011, there was an increase of GDP growth rate in the area of positive values. In accordance with the fifth section of the regularity, the two years GFCF decline was observed. In 2012, contrary to expectations, with a decrease of GDP growth rate in the sub-threshold area, there was some increase of GFCF (by approx. 4%). Finally, in 2013, with an increase of GDP growth rate in the area of positive growth values in the third section the regularity the decline of GFCF appeared.

On average for the group UMI (5 countries) the regularity was obvious in 89.59% of the cases. For one country out of five, the regularity is obvious in 100% of cases.

It's interesting that the identified dependence is manifested in a delay of GFCF in relation to the growth of GDP per year, i.e. GFCF is considered in this case as a reaction to last year's GDP growth rate.

Fig. 8 shows the dependence of the volume of GFCF on the values of the GDP growth rate with one year delay of GFCF in relation to GDP growth rate for the US economy.

The threshold for GDP growth rate remained 1.8%, as in the case without delay. We are considering GFCF of 1996 as a reaction to the GDP growth rate in 1995. Until 2000, there was the peculiar "serpent" or the first section of the regularity. In 2001, the value of the GFCF slightly decreased, although GDP growth rate in 2000 was in the above-threshold area. It can be stated that the regularity at this point was violated, although the decrease was only 0.05%. In 2002, GFCF decreased at the background of decrease of GDP growth rate in 2001 in the sub-threshold area (the second section of the regularity). With an increase of GDP growth rate in 2002 in the area of positive values to the threshold level, GFCF in 2003 increased (the third section of the regularity). In 2004-2006, there was the characteristic "serpent" (the first section of the regularity). In 2007, contrary to expectations, there was a decline by 1.2% GFCF. Although the reduction was slight, we assume that at this point the regularity was broken. In 2007, GDP growth rate was equal to the threshold value. The point behaved like a sub-threshold because there was a decline of GFCF in 2008, which corresponds to the second section of the regularity. The decline of GFCF in 2009 corresponded to the decline of GDP growth rate in 2008 in the region of negative values (the second section of the regularity). In 2010, the GFCF increased by 1%, although in accordance with the regularity it was to reduce or stabilize. In 2011, there was an increase of GFCF, with increased GDP growth rate in the area of positive values in 2010. This corresponded to the third section of the regularity.

In 2012 and 2013 there was the characteristic "serpent".

Thus, we can conclude that for the US economy when considering the GFCF with a delay for one year in relation to GDP growth rate the regularity was observed in 14 points from 17, i.e., in 82.35% points.

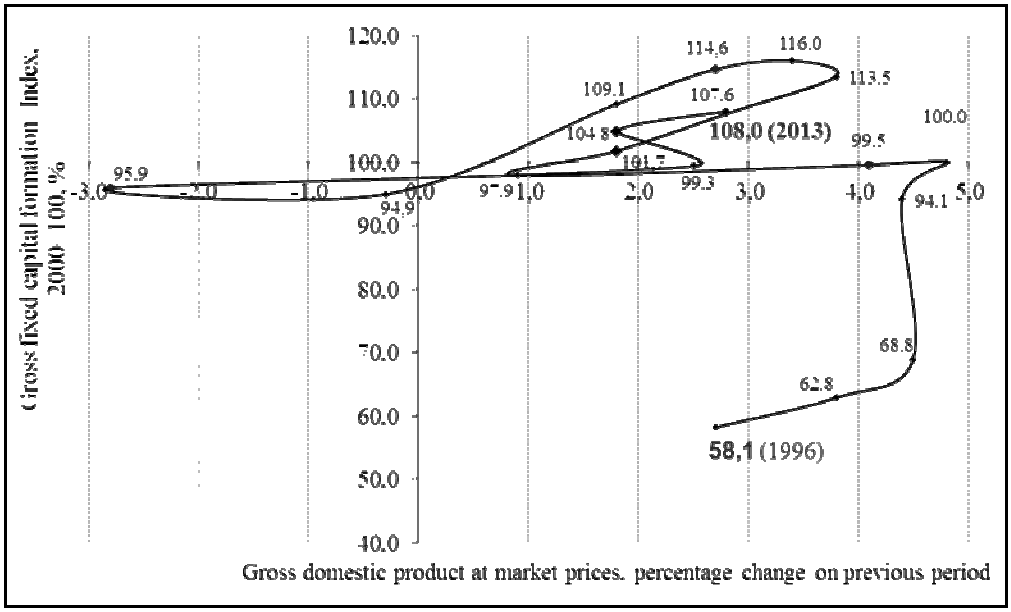


***Fig. 8. Graph of the Regularity between GFCF and GDP for the Unites States economy in 1995-2013 with annual delay***

**Conclusions.** The economic processes taking place in 35 countries around the world was analyzed during the study. For these countries, the regularity of a country's GDP growth rate affecting the volume of capital investment into their economy, previously discovered by the authors, has been verified. The results of verification are high. Thus, on average, in 93.52 % of cases of the economies of the countries analyzed the capital formation was held according to the regularity. In 14 of the 35 countries, investment processes came up to it.

Moreover, with the growth of the period considered compared to the previous study, the corresponding percentage rose from 90.7 to 93.52 despite the world crisis.

We propose to use the revealed regularity for predicting the volume of capital investment in the economy of a particular country.

At a later date, the geography of studies is supposed to be expanded so as to analyze the regularity performance in the countries with lower gross national income per capita. Another important area is the study of the behavior of the threshold value considering the time factor and the contemporary globalization processes.

**References:**

1. Adhikary, B.K. (2011). FDI, Trade Openness, Capital Formation, and Economic Growth in Bangladesh: A Linkage Analysis. International Journal of Business and Management Vol. 6, No. 1; 16-28.
2. Arby, M.F., Batool, I. (2007). Estimating Quarterly Gross Fixed Capital Formation, *SBP Working paper series*, 17.
3. Barro, R.J. (1991). Economic growth in a cross-section of countries. Quarterly Journal of Economics, 106, 407-444.
4. Blomstrom, M., Lipsey, R. E., Zejan, M. (1996). Is fixed investment the key to economic growth? Quarterly Journal of Economics February, 269-276.
5. Domar, E. (1957). *Essays in the Theory of Economic Growth*. Oxford University Press, N.Y.
6. Harrod, R.F. (1999). *On the Theory of Economic Dynamics*. Helios ARVs, Moscow. (Russian).
7. Kononenko, I.V., Repin, A.N. (2005). The Method of Forecasting Innovation and Scientific and Technological Development of the Country // *Vestnik NTU "KPI". A collection of scientific papers.* NTU "KPI", Kharkov, № 54, 100-105. (Russian).
8. Kononenko, I.V., Repin, A.N. (2006). Regularity effect of changes of Gross Domestic Product on the volume of investment into fixed assets for the European countries with economies in transition. *Certificate of registration of copyright № 16574.* MES of Ukraine. State Department of Intellectual Property. 11.05.2006. (Russian).
9. Kononenko, I.V., Repin, A.N. (2006b). The Modeling and Forecasting of the Technological and Innovational Development of a Transition-Economy Country. *3rd International Conference on Project Management (ProMac2006).* – Sydney, Australia. 27-29 September 2006. E-Proceedings. 7 p.
10. Kononenko, I.V., Repin, A.N. (2007). Rule of GDP Growth Rate Change Influence on Fixed Capital Investment into the Country's Economy. *The Third International Conference on Business, Management, and Economics (ICBME 2007).* Cesme. Turkey. 13-16 June 2007. E-Proceedings. 11 p.
11. Kononenko, I.V., Repin, A.N. (2010). The Regularity of Impact the Country's GDP Growth Rate Changes on the

Volume of Capital Investment into its Economy for Countries with Different Economic State. *Business Inform*, 11, 53-56. (Russian).
12. Kormendi, R.C., & Meguire P.G. (1985). Macroeconomic determinants of growth: Cross-country evidence. *Journal of Monetary Economics*, 16, 141-163.
13. Levine, R., & Renelt, D. (1992). A sensitivity analysis of cross-country regressions. *The American Economic Review*, 82(4), 942-963.
14. Mehrara, M., Musai, M., (2013). *International Letters of Social and Humanistic Sciences,* 8, 1-7.
15. Solow, Robert M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics (Oxford Journals),* 70 (1), 65-94.
16. Tyler, W.G. (1981) Growth and export expansion in developing countries: Some empirical evidence. *Journal of Development Economics*, 9 (1), 121-130.
17. Voronkin, I.I. (2004). Retrospect and Prospects aspects of investment activity. *Mechanization construction,* 6, 2-6. (Russian).

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