Industrial dynamics in Bulgaria – the connection between past and future

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Abstract

Industrial dynamic is a key indicator for sustainable industry growth. Industrial growth is an outcome of long term policy decisions, and it is marked by the past development path. The industrial growth of the Bulgarian industry has been marked by different economy systems. In the past decades it is transposed by variety of industrial policies. Despite that there are clear evidences for a strong link between the past growth and expectations about its future dynamic change.

This paper aims to analyze the state of industrial growth of Bulgarian industry over a 60-years period of dynamic changes in the economic environment and, to discuss the future measurements of this growth. The link among past and future industrial growth is set by the industrial dynamics function. The analysis is disregarded from most common endogenous and exogenous factors such as change of industrial structure or financial or/and economic crises. The analysis covers the change of the basic dynamic factors as: investment rate, innovation rate, purchasing power.

The hypothesis is that the Bulgarian industry growth is a result not just of common changes in the economic or policy environment but of the inherent in industrial dynamic processes. This hypothesis is verified with the analysis of change of industrial dynamic factors for Bulgaria. The dataset covers the change of the production and sells efforts of Bulgarian industry between 1939 and 2010. The conclusions are focused on our expectations for future industrial growth.

1. State of art

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Industrial dynamic is a specific result of the overall business activities. There are number of definitions about industrial dynamics and for the purpose of our analysis, we need to present a basic concept about industrial growth and its dynamic.

For the first time the definition of industrial dynamic is set by Forester (1961)[2]. He defines that industrial dynamic is a result of the increasing ability to enforce the industry evolution for a long-term periods (Forrester, 1988[3]).

Therefore, the industrial dynamic analyses the forces and directions of changes in industry architecture and may lead to evolution of markets (Mattig, 2009)[4]. Moreover, the industrial dynamics does not just describe and analyze the current industrial structure, but these market driven factors that can change economic structures over time. (Krafft, 2006; Dietrich, 2006).

So, our study is based on the following definition:

Industrial dynamic is a result of interaction between forces of demand and supply and the pricing signals that they generate. Thus, the industrial dynamic model is based on two basic components: (1) the receivable accounts such as: capital, delays, inventories, etc., and (2) the change of competition accounts such as: consumption, deliveries, expenses, production, etc.

In summary, the process of creative destruction by the confrontation between technological possibilities and the market opportunities gives the description of the industrial dynamics.[5] This process starts with radically new innovations that are normally carried by new entrants. These innovative entrepreneurs spread their business potential. According to this, some market winners pressure the more active the entrepreneurial entry process, and force them to reorganize or contract or leave.

Adoption of this "evolutionary approach" of industrial dynamic is fundamentally set by Schumpeter's entrepreneurs. Thus, the existence of "entrepreneurial governance" as an economic phenomenon changed the industry from the inside. Not surprisingly, managing the

[2] Forrester, J.W., (1961), Industrial Dynamics, Portland, Oregon: Productivity Press, 1961
[3] Forrester J.W., (1988), Designing Social and Managerial Systems, System Dynamics Group, Sloan School. Cambridge, MA. Massachusetts Institute of Technology, October 1988
[4] Mattig A. (2009), Industrial dynamic and the evolution of markets in the mutual Fund industry, Garbler, 2009
[5] Carlsson, B., Eliasson, G. (2001), "Industrial dynamics and endogenous growth", paper prepared for the Nelson and Winter Conference of the Danish Research Unit for Industrial Dynamics (DRUID), June, available at: www.druid.dk/conferences/nw/

endogenous factors for dynamic are the same which are the major challenge for industrial growth (Krafft 2006[6]).

2. Methodology

The study is based on Cobb-Douglas and Solow-Svensen's production function. Production function is represented as a multiplication of all productions' factors. It's because there is a direct correlation between them. In addition, the production function cannot exist without the simultaneous presence of all main factors of production (labour, capital and resources) (Formula 1):

(1) , where

L – labor (express the influence of the labor as a production's factor);

C – capital (express the influence of the capital as a production's factor);

R – resources (express the influence of the resources usage as a production's factor);

M – scientific and technological development (express the influence of the R&D as a production's factor);

b_1 – function parameter (express the degree of influence of variables – productions' factors: labor ***L***, capital ***C*** and resources usage ***R*** on production function ***P***);

b_0 – free article (express the influence unreported outside the productions' factors in the model);

ε – random variable (express the influence of changing production conditions over time).

The knowledge of the production function gives back the potential of industrial dynamic. It's like hardware of the industrial growth. The software of the growth is given by the Turnover (Sells) function that is connected with the current economic development forces (for instance: prize power, purchase power and etc.).

The sells function is represented as a multiplication of all sells' factors for the domestic and international markets. This function gives a light bright over the economic processes (inflation, economic model change and etc.) (Formula 2):

(2) , where

P_d – indices of prices on domestic market;

P_{int} – indices of prices on overseas (international) markets;

[6] Krafft 2006, Introduction: what do we know about industrial dynamics?, Revue OFCE, June 2006, http://www.ofce.sciences-po.fr/pdf/revue/hs-06-06/rhs-06-06-intro2.pdf

$\boldsymbol{P_p}$ – indices of consumer purchasing power on domestic market.

$\boldsymbol{c_1}$ – function parameter (express the degree of influence of variables – sells factors: prices on domestic market $\boldsymbol{P_d}$ and prices on international markets $\boldsymbol{P_{int}}$ on sells function $\boldsymbol{T_o}$);

$\boldsymbol{c_0}$ – free article (express the influence unreported sells' factors in the model);

ε – random variable (express the influence of changing sells conditions over time).

According to production and sells functions we can define a basic mathematical model for evaluating and analyzing the industrial dynamic ($\boldsymbol{I_d}$). This model represents as the result of industrial core changes as the exogenous economic variables changes (Formula 3).

(3) — , where:

$\boldsymbol{I_d}$ – industrial dynamic;

$\boldsymbol{P_i}$– production index;

$\boldsymbol{To_i}$– turnover index

$\boldsymbol{a_1}$ – function parameter (express the degree of influence of variables P and T_o on function result I_d)

$\boldsymbol{a_0}$ – free article (express the influence unreported factors in the model)

ε – random variable (express the influence of changing production and sell conditions over time)

3. Database

The analysis is based on the annual statistical data, published by the National statistic office, Bulgaria[7]. The analyzed economic sectors are Mining and quarrying (code ***B*** by NACE rev.2[8]), Manufacturing (code ***C*** by NACE rev.2), and Electricity, gas, steam, and Air conditioning supply (code ***D*** by NACE rev.2). The researched period is 1939 –.

The estimation of the production and turnover functions independently of economic and political changes we follow the next procedure:

a. Collect the data in current prices.
b. Constructed the index to align prices.
c. Convert all data in basic prices.

[7] See http://www.nsi.bg
[8] See **EUROSTAT**, NACE Rev. 2: Statistical classification of economic activities in the European Community, European Community 2008, ISBN 978-92-79-04741-1, http://circa.europa.eu/irc/dsis/nacecpacon/info/data/en/NACE%20Rev%202%20structure%20+%20explanatory%20notes%20-%20EN.pdf

The necessity of this procedure is based on the following state:

- There are three period of price value change (1945, 1990 and 1998). In those cases we find abnormal values of price indices and respectively hyperinflation (1997).
- There are two economy model change and respectively two transition periods (1944 – change between market economy and central planning economy models; 1989 – change between central planning economy and market economy models).
- The basic prices are the level of price in 1952. This year is chosen of Bulgarian national statistic office and in many publications this price level is used for comparison of production and turnover back to 1939 and forward to 1980.

All of the observed values are in the Bulgarian currency (BGN). The main reasons are&

- There are different methodologies for statistic observation. So the only unchanged values are at current prices.
- There are different industrial structures over this 60-years period. We have undeveloped industrial structure in the beginning of the period, a comprehensive industrial development in the middle, and industry repression at the end of this period.
- There are immeasurable changes of production structure. The products have changed their functionality as a result of different materials and production processes. So there is no base to compare the products in the beginning (1939) with the products at the end (2011). Even more, the changes in international cooperation and trade give their reflection over the production design and function, and its quality.

4. Basic findings

The construction of the model and its verification is done by SPSS. By testing all variables for correlation, the model shows a strong correlation between them (value around 0.8 – 0.9, and significance at the 0.01 level (2-tailed)).

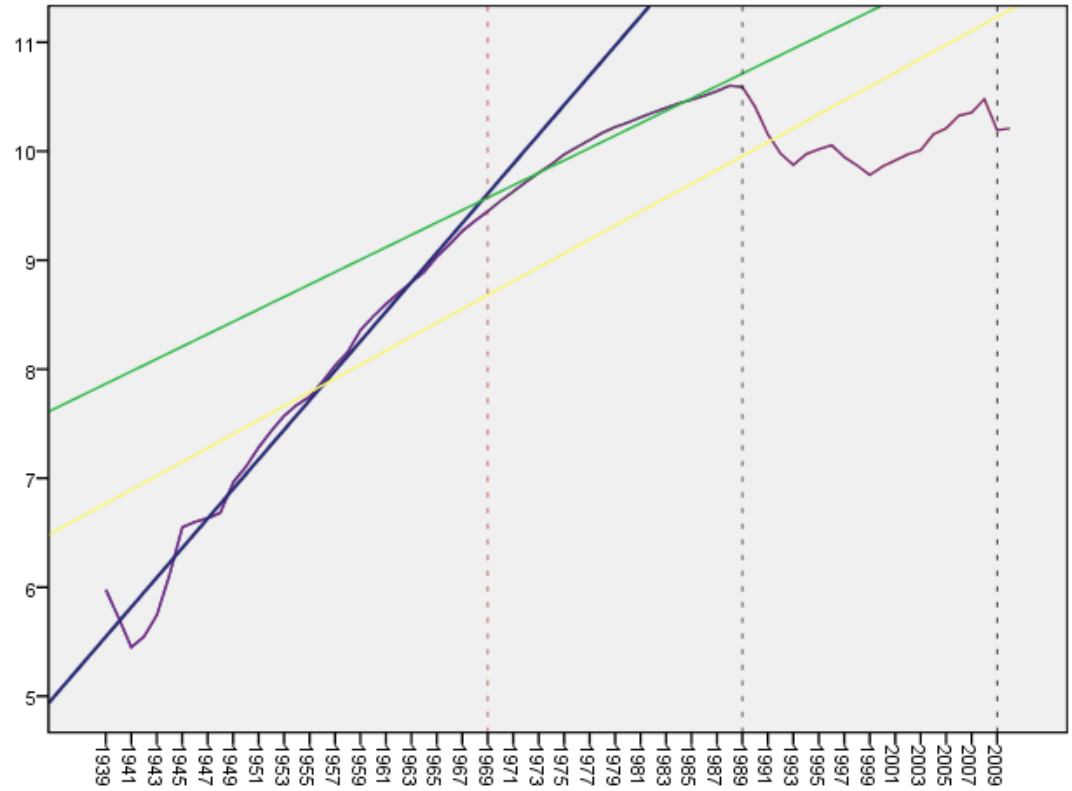
Analysis of production function and its change over the observed period is done by usage of the logarithmic function of production. This method helps to evaluate the dynamic trend of production function more precisely.

The analysis follows two step approach:

a. Analysis of production function growth.
b. Factor analysis of production function change.

c. Evaluate function type between the production growth and the factors dynamic.

The final result (Figure 1) of production function change construction is the picture of industrial growth for this 60-years period.



Source: Bulgarian National Statistic Office, Short term business statistics and own calculations

Figure 1. Log function of industrial production and linear trend estimations

Some basic conclusions are done by the analysis of production function change:

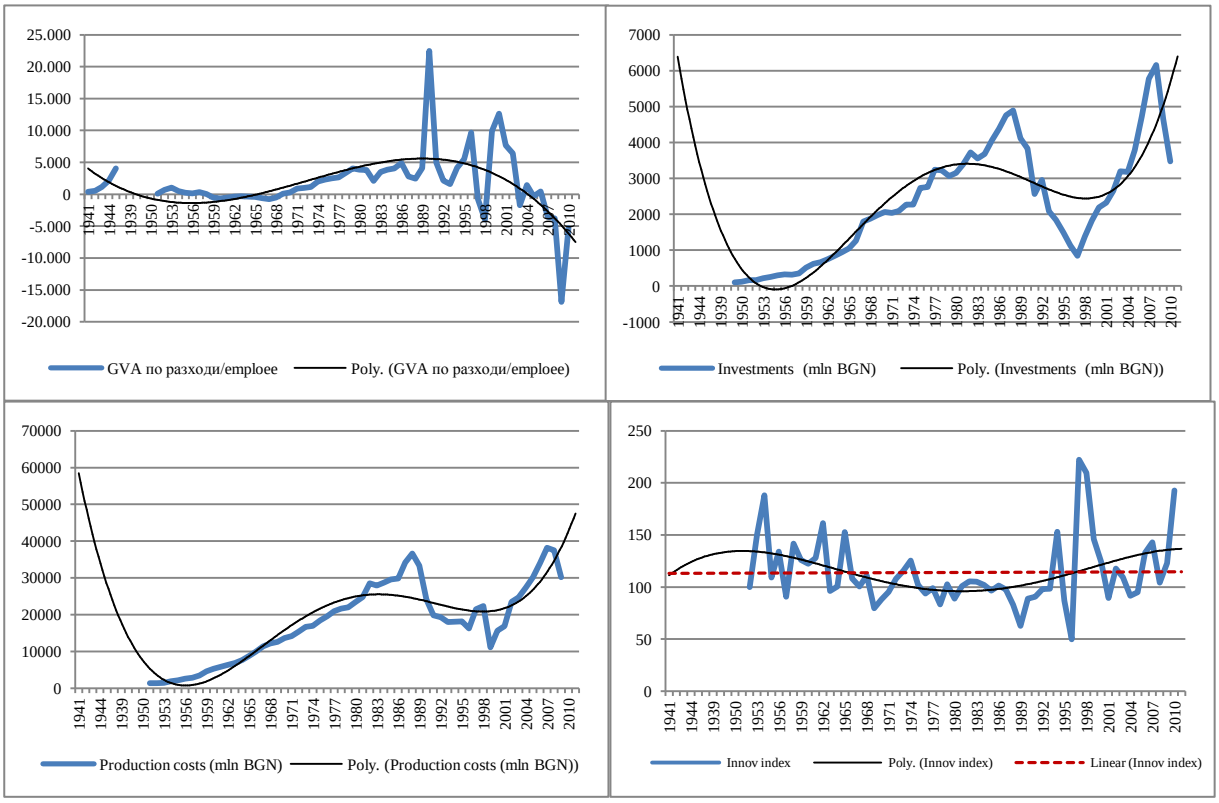
- Bulgarian industrial production has been developed dynamically for the observed period. It is find repeatedly increase of industrial production between 1939 and 2010. But this development is not a constant: there is a very fast industrial development in the beginning of the period that is followed by delayed industrial growth in the middle, and a big industrial recession at the end of the period. So we need to split the production dynamic out for the purpose of our analysis.
- Three periods of the industrial growth and its dynamic change are identified, respectively:

- 1st period (1939-1969) – 30-years period that is described as industrialization of the national economy. Growth rates of industrial production are impressive - nearly 30 times increase of industrial production over the period.
- 2nd period (1969-1989) – 20-years period that is characterized by slowdown of the industry production. It's explained by the saturation of the economy and the reduced absorption of industrial products. The international industry connection are not developed so there is no a chance for industrial growth by the mechanism of industrial export. Despite this slowdown in the industrial production dynamics we find out 4 times increase in production over the observation period.
- 3rd period (after 1989) – 20-years period that is characterized by fluctuation of industry growth dynamic. The beginning of the period is a beginning of economy model change. Therefore we have a rapid drop of production levels during the transition period (1989-1998). After that we find another 10-years industry growth. Nevertheless, the industry has not covered the production drop yet, and the level of production nowadays is comparable with the level in 1980s. Even more, the industry recession has been turn Bulgarian industry back to the end of 1960s.

- There is sufficient evidences that industrial production in the country is entering a new stage of industrial growth. The basic reason for the development change is common economic and financial crises (2009-2011), we find that the change of industrial development is more deep than the crises involves. Our expectations are that this new industry growth stage shall continue for 15 to 20 years period. The path of this new growth is depending on the degree of restructuring (product and technology) of industrial companies. Even more there is am evidence that we have an industry recession in transition period in the beginning of this stage and its duration is connected to the national industrial policy.

- There is a sufficient evidence for the cycle of industry dynamic. Analyzing trend for each period we can easily find that the angle that describes industrial growth is one and the same for the last two periods (1969-1989 and 1989-2009). It is more interesting that the position of the industrial dynamic trend for the last period is less than the previous one. This is connected with a worsen growth potential for the next periods.

The next step of the analysis is to evaluate the change of basic production factors such as: labour, capital and resources and the methods of their usage that is measured by innovation index (Figure2.).



Source: Bulgarian National Statistic Office, Short term business statistics and own calculations

Figure 2. Dynamic change and its trend estimations for the production function's factors as: Gross value added per employee (top left), Investments in long-term assets (top right), Material production costs (down left), innovation index (down right)

Our findings for industrial growth and its dynamic are supported by the data for production factors dynamic change.

1. GVA per employee has been stable growth since 1990s. After that we find a strong variety in the GVA. The explanation is that GVA change has been forced by the technology and product change in the industry. The loss of the traditional industry markets and the big gap between Western European and Eastern European market requires production exchange. Another point that is connected to the lower industrial growth potential is a very fast recession of the gross value added for the last 10-years period. This dynamic is explained by widespread malpractices of Bulgarian industry enterprises – to assume production of lower and lower added value products as they take up a production outsourcing orders.

2. Costs for materials have been changing according to production level and material absorption rate. Thus, the costs have been constantly increased since 1990, but their dynamic trend is fewer slopes than the industry growth one. Analyzing the cost change during last period (1989-2009) we find out some deviations:

   a. Production costs increased without production growth just before the term of hyper inflation (1995-1997);
   b. Production costs decreased in the period of industrial growth just before EU membership (2006-2008).

3. Investments in new technologies and products are directly pointed to industrial growth. Therefore, the growth of Bulgarian industry is connected to the investment level since 1990s. The value of long term fixed assets in enterprises increased by 6 times for this period as a result of fast growing modernization and industrialization of the Bulgarian economy since 1940s. Other reasons for this state are the high level of new-comers in industry for this period as the increased value of industrial production export to former Warsaw Pact countries. After that we have a huge loss of investments value during the transition period (1989-1999). This investment variation is explained by the higher level of uncertainty in the economic system and economic model change in 1989. Another reason is the industrial restructuring and change of ownership of all state enterprises in mostly private ones. The production growth is run up again forced by increasing investments, especially foreign investments in the begging of the 21st century. It's interesting the new industrial growth stage is characterized with another drop of investments in 2009. It is a result of the negative impact of the global economic crisis that shook the world economy nowadays.

4. Even though the innovations are very strong industry growth factor, the Bulgarian industry has not been characterized with a stable innovation growth. The picture shows that we have a strong variety of innovations and the overall effect of innovation is a straight line!

Nevertheless, the innovation activity of industry enterprises has never stopped for the researched period. But the observed variation does not give new and innovative products, technologies and processes that can provide competitive advantages of Bulgarian industry at the global market. Moreover, the close values of the innovation indices at the beginning and at end of the observed period show that Bulgarian industrial enterprises have lagging innovation level in comparison with other foreign competitors. The comparison between dynamics of innovation indices and investment rates gives a point of view that the common increase of investment in long term fixed assets is not forced by the replacement of old assets with the innovative ones, but just the replacement with new for the enterprise and not so innovative machines and equipment.

The last step is to find out the function type between the production growth and the factors dynamic. In the methodology we assume that the function type is linear (Formula 1). The data analysis shows that the connection between production and its factors is so simple. Therefore we test two sets:

a. Production value (in mln. BGN).
b. Factors value of function F=

Therefore, the Formula 1 has been changed to Formula 4.

(4)

The verification of the observed functions needs to find the correlation coefficients between them (Table 2).

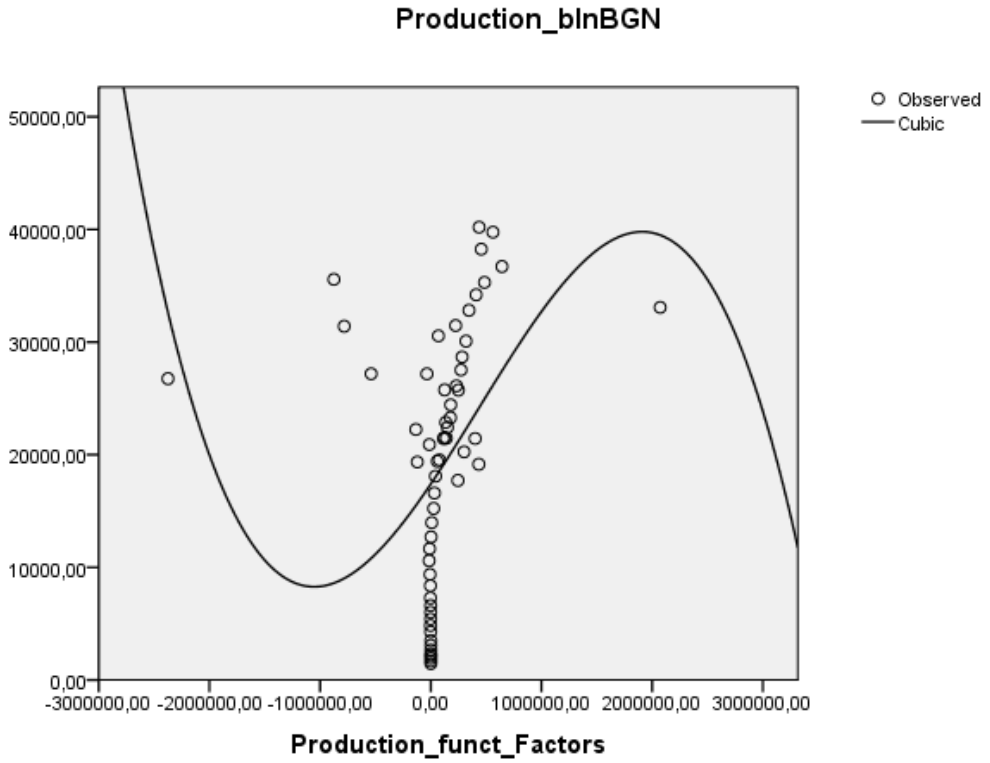
Table 2. Correlation coefficients

			Production_blnBGN	Production_funct_Factors
Spearman's rho	Production_blnBGN	Correlation Coefficient	1,000	,507**
		Sig. (2-tailed)	.	,000
		N	72	60
	Production_funct_Factors	Correlation Coefficient	,507**	1,000
		Sig. (2-tailed)	,000	.
		N	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Bulgarian National Statistic Office, Short term business statistics and own calculations

The data allows confirming the function in Formula 4. So we need to explore the function type. The statistic analysis gives just one significant function type – cubic (Figure 3).



Source: Bulgarian National Statistic Office, Short term business statistics and own calculations

Figure 3. Cubic function between Production value and Production function

The estimation of the cubic function is given on the Table 3.

Table 3. CUBIC Model Summary and Parameter Estimates

Dependent Variable:Production_blnBGN

	Model Summary					Parameter Estimates			
Equation	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Cubic	0,172	3,876	3	56	0,014	17398,51	0,015	3,11E-09	-2,42E-15

The independent variable is Production_funct_Factors.

Source: Bulgarian National Statistic Office, Short term business statistics and own calculations

According to the result the production function is set as follows (Formula 5).

(5) , where

F – function of production factors: labor ***L***, capital ***C*** and resources usage ***R*** on production function ***P***; ***F=***

b_1, b_2, b_3 – function parameter (express the degree of influence of variable function ***F*** – productions' factors: labor ***L***, capital ***C*** and resources usage ***R*** on production function ***P***);

c – free article (express the influence unreported outside the productions' factors in the model);

ε – random variable (express the influence of changing production conditions over time).

5. Conclusions

The influence of different factors on national and sector level that can support or hamper the industrial growth in the country for the forthcoming five to seven years are summarized in the following conclusions:

- We expect an industry recession for a short term (next 2-3 years) and after that dynamic growth for the next 7 – 10 years. This is a part of a new stage of industrial cycle that is started nowadays (2009).
- Our expectations are for increase of investments, especially domestic ones, in the next 3-5 years. The value of these investments depends on national industry policy. So as perquisite of investment growth we look for enlargement of government investments.
- Expectations about the level of material costs and GVA are for slower increase. These two factors are connected each one – better quality and with higher price materials mean more gross value added. But the change in these two factors need as requirement – enlargement in new technology and methods.
- Innovation rate nowadays are good but they are oriented to new product development (but just new for the enterprise). But these innovations do not bring out higher value added. Therefore we expect drop of the innovation potential of Bulgarian enterprises.
- The innovation development significantly lags from growth of investments for whole observed period. Thus, Bulgarian industry is oriented mainly to labor-intensive industries and respectively less innovative ones with lower gross value added. Although the stable level of innovations shows that Bulgarian industry has a slight potential for innovative development.

- According to the previous conclusion we do not expect dramatically change of the cubic function between production growth and production factors.

Finally, industrial growth should be desired of national governance and Bulgarian industry needs proper conditions to enlarge its production. Recent economic policy does not allow us to expect large industrial growth but gives us positive attitudes for industrial growth for the next 10-15 years.

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