Industrial dynamics in Bulgaria – the connection between past and future:

The Case of Food and Beverage Industry

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Abstract. Defining the industrial dynamics the important prerequisites that support achievement of a sustainable industrial and economic growth need to be identified. The industrial dynamics could be used as an instrument to analyze future economic behavior. In this paper we step on the basis of existing state of the art. In Section 1 the methodology is presented: designed and used industrial dynamics function and its components. Section 2 focuses on one of the traditional industrial sectors in Bulgaria - Food and beverage production, its state and key characteristics. In Section 3 the implementation of the industrial dynamics function to forecast the future development of the Food and Beverage production sector in Bulgaria is illustrated. On the basis of dataset perspectives for future development of food and beverage development in Bulgaria are analyzed and recommendations for concrete measures are provided.

Keywords: industrial dynamic, food and beverage, dynamic analysis, perspective analysis.

JEL codes: C15, L66, O47.

1. State of the art

There are many theoretical studies that define the industrial dynamics. As we stated (Kopeva, Blagoev and Sterev 2010a, 2010b, 2011a, 2011b and 2011c) we accept the Forester (1961) definition stating that industrial dynamics is a result of the increasing ability to enforce the industry evolution for long-term periods (Forrester, 1988 and 1999).

In addition, the analyses of the industrial dynamics changes are pointed to the main forces and their directions of changes that lead to the market evolution (Mattig, 2009). But we need to set that the industrial dynamics does not just describe and analyze the current industrial structure, but analyzes these market-driven factors that can change economic structures over time (e.g. Krafft, 2006; Dietrich, 2006).

So, industrial dynamics is a result of the interaction between forces of demand and supply and the pricing signals that they generate. Therefore industrial dynamics is based on two basic functions:

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(1) the production function as a result of change of all of the receivable accounts such as: capital, delays, inventories, etc., and

(2) the turnover function as a result of change of all of the competition accounts such as: consumption, deliveries, expenses, production, etc.

Both functions form cause-and-effect loops that show how economy has been developing over time. According to these statements, we can define a basic methodological scheme (mathematical model) for evaluating and analyzing industrial dynamics (Id): (Equation 1).

\[
I_d = f(P, T_o) = a_1 \cdot \frac{P}{T_o} + a_0 + \varepsilon
\]

where: \( I_d \) – industrial dynamic; \( P \) – production function; \( T_o \) – sale’s function; \( a_1 \) – function parameter (express the degree of influence of variables \( P \) and \( T_o \) on function result \( I_d \)); \( a_0 \) – free article (express the influence unreported factors in the model); \( \varepsilon \) – random variable (express the influence of changing production and sale conditions over time).

The knowledge of industrial dynamics could be used for the analysis of change at the national as well as at industry level. Therefore, the analysis of industrial dynamics turns back how the national resources are used in comparison with other nations or industry sectors.

To demonstrate how to use the tools of industrial dynamics we use data from one of the Bulgarian traditional industry sectors as the production of food and beverages.

2. Food and beverage development – Bulgarian case

To analyze the state of the food and beverage production in Bulgaria we need to set some basic points of view as follows:

- Period 1939 – 1944 – It’s characterized by the free market conditions. The national economy development is under the World War II conditions;
- Period 1944 – 1989 – It’s characterized by the central planning economic conditions. But Bulgaria is specialized in food production and exported food for the former Union of Mutual Economic Assistance and respectively for the CEE countries;
- Period 1989 – 2009 – – It’s characterized by restoring the free market conditions. Bulgaria became a EU member in 2007. But the overall economy conditions have been changing since 2008-2009 when the economic and financial crisis started.

The analysis is done at constant prices (prices in 1952) to prevent the influence of the money value change during the whole period. The main results are given by Fig. 1 and Fig. 2.

Some basic conclusion could be drawn as follows:

- The food production and turnover are changing and it’s easy to find some basic periods.
- The food production is growing function for a long-term period but there are some changes in point of the production dynamics as well as the development direction.
- The picture shows that the food production development has started a new life cycle from 2009.

The picture helps to find the following basic conclusions (Fig.1):
Three periods of food production development could be found as follows:

- **Production growth** – food production and turnover sustainably had been grown since the beginning of the 1970s. This is as a result of enlargement of food needs as well as the process of industrialization of the Bulgarian economy. We find a production and technological changes as the product restructuring of the food production.

- **Production stagnation** – the growth had been slowed down its development pace for the 1970s and 1980s. This is a result of the saturation of food needs as well as lack of food production changes.

- **Production level change** – the food production changed its level as a result of the economic and political changes in the beginning of the 1990s. After that we find out technological changes of food production that reflected on production growth for the first decade of 21st century. The free food market at EU level after 2000 has enlarged food exports as well as food imports.

The current pace of the production is comparable to the rate of change for the entire period. But the food production and turnover is at lower growth position compared to the previous (1939-1989) growth.

The current level of food production is estimated as the production level at the beginning of 1970s. The food sales are estimated as the sells level at the beginning of 1980s.

But **How has the dynamics of food industry been changed?** The picture (Fig. 2) shows that the industrial dynamics of food industry has been changing negatively:

- There is a steady decrease of the ratio of food production and turnover. This situation is characterized by relatively high loss of competitive advantage for a long-term period.

- There is a confirmation of the identified three periods of development of production and sales of food and beverages.

Fig. 1. Food and beverage production (left) and turnover (right) for 1939-2010

Fig. 2. Industry dynamics of food and beverage production for 1939-2010
This knowledge could help us to do a forecast of food and beverage production and sales development for the next 30 years, respectively for the years 2011-2045.

3. Perspective analysis of food and beverage development

On the basis of the perspective analysis we do two different forecasts:

- Pessimistic forecast is grounded on the perception that the economic cycle has two main stages – economic growth and economic recession. Therefore, the pessimistic forecast includes two periods with one and the same duration as follows: 10 years economic growth and 10 years economic turn-down.
- Optimistic forecast is based on the anticipation that the economic recession periods are shorter than the economic growth ones. So, the real economic development is achieved by 7 years economic recession vice versa 13 years economic upgrowth.

The forecast construction is made by analysis of the previous economic development as follows:

- The forecast is done by usage of natural logarithm function (Equation 2) (see Cramer J, 2003.)

Equation 2.

$$\log(Y) = \frac{\log(Y)}{1 - Y},$$

where $Y$ is the estimated function;

- The food and beverage development is found on the industry production and industry turnover for 1939-2010. The analysis excludes the period for 1939-1989 as a period of central planning economy system in Bulgaria. Therefore, the forecast anticipates economic recession period (1989-1999) as well as the economic growth period (1999-2009). So, it’s obvious that the new downgrowth period started in 2009.
- Six stages process is used for the recent forecast as follows (Fig. 3):

![Fig. 3. Forecast process’s stages and basic results at each stage](image-url)
a. Basic function description – The equation of the growth is returned at this stage. We use a linear function equation (Equation 3) as the economic change has just one way direction.

Equation 3.

\[ Y = a \cdot X + b \]

where \( Y \) is the estimated function; \( X \) is the number of the year at growth / recession; \( a \), \( b \) are the function parameters.

b. Basic function estimation – The forecast needs to construct growth / recession function for each period. The value of the parameter \( b \) gives the value of the economic measurements just before the estimated period, and the ratio \( b/a \) gives the rate of measurements’ changes.

c. Prediction of economic measurements – The preliminary value of economic function is turned back at this stage.

d. Constructing economic development – natural log values for each economic measurement are calculated. These values give the basic economic development picture.

e. Verification of the development functions – The time fit estimation is done at this stage. We confirmed the development function if the time fit is one and the same for each growth / recession period. If this condition is not fulfilled the stages from c. to e. are repeated.

f. Economic development perception – finally, the values of the economic function are set up. So, the forecast is finally done.

4. Food and beverage dynamics forecast

Food and beverage dynamics change in Bulgaria is done by doing all stages at Figure 4. The database is from the Bulgarian National Statistical Office (http://www.nsi.bg).

Some basic preconditions are set as follows:

- Two basic economic functions are studied:
  a. Production function of food and beverages
  b. Turnover function of food and beverages.

- The basic scenarios are perceived:
  a. Pessimistic one – economic turndowns periods between 2009-2019 and 2029-2039 as well as the economic growth periods between 2019-2029 and 2039-2045.
  b. Optimistic one – economic turndowns periods between 2009-2016 and 2029-2036 as well as the economic growth periods between 2016-2029 and 2036-2045.
  c. Expected scenario – it is set as 35 % probability of optimistic scenario and 65 % probability of pessimistic scenario.

- We use all of the economic measures at basic value. The basic year is 1952 for the production function as well as the turnover function.

- The process at Figure 4 is fulfilled just for illustration.

  a. Basic function description – the function estimation is done for the food production function (Fig. 4.)
b. Basic function estimation – the construction of the production function in Fig.4 has turned back the production time-fit as follows (Equation 4. And Equation 5):


Equation 5. Growth period (1999-2009) 

c. Prediction of economic measurements – for example the preliminary value of production function of food and beverage is given at Table 1. The preliminary functions for pessimistic forecast are set as follows (Equation 6. to Equation 9)


Equation 7. Growth period (2019-2029) 

Equation 8. Recession period (2029-2039) 

Equation 9. Growth period (2039-2045) 

Table 1. Preliminary values of production function (pessimistic forecast)

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d. Constructing economic development – natural log values give the basic economic productions’ development picture (Fig. 5 – left).

e. Verification of the development functions – gives the confirmation of the productions’ development function (Fig. 5 – right).
Fig. 5. Constructing the production development for period 1939-2045 (left) and verifying the development construction for period 2011-2045 (right)

f. Economic development perception – finally, the values of the production and turnover functions are set up as follows (Fig. 6 and Fig. 7.)

Fig. 6. Production function pessimistic forecast (left) and optimistic forecast (right)

Fig. 7. Turnover function pessimistic forecast (left) and optimistic forecast (right)
The industrial dynamics function of producing food and beverages in Bulgaria is done as well as pessimistic and optimistic scenarios (Fig. 8 – left) as the expected scenario (Fig. 8 – right).

Some conclusions could be drawn as follows:

a. The industry dynamic picture shows continuing the trend of the Bulgarian food production losses for the next 30 years. Therefore, the food turnover had to exceed the food production in Bulgaria.

b. There is a significant differentiation in industry dynamics value for pessimistic and for optimistic forecast. Even though, the Bulgarian food industry will lose more of ½ of its industrial competitive advantage.

c. The expected value of the industrial dynamics had to change with a trend that is very close to the trend of dynamic for 1999-2009. This result is a continuation of the opening of the food market at the EU level. Therefore the Bulgarian food industry had to keep its loss over the EU food producers.

d. By the middle of the 2040s the industrial dynamics of food production has to be stabilized at the level of 0.300 as a result of the fact that 1/3rd of consumed food shall be produced in Bulgaria.

The shown picture has to become true if the food industry continues to refuse product and technological restructuring in the near future. So we need to set that there are some basic economic conditions that could change the forecast as follows:

a. Some changes of the economy development of the country. This will change the economic cycle and could be a beginning of new recession stage irrespective of the stage before.

b. Some changes of common European policy especially directly connected to the food production and its quality level. This will change the quantity of export and import of the food trade.

c. Some changes of transport infrastructure. This will allow increasing the level of exported food at national recession periods as an anti-crisis instrument. So the variation during the economic stages had to depend on food production added value.

5. Conclusions

The analysis outcomes of the industrial growth of food and beverages sector are an illustration of the policy measures that have an influence on industrial development. The dynamics of the Bulgarian food and beverage industry shows continuing trend of production losses for the next 30 years. This means that
Bulgarian food industry is losing competitive advantages and has little perspectives for growth in a near future. Policy makers have to prioritize the importance of the food industry, as a traditional industrial sector. Regaining the positions of the past requires involvement of business in sectorial strategy development. A key factor for sectorial growth is the increase of investments, differentiation of product mix and implementation of innovations. Policy makers have to create favorable conditions for establishment of technological and trade alliances, networks and partnerships. This will help to divide the whole risk of investments in innovations and market efforts. There is a potential in the sector, but it needs specific exogenous conditions to flourish.

6. Reference

[1] Bresnahan T. and F. Malerba, Industrial dynamics and the evolution of firms and nations competitive capabilities in the world computer industry, 1997, paper;


