ANALYSIS OF SENTIMENT INDICATOR FOR THE EURO AREA (19 COUNTRIES) UNDER THE INFLUENCE OF FOUR MANAGEMENT INDICATORS USING GRAPHICAL REPRESENTATION

Margareta ILIE*

Abstract

The present paper reveals the second part of early research results obtained from the simulation of the annual sentiment indicator evolution under the influence of the production in industry, the intramural research and development expenditure, the turnover and volume of sales and the employment. The research uses for the process' simulation the three dimensional representation of the above indicators.
The main goal of the research is to be able to determine the four indicators hierarchically listed based on the influence of each indicator on the sentiment indicator evolution. The secondary objective is to compare if the previous results of the research, acquired through the use of artificial neural network simulation, determined the same hierarchy and influence of the four. The data used represent the values for the Euro area (19 countries) recorded between 2006 and 2016, provided by the Eurostat – from the European Commission statistical data website. The author considered that the initial 19 countries represent the most influential ones over the economy and, thus, over the economic sentiment evolution. The method uses the real data and MathCad software for the calculus of polynomial functions that governs the graphic representation of economic sentiment trend under the positive evolution of the each of the four influencer indicators. The polynomial function was chosen by the author because of the incipient phase of research and the trends evolutions.

Keywords: economic sentiment indicator, management indicators, 3d graphical representation

Introduction

Considering the present economic and social estate of the European Union, the author considers that an analysis and a simulation of certain economic indicators with the use of modern techniques is essential for the future decisions.

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ISBN 978-606-714-502-1 | ISSN 2393-2384 | ISSN-L 2392-8867

In the academic literature, as Barsky (2012, p. 1362) there are two main opposing approaches: the "information" vision, which proposes that confidence indicators contain information about future economic developments, and about "animal spirits" vision, which states that independent deviations in principles have causal effects business cycles. Both visions: information and animal spirits can yet be compatible with the properties of the leading confidence indicator, but only the latter would involve causality. Empirically, however, the conclusions persist to be unclear. At one of the extreme, it is demonstrated that there are trusted confidence measures that have both predictive power and a role in understanding fluctuations in the business cycle. At the other extreme, some research concludes that the concept of trust does not play an important role in macroeconomics (European Central Bank, 2013, p. 46).

As Martináková and Kapounek (2013, p. 2491) said that the Economic sentiment is not fully appreciated or embedded in economics. However, controversial economists such as Keynes or Minsky puts a great emphasis on sentiment changes to explain fluctuations in the business cycle, but their ideas have not been entirely respected by mainstream economics. Modern economy is increasingly focusing on the perception and anticipation of economic agents, in particular with regard to the effects of the information on economic activity and fluctuation in asset prices.

The 2009-2012 financial and economic crisis and the present situation especially on the stock exchange markets evoke these ideas back onto the discussions. As stipulated by van Aarle and Kappler (2012, pp. 1-2) a solid decline in economic sentiment surely contributed to the magnitude and quickness of the outburst of financial turmoil succeeding the collapse of Lehman Brothers and the following economic slowdown. They also stipulated that if economic sentiment weakens, first modification that agents usually make is to slow down spending and move from risky assets to money, firms may stop hiring and delay capital investment. Output falls and unemployment rises. Instead, as economic agents become more conscious of financial turmoil, economic slowdown and hostile unemployment dynamics – though they are not straight affected – they are likely to revise downward economic sentiment, adding momentum to the slowdown.

In their book "*Animal Spirits. How Human Psychology Drives the Economy, and Why it Matters for Global Capitalism*" Akerlof and Shiller (2010) present the role of "animal spirit" during the financial crisis and the development of the notion. In their approach, animal spirits are related to confidence, fairness, corruption and bad faith, money illusion and stories. Alterations in these characteristics can push towards changing in animal spirits and economic sentiment in overall. Cycles of over-optimism and over-pessimism by economic agents may then be (speculative) going to boom-bust cycles along the panic lines and Minsky's mania (Aarle and Kappler, 2012, p. 2). The traditional macroeconomics would typically overlook these more psychological features and their effects on business cycle oscillations.

We suppose that if consumers and entrepreneurs respond positively to the news and feel confident about the current and future economic situation, they could increase their consumption and production. If so, they use the perceptions and expectations in affecting their economic behaviour.

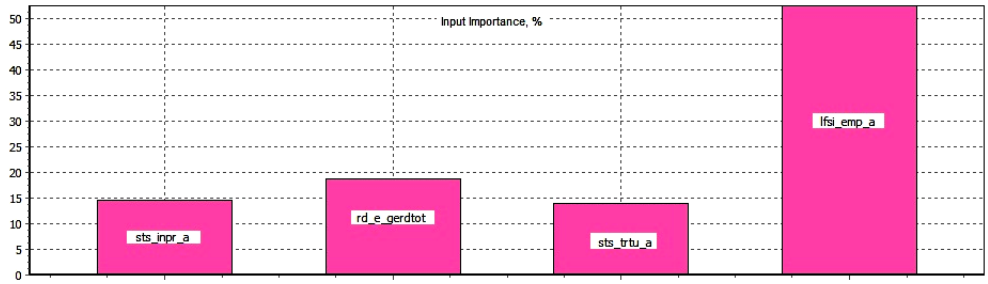
In the first phase of the research the following objectives were achieved:

- Using 17 records (13 records to Training set (76.47%), 2 records to Validation set (11.76%), 2 records to Test set (11.76%)) the data covers the influence of the Eurostat statistical data about*: Volume index of production*, *Intramural R&D expenditure*, *Index of deflated turnover* and *Employment and activity* over the evolution of Economic sentiment indicator, from 1999 to 2016;
- The influence was considered for the next year for the economic sentiment indicator;
- An artificial neural network was built with the following specifications: 4-9-6-1: 5 layers with 4 neurons in the input layer (the number of input indexes), 15 neurons in 2 hidden layers (first with 9 neurons, second with 6) and 1 neuron in the output layer (the neuron for the economic sentiment indicator);
- The ANN was a feedforward one and the training algorithm was Fahlman's quick propagation, with modification of the activation functions like: hyperbolic tangent function for hidden layers activation and logistic function for output layer;
- The result of the training was more than satisfactory in regards of the defined objective of the research: Train error = 0.099; Validation error = 3.035102; Test error = 9.9675;
- Also a query testing was made for the prediction of economic sentiment indicator for 2004 considering the other 4 indicators value from 2003. The result of this test was: absolute difference was -1.94 and the relative difference was 2.02%.

Taking into account all the above results and looking at all the goals defined at the beginning of the research we can certainly say that all the objectives of the first phase were achieved. The results of the training, testing and query were more than satisfactory even that for the accomplishments of those made the research tough and extensive.

Also in the first stage, the results of the artificial neural network process of training developed the contribution of each input column (that contains the 4 indicators *Volume index of production*, *Intramural R&D expenditure*, *Index of deflated turnover* and *Employment and activity*) to the neural network performance. This parameter is called *Input importance* and it is calculated using sensitivity analysis techniques. The input importance is showed in Figure 1 and detailed in Table 1.

Figure 1. Input importance after training process



Source: Author's graphic representation using Alyuda NeuroIntelligence.

Table 2. Input importance

Input column name	Importance, %
sts_inpr_a	14.60583
rd_e_gerdtot	18.848676
sts_trtu_a	14.005347
lfsi_emp_a	52.540147

Source: Author's representation; the abbreviations used are presented below.

This input importance was used for the present phase of the research and is one of the subjects for present paper, being analysed for the determination of a hierarchy of indicators considered from the influence over the economic sentiment indicator. In the present phase the author will verify this hierarchy and hypothesis will be made in order to explain the hierarchy.

The use of software programs in the analysis of data is not new and even more, along the years the field became more important and more extensive. In the last years we talk about Big Data as the only way we can comprehend the large amount of data that govern every aspect of our life. When we are talking about big data we refer also to processing techniques addressing, but not limited, to various BI (business intelligence) requirements, like: reporting, batch analytics, online analytical processing (OLAP), data mining, text mining, complex event processing (CEP) and predictive analytics.

Graphical representations for data analysis is used by the most known IT companies, like IBM System G (G stand for graphs) that is a comprehensive set of Graph Computing Tools, Cloud, and Solutions for big data[1]. IBM System G can be used in many cases such as social network analysis, anomaly detection, smarter commerce, smarter planet, cloud, telecomm, etc. Among other tools it includes:

[1] Read more on http://systemg.research.ibm.com/.

Graph Visualizations - following complex graphs and networks to facilitate graph data exploration and analysis:

- Visualization of Huge Graphs: Visualization of Huge Graph based on Hierarhical Clustering, Static Graph Visualization and Analysis;
- Visualization of Mulitivariate Graphs: Visual Analysis of Multivariate Graphs and Multidimensional Clusters;
- Visualization of Hetergenous Graphs: Visual Analysis of Hetergenous Document Networks
- Visualization of Dynamic Graphs: Information Flow Modeling in Social Network
- Visualization of Static Graphs: Ego Network Visualization, Graph Layout Transition.

As previous researches displays (Ilie *et al.*, 2017, p. 533), function modelling can be used to calculate a hierarchy influence from some indicators or parameters on another indicator or parameter. There are few researches that consider the present paper approach, especially because of the difficulty to obtain and use the mathematical function necessary to build an accurate graphical representation.

The importance of research results from the possibility to analyse and define a hierarchically listed indicators that influence the evolution of sentiment indicator, starting in the present paper only with four. Also the author uses specialised software in order to determine mathematical function for their implementation in building three dimensional representation of the indicators' evolutions. The representation and the hierarchy can be used thinking about the micro- and macro-economic and social decisions that influences the evolution of economic sentiment under the impact of various factors, so that can the European countries to cover economic and social needs.

The importance of the paper emerges from the need to know the evolution of economic sentiment indicator in order to take the best management decision regarding the action that must be taken for the growth of the trust in the economy in in its whole.

Data

Several indices were considered for the analysis.

Volume index of production - sts_inpr_a, (Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply), calendar adjusted data, not seasonally adjusted data, [Index, 2015=100]. The industrial production index (abbreviated IPI and sometimes also called industrial output index or industrial volume index) defined by Eurostat is a business cycle indicator which measures monthly changes in the price-adjusted output of industry. The index of industrial production measures the evolution of the volume of production for industry excluding construction, based on data adjusted for calendar and

seasonal effects. Seasonally adjusted euro area and EU series are calculated by aggregating the seasonally adjusted national data. Eurostat carries out the seasonal adjustment of the data for those countries that do not adjust their data for seasonal effects (Grandovska, 2018, p. 2).

The volume index of production (*sts_inpr_a*) defines the volume variation of goods and/or services produced in a certain amount of time. Its main goal is to provide a measure of short-term changes in value added over a given reference period. But, because it is difficult to gather high frequency data to precisely measure value added, gross outputs measures such as production value or turnover data are more frequent used. sts_inpr_a being a volume index one can see that the index is not influenced by the price fluctuations (United Nations Statistics Division, 2010, p. 12).

The index *sts_inpr_a* is an important short-term economic indicator in official statistics. Is an important indicator *per se* as well as in comparison with or in combination with other short-term indicators to evaluate the performance of an economy. The index *sts_inpr_a* is also in some countries a key contributor to the volume calculation measures as part of the quarterly national accounts.

Production indices for the industrial sector are used as the key short-term economic indicator due to the impact that industrial activity fluctuations have on the rest of the economy in many countries. The accessibility of production indices and the close relationship between variations in the level of industrial production and economic cycles ease the use of production indices as a series of references for determining or forecasting turning points in business cycles. Therefore, a benefit of the production index related to other indicators is its mixture of high frequency, rapid availability (relative to economic sentiment indicator, for example) and a detailed analysis of its activity.

Intramural R&D expenditure - *rd_e_gerdtot*, by sectors of performance, all sectors (Euro per inhabitant). As defined by Frascati Manual (2002, p. 208), the Intramural expenditures are all expenditures for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds.

Funding of Research and Development (R&D) is extremely mixed across countries and inclines to modification over time. The stimulating consequence of R&D funding fluctuates with respect to its generosity: it rises up to a certain threshold and then declines beyond (Guellec and Pottelsberghe De La Potterie, 2010, p.231). However, we also believe that the negative effect of university research is diminished when government funding for R&D in business grows. The targeted government programs are likely to help firms consume the information and knowledge produced by universities.

Also we have to remember that, as Yegorov (2013) said, R&D expenditure is the resources actually spent on R&D activities, rather than only budgeted. He also presented the full procedure for measuring expenditures:

- Detect intramural expenditure on R&D performed by each statistical unit;
- Identify the sources of funds as stated by the performers;
- Aggregate the data by sectors of performance and sources of funds to derive significant national totals;
- Optional: Identify the extramural R&D expenditures of each statistical unit.

Sources of R&D expenditure must rely on criteria for identifying flows of R&D funds: there must be a direct transfer of resources and the transfer must be both intended and used for the performance of R&D. Separation for the R&D sources must be done for determining the following group classification: institutional classification, type of activity, fields of science and socio-economic objective. The sources of R&D must be subjected to institutional classification (Yegorov, 2013):

- Business enterprise:
  - Includes private non-profit institutions mainly serving business;
  - Includes public enterprises;
- Government:
  - Includes private non-profit institutions mainly serving government;
  - Excludes public enterprises;
- Higher education:
  - Includes clinics operating under the direct control of or administered by or associated with higher education institutions;
- Private non-profit:
  - Includes private individuals or households;
- Abroad (only as source of fund):
  - Includes international organisations (except business enterprises) within the country's borders.

Considering the type of activity one can divide the R&D in: basic research, applied research and experimental development.

The Index of deflated turnover - sts_trtu_a, wholesale and retail trade and repair of motor vehicles and motorcycles, calendar adjusted data, not seasonally adjusted data, (Index, 2010=100). It is the objective of the turnover index to show the development of the market for goods and services.

Turnover comprises the totals invoiced by the observation unit during the reference period, and this corresponds to market sales of goods or services supplied to third parties. Turnover also includes all other charges (transport, packaging, etc.) passed on to the customer, even if these charges are listed separately in the invoice. Turnover excludes VAT and other similar deductible taxes directly linked to turnover as well as all duties and taxes on the goods or services invoiced by the unit.

The indices of domestic and non-domestic turnover require turnover to be split according to the first destination of the product based on the change of ownership. The destination is determined by the residency of the third party that purchased the goods and services. Non-domestic turnover is further sub-divided

into turnover despatched to euro-zone countries and all other non-domestic turnover (Eurostat). The turnover is a "preferred method" which deflate gross turnover by relevant price indices.

Employment and activity by sex and age - annual data - lfsi_emp_a, from 15 to 64 years, [thousand persons, total]. Employment by industry is broken down by agriculture, construction, industry including construction, manufacturing and services activities. This indicator is seasonally adjusted and it is measured in thousands of people (OECD, 2018). The active population, also called labour force, is the population employed or unemployed (Eurostat).

Economic sentiment indicator - ei_bssi_m_r2, seasonally adjusted data, not calendar adjusted data. The economic sentiment indicator (abbreviated as ESI by the European Commission) is a composite indicator made up of five sectoral confidence indicators with different weights: industrial confidence indicator (40 %); construction confidence indicator (5%); services confidence indicator (30%); consumer confidence indicator (20%); retail trade confidence indicator (5%) (Eurostat).

Every month, the European Commission publishes the European economic sentiment indicator.

Very well presented by Gelper and Croux (2010, p. 2) the economic sentiment indicator is a survey-based indicator that seeks to understand the beliefs of economic agents, both on the demand side and on the supply side of the economy. If consumers and producers feel confident in the current and future economic situation, consumption and production could increase accordingly with their actions. Furthermore, sentiment data provides new information because it is available earlier than most economic indicators, such as GDP or industrial output.

These reasons, along with the growing integration of the European market, have motivated us to study whether we can use new techniques for the forecast (artificial neural networks) and evaluation of the influences that others economic indicators can have over the economic sentiment indicator (3D graphic analysis). This technique can be informative for the current and future state of economic activity in Europe and its nations.

The purpose of constructing an aggregate indicator is to summarize the information contained in a large number of series into one single indicator series. The data for building an EU aggregate sentiment indicator is based on studies conducted in all Member States of the European Union. There are four business studies (surveys) for the industrial sector, services, construction and retail and a consumer survey. For each country, a subset of 15 questions from these surveys is used to build economic sentiment indicator, resulting in a large number of series of sentiments. The component weights are based on intuitive economic reasoning.

The use of the four business surveys may offer different responses and results from country to country or form region to region. Like in Finland, Kangasniemi *et al*. (2010) study the differences between consumer and

manufacturing surveys. The study did not find any systematic clash among consumer surveys and manufacturing surveys. Though, they debate that consumer surveys collect information from both the personal economy and the macro economy. They display that the consumer confidence indicator is more anticipative and is also based on a general sentiment and spirits plus economic intentions.

The predictive power of sentiment studies is discussed in many research. For example, Slacalek (2005), who applies a dynamic factor model to Michigan sentiment survey components. The resulting factors are found to be a steady predictor of US consumption growth. Another study of sentiment indicators is developed by Hansson *et al*. (2005), which researches the performance of forecasting data from the business survey in Sweden. They used a dynamic factor model and find more than acceptable results for forecasting the growth of GDP.

As one can see the author use the Eurostat code for each of the indicators for an easier tracking and authentication of the values.

The author considered the data for the Euro area (EA19) which includes Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Austria, Portugal, Slovenia, Slovakia and Finland. The reasons for this choice are that the EA19 are the most influential countries for the Europe economy in terms of industry, constructions, retail and services and because the data are reliable and easy to find and verify, than the ones from younger European Union countries. The values cover the period between 1999 and 2016, the main sources of the data values is the Eurostat[2] – the statistical office of the European Union. Thus, the data are reliable.

Method

In order to determine the function which governs the trend of economic sentiment indicator under the influence of the each of the 4 indicators, the author used Mathcad software. Here the values of the 5 indicators were included in vector forms and function were defined to which the free terms were calculated using the Mathcad Minerr command. In table 2 an example is revealed for the use of the software in order to determine the mathematical function which governs the trend of economic sentiment indicator (ei_bssi_m_r2) under the influence of volume index of production (sts_inpr_a) for mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply.

[2] More information at: http://ec.europa.eu/eurostat.

Table 2. Mathcad example for function calculus for the sts_inpr_a

d:=0	e:=0	f:=0	g:=0	Given
sts_inpr_a := (89.8 90.3 95.2 95.3 95.7 95.7 96.2 96.4 97.1 97.4 97.8 99.4 99.5 100.0 101.6 103.4 105.4 107.3)		$ei\_bssi\_m\_r2$:= (93.51 105.9 106.9 102.4 115.98 95.98 78.87 89.56 101.56 92.78 94.67 100.98 102.92 100.88 103.64 99.85 110.18 107.83)		$d \cdot p^3+e \cdot p^2+f \cdot p+g=q$ Minerr(d,e,f,g) = ($2.412 \cdot 10^{-3}$ -0.633 54.833 $-1.468 \cdot 10^3$)
ei_bssi_m_r2(sts_inpr_a):=$2.421 \cdot 10^{-3} \cdot p^3-0.633 \cdot p^2+54.833 \cdot p-1.468 \cdot 10^3$				
sts_inpr_a:=89..108				

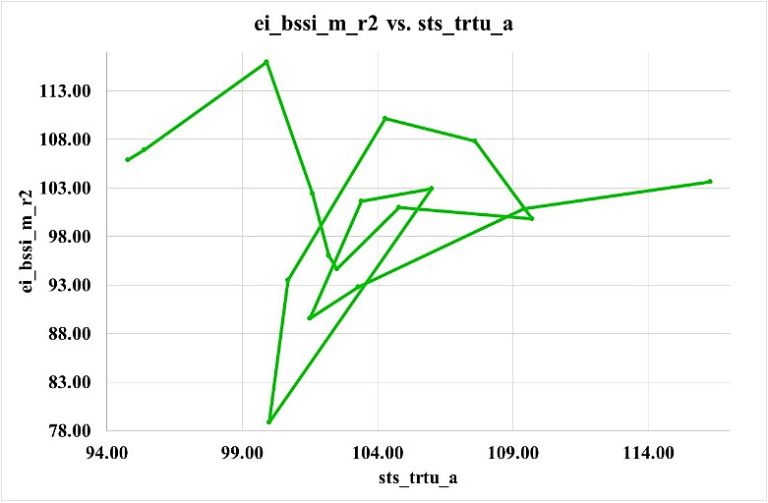
Source: Author's representation.

Using the example from table 2 the following function for each of the 4 indicator were calculated:

- For sts_inpr_a indicator: $f^{(3)} = 2.412 \cdot 10^{-3} \cdot p^3 - 0.633 \cdot p^2 + 54.833 \cdot p - 1.468 \cdot 10^3$, for indicator values [89; 108];
- For rd_e_gerdtot indicator: $f^{(3)} = 1.434 \cdot 10^{-6} \cdot r^3 - 1.966 \cdot 10^{-3} \cdot r^2 + 0.827 \cdot r - 2.353$, for indicator values [372; 675];
- For sts_trtu_a indicator: $f^{(2)} = 0.05 \cdot t^2 - 10.275 \cdot t + 627.01$, for indicator values [94; 117];
- For lfsi_emp_a indicator: $f^{(3)} = 3.1767 \cdot 10^{-11} \cdot m^3 - 1.281 \cdot 10^{-5} \cdot m^2 + 1.72 \cdot m - 7.68 \cdot 10^4$, for indicator values [127756; 144645].

By the influence of the indicators over the economic sentiment indicator the author means how the ei_bssi_m_r2 trend evolve for each of the indicators. Considering the real data downloaded from Eurostat website. One example of this evolution is presented in figure 2 – yearly evolution of ei_bssi_m_r2 against the yearly evolution of ei_bssi_m_r2. We must remember that the evolution for ei_bssi_m_r2 is delayed by one year.

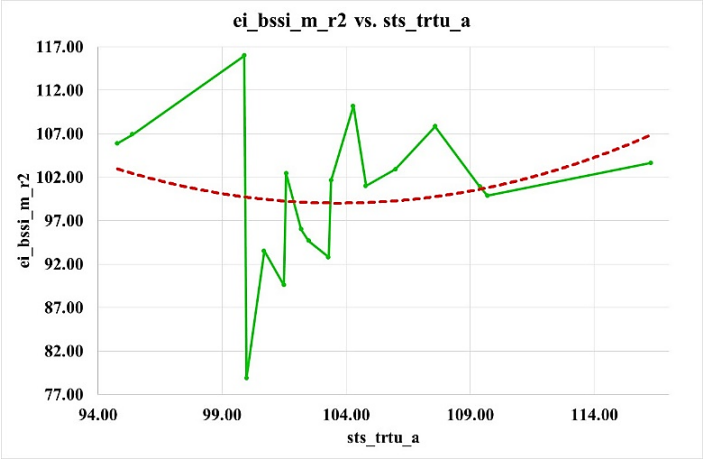
Figure 2. Economic sentiment indicator yearly evolution against the yearly evolution of index of deflated turnover



Source: Author's representation.

Analysing figure 2 is very hard to determine a logical evolution of ei_bssi_m_r2 and adding a trend to that graph will be irrelevant for almost any kind of analysis.

Figure 3. Economic sentiment indicator yearly evolution against the yearly evolution of index of deflated turnover. Smallest to largest values reordered by the sts_trtu_a.

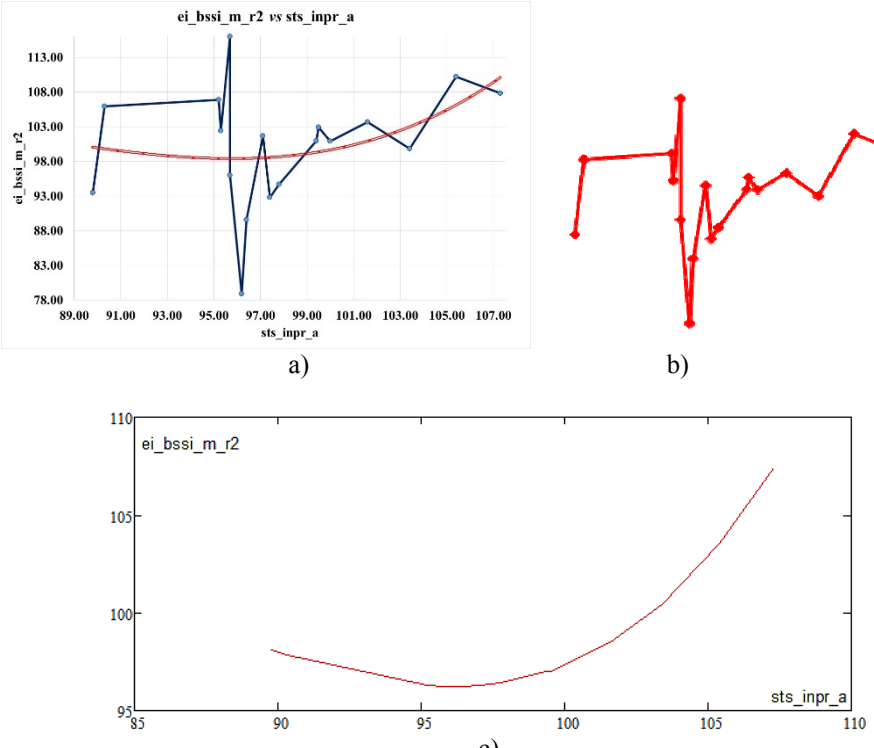


Source: Author's representation.

For the possibility to read and understand how the sts_trtu_a influence the evolution of ei_bssi_m_r2, authors use the Sort command from Microsoft excel and rearranged the values of both indicators considering the smallest to largest values reordering of sts_trtu_a. The result of the new graphical representation is presented in figure 3. Also, the new graphical representation allows to add the trend for the reorganised evolution.

Being of the most importance for the method used in the present paper, the graphical representation must be accurate. In order to verify the representation in Mathcad (graphical representation based on the indicator values), another simple image was created in Microsoft Excel and the two were compared. In figure 4 one can see in 4.a) the Excel image and in 4.b) the graphical representation created in Mathcad. It can be easily observed that the two are identical, which means that the values for the ei_bssi_m_r2 and sts_inpr_a were proper implemented.

Figure 4. 2D graphical representation of the ei_bssi_m_r2 variation under the influence of sts_inpr_a evolution: a) representation of evolution and trend; b) representation of evolution; c) representation of trend after the calculus of function.

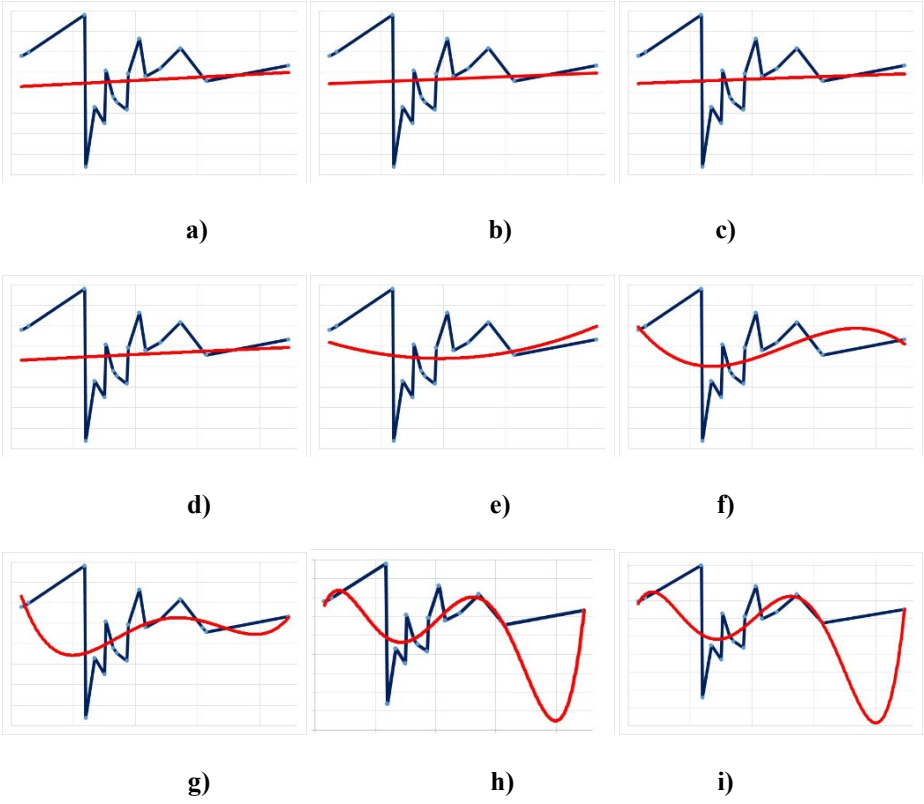


Source: Author's representation.

Also in figure 4.a) the trend of economic sentiment indicator is added to the graphic. The reason emerges as the author created in Mathcad a trend for the same data, in figure 4.c). But we must have in mind that the Mathcad representation of ei_bssi_m_r2 trend under the influence of sts_inpr_a is made after the calculation of the mathematical function that govern this influence. Thus the importance that the two representations must be at least similar to each other.

Regarding the mathematical functions that govern the graphical representation of the ei_bssi_m_r2 against each of the 4 indicators, the choice of function formulas was made considering their form representation on the graphics. For better explanation the example of sts_trtu_a is presented in figure 5, where 9 graphics represent 5 types of mathematical function as there were used for the trend design.

Figure 5. Example of different function representation for indicator ei_bssi_m_r2 evolution against sts_trtu_a: a) exponential function; b) linear function; c) logarithmic function; d) power function; e) polynomial function order 2; f) polynomial function order 3; g) polynomial function order 4; h) polynomial function order 5; i) polynomial function order 6; (in blue the ei_bssi_m_r2 e, in red the trend).



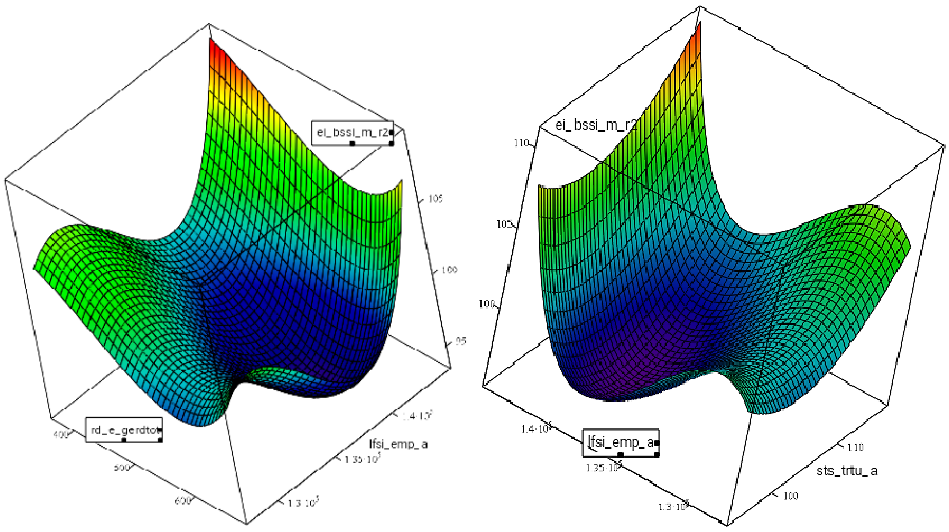
The 5 mathematical function are: exponential, linear, logarithmic, polynomial (order 2 to 6) and power. It must be highlighted that the example is elaborated in Microsoft excel, and even it not may be the best software for mathematical determination of functions, it served only as tool for showing the reasons for the choice of functions formulas.

Examining the graphs from figure five one can conclude the following:

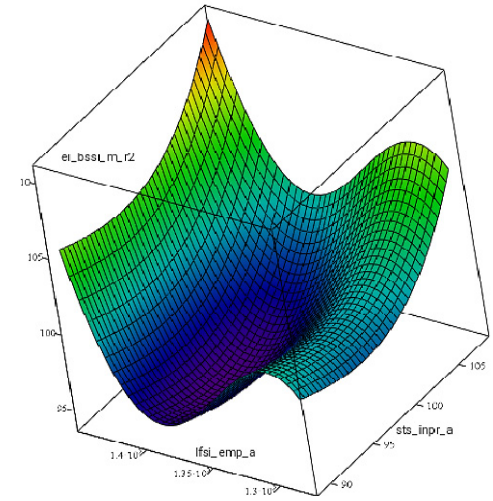
- The exponential function; b) linear function; c) logarithmic function; d) power function have almost the same form that is almost flat linear and because of this was not considered by the author as suitable, considering the inflexion point seen on the graph;
- The only formulas that can be applied is polynomial function with order 3 (and in the case of sts_trtu_a with order 2) because the other orders distort the trend significantly, for example in figures 5.h) and 5.i) the trends are distorted close the end.

The representation of 3D response surfaces is found in figure 6.

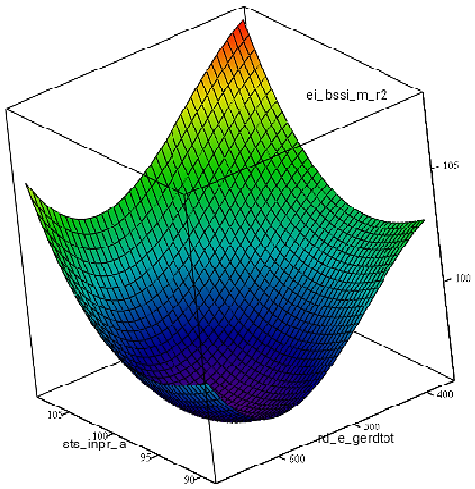
Figure 6. 3D graphical representation of the ei_bssi_m_r2 variation under the influence of the following parameters, considered two by two: a) lfsi_emp_a & rd_e_gerdtot; b) lfsi_emp_a & sts_trtu_a; c) lfsi_emp_a & sts_inpr_a; d) sts_inpr_a & rd_e_gerdtot; e) sts_inpr_a & sts_trtu_a; f) sts_trtu_a & rd_e_gerdtot.



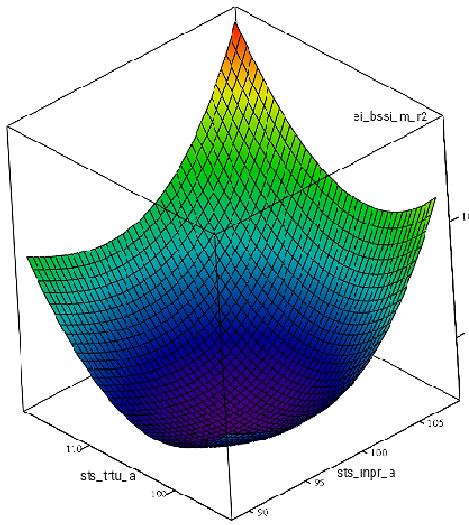
a) b)



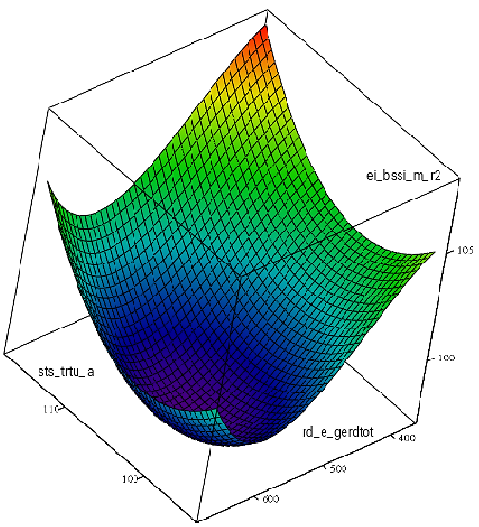
c)



d)



e)



f)

Source: Author's representation.

In order to analyse and compare the influence of each of the 4 indicators over the economic sentiment indicator author followed just two criteria:

- How steep the trend of the ei_bssi_m_r2 is against the evolution of certain indicator. The more abrupt the trend is, the more influential the indicator is. So comparing the influential of 2 indicators, the author considered more

influential the one determining the more abrupt trend of the economic sentiment indicator;

- It is more influential the indicator which have more inflexion point on the trend of the ei_bssi_m_r2.

In table 3, author indicate how the influences were considered for each of the indicators while they are compared. The explanation of the table is: each of the 4 indicators from the first row is compared to each of the indicator from the first column of the table. For easier presentation, and in order to be read more easily, only situation with the influence "higher than" were revealed in the table.

Using the above mentioned criteria and viewing each of the six 3D graphics from figure 6, and also considering the elaboration of a table that can explain the determination of the level of influence (table 3), the following notes can be written:

- In figure 6.a) - ei_bssi_m_r2 against lfsi_emp_a & rd_e_gerdtot: *indicator lfsi_emp_a has much more influence over the ei_bssi_m_r2 than rd_e_gerdtot*, considering that lfsi_emp_a has 2 inflexion points determined in the trend of ei_bssi_m_r2 and this trend evolution has much bigger value modification in the case of lfsi_emp_a than the rd_e_gerdtot;
- In figure 6.b) - ei_bssi_m_r2 against lfsi_emp_a & sts_trtu_a: *indicator lfsi_emp_a has much more influence over the ei_bssi_m_r2 than sts_trtu_a*, considering that lfsi_emp_a has 2 inflexion points determined in the trend of ei_bssi_m_r2 and this trend evolution has much bigger value modification in the case of lfsi_emp_a than the sts_trtu_a;
- In figure 6.c) - ei_bssi_m_r2 against lfsi_emp_a & sts_inpr_a: *indicator lfsi_emp_a has much more influence over the ei_bssi_m_r2 than sts_inpr_a*, considering that lfsi_emp_a has 2 inflexion points determined in the trend of ei_bssi_m_r2 and this trend evolution has much bigger value modification in the case of lfsi_emp_a than the sts_inpr_a;
- In figure 6.d) - ei_bssi_m_r2 against sts_inpr_a & rd_e_gerdtot: the evolution of ei_bssi_m_r2 trend is very similar in the case of sts_inpr_a and rd_e_gerdtot. There is no indicator from the two that has more than one inflexion point. The only difference is that *rd_e_gerdtot has a very small advantage in influencing the trend than sts_inpr_a*, just determining the a little more decline in the ei_bssi_m_r2 trend;
- In figure 6.e) - ei_bssi_m_r2 against sts_inpr_a & sts_trtu_a: again, the evolution of ei_bssi_m_r2 trend is very similar in the case of sts_inpr_a and sts_trtu_a. There is no indicator from the two that has more than one inflexion point. The only difference is that *sts_trtu_a has a very small advantage in influencing the trend than sts_inpr_a*, just determining the a little more decline in the ei_bssi_m_r2 trend;
- In figure 6.f) - ei_bssi_m_r2 against sts_trtu_a & rd_e_gerdtot: also almost the same as above 2 situations, evolution of ei_bssi_m_r2 trend is very similar in the case of rd_e_gerdtot and sts_trtu_a. There is no indicator from the two that

has more than one inflexion point. The only difference is that *rd_e_gerdtot has a very small advantage in influencing the trend than sts_trtu_a*, just determining the a little more decline in the ei_bssi_m_r2 trend.

The result of the above analysis is concluded in table 3.

Explaining the manner the table was elaborated the author present the following example of reading: Considering one of the indicators from the first row from the table 3 - rd_e_gerdtot – we compare the influence of this indicator against each of the other 3 indicators from the first column of the same table (sts_inpr_a, sts_trtu_a, lfsi_emp_a). So, looking at the figures 6.a), 6.d) and 6.f) and considering the two criteria defined above in the paper we can say that rd_e_gerdtot has a smaller influence than the lfsi_emp_a over the evolution of ei_bssi_m_r2.

Table 3. The comparison of the 4 indicators influence over the evolution of the bssi_m_r2

Indicators	sts_inpr_a	rd_e_gerdtot	sts_trtu_a	lfsi_emp_a	Level of influence
	Comparison of the above row with the first column:				
sts_inpr_a		=<	=<	<<	IV
rd_e_gerdtot				<	II
sts_trtu_a		=<		<<	III
lfsi_emp_a					I
No. indicators that are less influential than the one presented in the first row of the table (on each column)	0	2	1	3	
Legend: =< - almost equal, but with a small advantage than … < - more influential than … << - much more influential than …					

Source: Author's data representation using Microsoft Excel.

This is way in table there is no mark corresponding to the rd_e_gerdtot column and lfsi_emp_a row, having in mind that the author decided to highlight only the influence "higher than". If we consider rd_e_gerdtot and sts_trtu_a and we are looking at figure 6.f), again bearing in mind the criteria, we can see that the evolution of ei_bssi_m_r2 is slightly more influenced by the rd_e_gerdtot than the sts_trtu_a. Thus, to the intersection of rd_e_gerdtot column and sts_trtu_a the sign "=<" was introduced

The author now can finalize the hierarchical list of the influences of the 4 indicators over the economic sentiment indicator. Considering that lfsi_emp_a has 3 cells with more influential conclusion, which shows that it is more influential

than all others 3 indicators, and, thus it has level 1. Also one can see that is the only one which have 2 inflexion point on bssi_m_r2 trend. Further the rd_e_gerdtot is more influential than 2 others indicators (of course it is not more influential than lfsi_emp_a) and has level 2. The sts_trtu_a indicator is more influential than just one other indicator, sts_inpr_a, which is the indicator with all influences smaller than all other 3 indicators. So the final hierarchy is:

level 1. lfsi_emp_a - Employment and activity;
level 2. rd_e_gerdtot - Intramural R&D expenditure;
level 3. sts_trtu_a - Index of deflated turnover;
level 4. sts_inpr_a - Volume index of production.

The hierarchy emphasize that the "animal spirit" is the one that influence the most the economic sentiment indicator and it does it at a great distance than the other 3 indicators considered in the present work. So, the way that the economy is evaluated is strongly regarded from the point of view of the welfare of the individual, like Employment and activity indicator. The intramural R&D expenditure even that comes far behind the Employment and activity, explain the need to find new technologies and knowhow in order to give the reason to believe in a strong economy by the means of future assurance of better life.

The last two indicators Index of deflated turnover and Volume index of production, which are almost equal in level, show through their positioning to other two the impression to the public as a background activity, which are left to be evaluated more by the specialists or specialized techniques and are less viewed as indicators (activities) with direct action and results on everyday life.

Consider the result of artificial neural network about the importance that for the 4 indicators, a comparison between the two techniques used is presented in table 4.

Table 4. Comparison between the results of hierarchy determined by the artificial neural network and by the 3D graphics analysis.

Tehniques		Artificial neural network	3D graphics analysis	Checking
Hierarchy	1.	lfsi_emp_a (52.544%)	lfsi_emp_a	√
	2.	rd_e_gerdtot (18.85%)	rd_e_gerdtot	√
	3.	sts_inpr_a (14.61%)	sts_trtu_a	X
	4.	sts_trtu_a (14.00%)	sts_inpr_a	X

Source: Author's representation.

Observing table 4 one can say that the artificial neural network found almost the same result as the 3D graphics analysis. The top two places in the leader board are occupied by the same indicators and, even more, so the gap between the first place and the second is also very good determined through the simulation. The only error comes from the switching between the last two indicators. But the ratio

difference calculated by the artificial neural network for the two indicators and the difference determined by the 3D graphics analysis for the same indicators are so small that determined the author to consider that the both results are acceptable, even that are not the same. If we must choose between the two techniques for awarding the "honesty award", hardly the author must choose the result calculated by the artificial neural network and this only on the grounds that the index of deflated turnover is in way a result of volume index of production. This made the production more direct (in the first steps of economy) involved in determining the result of economy.

Conclusions

The present paper had the objective to reveal the results of a research divide in two phases. The first phase of the research, presented in another paper, considered the training of an artificial neural network in order to simulate and finally to forecast the evolution of the 5 indicators presented above. The results of the second phase of the research was indicated in the present paper and contain the hierarchical representation of influences of for 4 indicators over the economic sentiment indicator. The hierarchy was obtained with the use of 3D graphic analysis for the trend evolution of the economic sentiment indicator against the 4 indicators, used two by two, and based on function calculated by the author with Mathcad software.

The result of the graphical analysis offered a hierarchy in accordance with the theory of "animal spirit" considering the most important indicator that influences the economic sentiment indicator to be the Employment and activity indicator, far in front of the other 3 indicators. The other 3 in order of their level were: Intramural R&D expenditure; Index of deflated turnover and Volume index of production (the last two almost at the same level of influence over the economic sentiment indicator).

As last objective of the research the result of the artificial neural network importance (that also hierarchize the 4 indicators) was compared with the 3D analysis hierarchy. The results were almost identical in the terms of hierarchy and differences between the ratios of influence. The only difference between the results of the two techniques was the changing with one another at the last two indicators from the hierarchy: Index of deflated turnover and Volume index of production. But the ratio difference calculated by the artificial neural network for the two indicators and the difference determined by the 3D graphics analysis for the same indicators are so small that determined the author to consider that both results are acceptable, even that are not the same.

The future research should consider the adding of more indicators in the analysis and increasing the time period for which research will be done.

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