DIRECTIONS FOR IMPROVING EFFICIENCY OF KNOWLEDGE USE IN MODERN ECONOMY

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Abstract: *Currently, any country that does not progress in the research and development field is regressing economically and socially. Romania, in order to advance in the scientific field to the level of other EU countries, it must make considerable efforts by developing and applying future sciences. It is necessary to motivate activities of innovation and to encourage private capital in the research and development field.*

Keywords: knowledge, research and development, efficiency, artificial intelligence, innovative products.

1. Introduction

Knowledge is needed to generate ideas. Knowledge, however vast, does not have efficiency. Only knowledge generated products, under certain conditions, may have economic, ecological, social, military, political efficiency. The “knowledge efficiency” allegation, in our view, is questionable.

Since 2002 in the European Union all knowledge creation and usage activities are coordinated by programs (plans). The first program took place between the years 2002-2006, the second - between the years 2007-2013 and now the program Horizon 2020 is running, which, as the name indicates takes place between 2014-2020.

The research - development field ensures driving forces of economic growth. The EU economy, including national economies, transforms into a multi-structural system under the impact of scientific research results and

inventions [6 p.383]. The intellectual development of the society is the most powerful productive force.

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Intellect, according to DEX, [2 p.497], represents the ability to think, to know, to have a rational activity, to operate with concepts, mind, thought, reason. What the intellect produces, respectively – ideas, these are called intellectual products. *Intelligence* is the ability to understand easily and well, to notice what is essential, to solve new problems or situations based on previous experience. *Artificial intelligence* is the ability of advanced technical systems to obtain quasi-human performances. In this context, the products created by intellect, intelligence (ideas, knowledge, innovations etc.) are “intellectual products” or “smart products”.

Throughout economic history, a country could become a developed country if it had natural resources, favorable geographic location and climatic conditions. Currently, a country like Romania will become rich only if that wealth consists of "ideas" [1 p.114.]. There is a list of main factors that may contribute to the development of Romania, a list that includes, in our assessment, the following:

1. Levels of uncertainty for possible directions of basic, applicative scientific research of innovations and their uses in creating new technologies (X1).

2. The number of industrial enterprises that create innovative technologies in productive, unproductive and service providing areas (X2).

3. The share of GDP funding for research – development activities (X3).

4. The number of scientific researches, of innovators per 10,000 inhabitants (X4).

5. The efficient use of informational technologies in all activities of the country (X5).

6. The number of scientific products elaborations in the country, imported into the country (X6).

7. The high degree of education of the society, as a whole (X7).

8. The developed infrastructure of scientific research, innovation, their projections and the implementation of their results (X8).

9. The technological level of the country at territorial, branch, micro and macro level (X9).

10. The demand/request by economic entities in the country for innovations, ideas in the research – development field (X10).

11. The number of super-specialists (the critical number) generating ideas, inventions in the field of research - development (X11)

12. The level of technological development of economic activities in the country, the percentage of primitive

technologies based on using cheap manual labor in the country (X12).

13. Efficient instructional technologies, high-quality teaching textbooks (X13).

14. The level of expansion of scientific, innovational, educational and internship collaborations in the country with advanced countries in the field of research - development (X14)

15. The level of motivation of work, including remuneration of the results achieved by the authors in the field of research - development (X15).

16. Efficient management of activities in the field of research – development, by the government, by the academic system management, including through the methods "program - purpose" (X16).

17. The level of work remuneration in the country under the level of labor remuneration in the research – development field at territorial, branch, micro level (cheap labor - does not generate innovational demands) (X17).

18. The number and gravity of the problems that the society is facing in all human activities, including economy, ecology and in the social, medical, institutional field etc. (X18).

19. Effective ways of accumulating scientific ideas, innovative inside the country, but also abroad (X19).

20. Effective ways of organizing continuous education in the country in all human activities (X20).

21. The level of remuneration for authors' work for publishing ideas, innovations for the research – development. Economic growth (GDP) can be correlated with the listed coefficients by enunciating a production function, which can be written as:

$$Y=F(x_1,x_2,...x_{21}) \quad (1.1)$$

$$\text{where } x_i \geq 0, \quad i=1,2,...,21$$

A particular case of function [1.1] is the Cobb Douglas function:

$$Y = A x_1^{\alpha_1} x_2^{\alpha_2} \dots x_{21}^{\alpha_{21}} \quad (1.2)$$

where A = coefficient of proportionality; $x_1, \dots, x_{21}$ = 21 disturbance factors of socio – economic development of society; parameters α_i , where $i=1, \dots, 21$ – quantifying the elasticity of the respective factor.

To simplify the referred aspects, the function [1.2] is expressed in natural logarithms:

$$\ln Y = \ln A + \sum_{i=1}^{21} \alpha_i \ln x_i \quad (1.3)$$

By deriving the equation [1.3] compared to x_i , $i=1, 2, \dots, 21$ the following measurements are obtained:

$$\frac{1}{Y} \frac{\partial Y}{\partial x_i} = \frac{\alpha_i}{x_i}, \quad i=1, 2, \dots, 21 \quad (1.4)$$

which can also be written as:

$$x_i \frac{\partial Y}{\partial x_i} = \alpha_i Y, \quad i=1, 2, \dots, 21 \quad (1.5)$$

By summing up the equations [1.5] the following results

$$\sum_{i=1}^{21} x_i \frac{\partial Y}{\partial x_i} = Y \left(\sum_{i=1}^{21} \alpha_i \right) \quad (1.6)$$

From the above equation it results that the GDP (Y) of the exemplified country, Romania, can be multiplied of $\left(\sum_{i=1}^{21} \alpha_i \right)$ times, representing the GDP elasticity in relation to the variables x_i , $i=1, 2, \dots, 21$. In turn, the sum can be:

$$\sum_{i=1}^{21} \alpha_i = \begin{cases} > 1, & \text{coefficients with an increasing yield} \\ = 1, & \text{coefficients with a constant yield} \\ < 1, & \text{coefficients with a decreasing yield} \end{cases} \quad (1.7)$$

The shape of the production function (1.1) is of main importance. The production function must not only provide us with data on the country's GDP development under the impact of the mentioned factors, but adequately describe

the evolutionary processes. Function (1.1) should have the following properties: to be continuous, to be non-negative for any positive values of the variable x_i , $i = 1, 2, \dots, 21$; to have univocal values, well defined, restricted; to convert to zero if one or more of the coefficients x_i , $i = 1, 2, \dots, 21$ equal zero, to be differentiable; the decrease of the impact of a factor to be complemented with the effort of another coefficient of the 21 coefficients; GDP elasticity to be determined by the efficiency of each coefficient; the values of 21 coefficients to determine the extreme of the GDP; mathematical transformations to be interpreted economically. Function (1.1) of linear, parabolic, hyperbolic, Coob-Douglas, Mitcherli-Baul, Spliman, Balmucand or Lomax type does not satisfy the conditions (properties) above listed. To infer the form of function (1.1), the GDP growth examination is decreased for the case when it is dependent on only one coefficient - x_1 .

It is considered that function (1.1) has the form $Y=F(x_1)$, GDP depends only on coefficient x_1 . We represent by b_1 the growth of the GDP logarithm per one unit of growth of coefficient's x_1 logarithm; $b_1 \ln x_1$ - the growth of the GDP logarithm per $\ln x_1$ units of growth of coefficient x_1 ; $\gamma_1 x_1$ - the growth of coefficient x_1 , γ_1 - coefficient of proportionality.

$$\frac{b_1 \ln x_1}{\gamma_1 x_1} - \text{the growth of the GDP}$$

logarithm per one unit of growth of coefficient x_1 .

This results in:

$$\ln Y = \frac{b_1 \ln x_1}{\gamma_1 x_1 \ln e} = \frac{\ln x_1^{b_1}}{\ln e^{\gamma_1 x_1}} \text{ or } Y = \frac{x_1^{b_1}}{e^{\gamma_1 x_1}}.$$

In a similar manner there can be interpreted also the intake of coefficients

$i = 2, 3, \dots, 21$ to GDP growth. Function (1.1) will take the form shown in *Figure 1*:

$$Y = A \frac{x_1^{b_1}}{e^{\gamma_1 x_1}} \cdot \frac{x_2^{b_2}}{e^{\gamma_2 x_2}} \cdot \dots \cdot \frac{x_{21}^{b_{21}}}{e^{\gamma_{21} x_{21}}} = A \frac{\prod_{i=1}^{21} x_i^{b_i}}{\prod_{i=1}^{21} e^{\gamma_i x_i}} = A \prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}}$$

Figure 1

In this interpretation of the element, $e^{\gamma_i x_i}$ plays the role of mathematical standard, each coefficient i , $i=1,2,\dots,21$ is standardized. GDP elasticity related to the variable x_i , $i=1,2,\dots,21$ is:

$$E_{x_i}(Y) = \frac{\partial Y}{\partial x_i} \cdot \frac{x_i}{Y} = b_i - \gamma_i x_i, \quad i=1,2,\dots,21 \quad (1.8)$$

To determine GDP's elasticity per one unit of growth of coefficient i , $i = 1,2,\dots, 21$ means:

$$\begin{cases} \frac{\partial Y}{\partial x_1} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_1} = A \prod_{i=2}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \cdot x_1^{b_1-1} e^{-\gamma_1 x_1} \cdot \gamma_1 \left(\frac{b_1}{\gamma_1} - x_1 \right) = 0 \\ \frac{\partial Y}{\partial x_2} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_2} = A \prod_{i \neq 2}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \cdot x_2^{b_2-1} e^{-\gamma_2 x_2} \cdot \gamma_2 \left(\frac{b_2}{\gamma_2} - x_2 \right) = 0 \\ \dots \dots \dots \frac{\partial Y}{\partial x_{21}} = \left(\prod_{i=1}^{21} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \right)'_{x_{21}} = A \prod_{i=1}^{20} \frac{x_i^{b_i}}{e^{\gamma_i x_i}} \cdot x_{21}^{b_{21}-1} e^{-\gamma_{21} x_{21}} \cdot \gamma_{21} \left(\frac{b_{21}}{\gamma_{21}} - x_{21} \right) = 0 \end{cases}$$

Figure 2

Determine $x_i = \frac{b_i}{\gamma_i}$ - the value of coefficient i , $i=1,2,\dots,21$ for which GDP will reach extremum.

Since $\frac{\partial^2 Y}{\partial x_i^2} > 0$, then for $x_i = \frac{b_i}{\gamma_i} \rightarrow$ GDP will be maximized.

For $X < \frac{b_i}{\gamma_i}$, GDP growth if positive,

$$\frac{\partial Y}{\partial x_i} > 0$$

For $X > \frac{b_i}{\gamma_i}$, GDP will decrease.

$$\frac{\partial E_{x_i}(Y)}{\partial x_i} = -\gamma_i \quad i=1,2,\dots,21$$

(1.10)

This result can be interpreted as follows: GDP grows under the impact of the knowledge coefficient x_i , but this (GDP growth) is decreasing.

Function *Figure 1* has the extremum (maximum), deducted from the system in *Figure 2*.

Further, we move to identifying the parameters b_i, γ_i . In some cases these parameters can be determined by using the minimum squares method, in others the experts' data analysis method is used.

It results that every scientific field, research direction can be measured by various criteria. These (the criteria), in turn, may form an incompatible system. Economic criteria and fundamental sciences criteria, most often create negative profit in the present time, but in the future, could generate considerable profits. In these circumstances, the

problem paths selections can only be carried out by experts of different fields.

For each field the direction of scientific research d_i ($i=1,2,\dots,m$) is estimated in terms of the criteria α_j , ($j=1,2,\dots,n$).

The domain d_i , based on α_j criteria, has assigned to it (by experts) d_{ij} points. The criteria j , ($j=1,2,\dots,n$) is also estimated, to which correspond α_j points (percentages of the total)

$$\sum_{j=1}^n \alpha_j \geq 0, j=1,2,\dots,n. (1.9)$$

Therefore, $\sum_{j=1}^n \alpha_j d_{ij}$ represents a

shared estimate of domain i through the share of each of the criteria $i=1,2,\dots,m$. In other words, the domains $d_1, d_2, \dots, d_i, \dots, d_m$ are precisely estimated by the equation shown in *Figure 3*:

$$\begin{pmatrix} d_{11} & d_{12} & \dots & d_{1j} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2j} & \dots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{i1} & d_{i2} & \dots & d_{ij} & \dots & d_{in} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ d_{m1} & d_{m2} & \dots & d_{mj} & \dots & d_{mn} \end{pmatrix} \begin{pmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_j \\ \vdots \\ \alpha_n \end{pmatrix} = \begin{pmatrix} \sum_{j=1}^n d_{1j} \alpha_j \\ \sum_{j=1}^n d_{2j} \alpha_j \\ \vdots \\ \sum_{j=1}^n d_{ij} \alpha_j \\ \vdots \\ \sum_{j=1}^n d_{mj} \alpha_j \end{pmatrix}$$

Figure 3

The research direction (field) d_i ($i = 1,2, \dots, m$) is estimated by experts in the field of estimated criteria (by level of importance, actuality, gravity etc.), in the respective fields of scientific research.

To the domain (the direction) d_i , $i=1,2,\dots,m$ are assigned $\sum_{j=1}^n d_{ij} \alpha_j$ points.

The directions, the areas in which researches need to be conducted, cannot

always be covered with the experimental innovational - scientific potential from the EU countries, including Romania [4 p198]. In these cases, some directions, research areas will be excluded from the nomenclature of the scientific research by adding variables. The vector of the fields, of the directions of scientific national coverage is determined through the following matrix shown in *Figure 4*:

$$(d_1, d_2, \dots, d_i, \dots, d_m) \begin{pmatrix} \beta_1 & 0 & \dots & 0 & \dots & 0 \\ 0 & \beta_2 & \dots & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & \beta_i & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & 0 & \dots & \beta_m \end{pmatrix} = (\beta_1 d_1, \beta_2 d_2, \dots, \beta_i d_i, \dots, \beta_m d_m)$$

where:

$$\beta_i = \begin{cases} 1, & \text{if domain } i \text{ is investigated in Romania, } i=1,2,\dots,m \\ 0, & \text{if domain } i \text{ is investigated in EU, } i=1,2,\dots,m \end{cases}$$

Figure 4

Starting from the scientific, creative, innovational potential, from the infrastructure of Starting from the scientific, creative, innovational potential, from the infrastructure of investigational processes, with the variables which are divided/are shaping a matrix D, composed

of elements $D = \{d_{ij}\}_{m \times n}$ in matrices $D^{(R)}$ and $D^{(ue)}$, where $D^{(ue)}$ is the selective research matrix for the scientific potential from EU countries, and $D^{(R)}$ - for researchers from other areas shown in Figure 5:

$$D^{(R)} = \begin{pmatrix} \beta_1 & 0 & \dots & 0 & \dots & 0 \\ 0 & \beta_2 & \dots & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & \beta_i & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & \beta_m \end{pmatrix} \begin{pmatrix} d_{11} & d_{12} & \dots & d_{1j} & \dots & d_{1n} \\ d_{21} & d_{22} & \dots & d_{2j} & \dots & d_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ d_{i1} & d_{i2} & \dots & d_{ij} & \dots & d_{in} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ d_{m1} & d_{m2} & \dots & d_{mj} & \dots & d_{mn} \end{pmatrix} = \begin{pmatrix} \beta_1 d_{11} & \beta_1 d_{12} & \dots & \beta_1 d_{1j} & \dots & \beta_1 d_{1n} \\ \beta_2 d_{21} & \beta_2 d_{22} & \dots & \beta_2 d_{2j} & \dots & \beta_2 d_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \beta_i d_{i1} & \beta_i d_{i2} & \dots & \beta_i d_{ij} & \dots & \beta_i d_{in} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \beta_m d_{m1} & \beta_m d_{m2} & \dots & \beta_m d_{mj} & \dots & \beta_m d_{mn} \end{pmatrix}$$

$$D^{(ue)} = \begin{pmatrix} 0 & (1-\beta_2) & \dots & 0 & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & (1-\beta_i) & \dots & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 0 & \dots & (1-\beta_m) \end{pmatrix} \begin{pmatrix} d_{21} & d_{22} & \dots & d_{2j} & \dots & d_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ d_{i1} & d_{i2} & \dots & d_{ij} & \dots & d_{in} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ d_{m1} & d_{m2} & \dots & d_{mj} & \dots & d_{mn} \end{pmatrix}$$

Figure 5

The main directions, the areas of research - development (i) are: communicative informational systems; life science; sustainable economic development; nano-systems industry; transport systems; energy systems. The knowledge of the society turns into means of generating problem solving ideas: how to build a good future (based on available knowledge), how the knowledge of the

society has developed in order to succeed at building the future. In the processes of studying the future there are three problems: 1) to predict; 2) to acknowledge; 3) to find solutions.

3. Conclusions

We appreciate that the above calculus elements are significant for examining or evaluating the in advance

investments towards the knowledge based society.

Fundamental, applied and innovational sciences can contribute to the improvement of technologies which have become traditional, but can also create new technologies called nanotechnologies.

Economic and financial crises determine the acceleration of the processes for implementation of the successes achieved in the field of research – development and innovation. Scientific successes of society's knowledge in each country are implemented in different periods of activity and generate different

effects. We find that in Romania, industrial enterprises are inadequately trained in supporting society's knowledge. The EU has developed The Program - EU - 2007 - 2013 which provided the premises for the development of science in all the EU member states, including Romania.

Fundamental sciences, being non programmable, develop by following unpredictable "rules". In the EU countries the emphasis is on creating the necessary infrastructure for research activities and the results turn into "coordinators". Scientific successes are determined by the presence of many factors of influence.

References

- [1] Burtea E., *Edificarea societății cunoașterii bazată pe informație a economiilor emergente în accord cu reglementările europene și internaționale*, Ed. Print-Caro, Chișinău, 2014.
- [2] *Dicționarul explicativ al limbii române DEX*, București: Ed.II, Universul Enciclopedic, 1998, p.1192
- [3] Gribincea A., *Imitational Models of the Innovation Development of the Country in Conditions of the Internationalization of the Economy*, Chisinau-Sibiu: In Revista Economică. Nr. 5-6, 2008, 33 p.
- [4] Hurloiu L.R., Burtea E., Hurloiu I.I., Meruță A., Preda B.F., Șerban M., Ștefan R.M. *Documente contabile – management, control, audit, clasificare și securitate*, Editura Print-Caro, Chișinău, 2014.
- [5] Nonaka I., Hirotaka T., *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford: Oxford University Press, USA, 1995. 304 p.
- [6] Șerban M., Burtea E., *Compatibility Between Romanian Economic and Entities in Terms of Document Management*. Sibiu: Conferința Științifică Internațională „The Knowledge-Based Organization”, Academia Forțelor Terestre Nicolae Bălcescu, Sibiu, Editura „Nicolae Bălcescu” Land Forces Academy Publishing House, 2008, p. 383.