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ECONOPHYSICS Section

A CLASSIFICATION OF THE ECONOPHYSICS DIRECTIONS

Ion SPÂNULESCU* and Anca GHEORGHIU*

Abstract. *In this article we attempted a systematization of different directions and branches of econophysics. Thus, all subdomains or branches that use statistical mathematics and statistical physics methods are grouped in the major domain of statistical econophysics, while econophysics subdomains and models that use models inspired by phenomena and laws from other domains of physics or from other sciences are grouped in the major domain of phenomenological econophysics.*

In the paper, some phenomenological econophysics models are also briefly presented.

Keywords: *statistical econophysics, econophysics directions, phenomenological econophysics, economic amplifier, macrostate parameter, economic entropy.*

1. Introduction

To study the economic phenomena and processes, in addition to specific methods and processes of economic science, researchers turned to methods, theories or models borrowed from other sciences, especially from the exact sciences (mathematics, physics) or natural sciences (physics, chemistry, biology) whose laws and phenomena have an exact character, a deterministic one. Such approaches have led to the emergence of directions or even interdisciplinary sciences through which the economic science interacts with the exact sciences, as well as with other types of sciences as social sciences, engineering sciences and others, as we will show in one of the following sections.

The research of economic processes with the help of mathematics or physics started as early as the first decades of the 20th century, through the development of statistics and econometrics by mathematicians (in the third decade of the last century). The economists have taken these techniques

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and have developed them achieving some interesting results and models, particularly in the domain of econometrics but also in economic statistics through the systematic processing of the economic data series.

The econometrics methods were also approached by physicists or by economists-physicists who afterwards have developed econophysics study methods and models for economic phenomena or processes. It is appropriate to recall here one of the forerunners of this science, Nicholas Georgescu Roegen, Romanian statistician and economist that showed the role and importance of the concept of entropy from physics in the study of economic processes and has proposed the model of ecological economy [1]. At the border between the twentieth and twenty-first century appeared a special interest for econophysics expressed through the publication of a large number of articles, studies and books in this domain, as well as increasing the number of international conferences and symposiums, at which numerous original papers and communications in the domain of econophysics were presented.

As it was already mentioned, the interest in the study of economics did that for the study of economic phenomena and processes, in addition to mathematics and physics to also appeal to other sciences as will be seen in next section. The methods and techniques used for this purpose have acquired a great diversity, which in turn requires the introduction of a classification to make some order in this area. This is the subject of the present study which will be developed in sections 3-5 of this paper.

2. Study of economic phenomena and processes with the help of other sciences

The evolution and research on the economic processes are influenced by the presence of the human factor in the economy whose influence is, most of the times, hard to quantify. Due to this fact, economic decisions and measures taken at company level, industry level or even at the state level can have a great deal of subjectivity, and sometimes may even be inaccurate or discretionary (to the economies of totalitarian states). This shows the tight character of the interaction between the economy and society. In this case, can we consider that the science of political economy or the economic science fall into the category of social sciences? Possible, but in economics there are also certain laws, most of them being found empirically, which can have a deterministic character especially if for their

analysis or modelling are used mathematical methods or those of the exact sciences (as Physics) as is the case of econometrics or econophysics or other borderline sciences in connection with the economy.

There are many sciences or more precisely interdisciplinary scientific directions sometimes called borderline sciences, which are in fact an interface making the connection between two or more scientific domains.

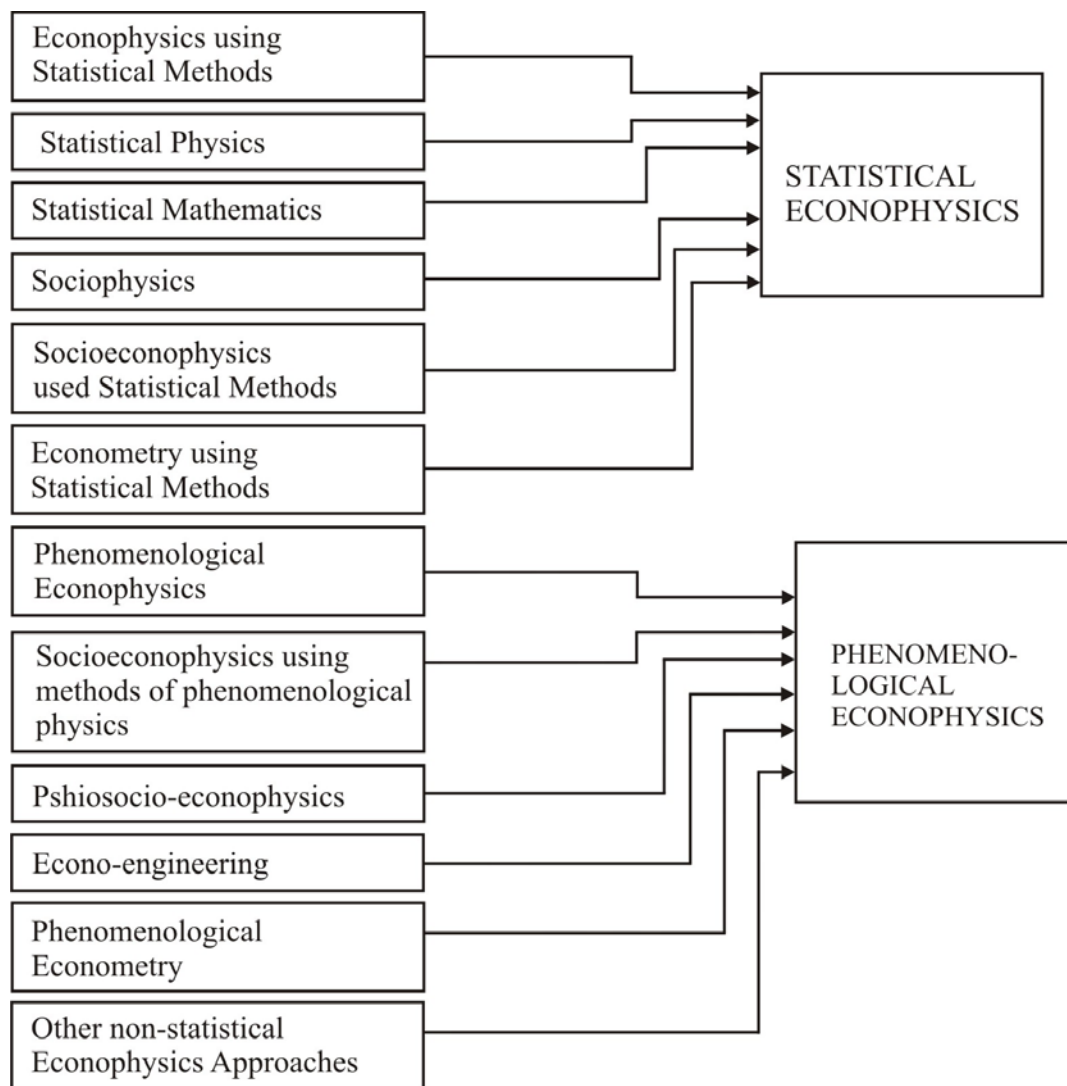


Figure 1. Econophysics directions.

Regarding the economy and physics or mathematics one can speak of econometrics where for economic researches are used mathematical

methods, of econophysics, and more recently of sociophysics [2-4] or more exactly socioeconophysics as well as of psychosocio-econophysics, the latter being particularly involved in the issue of stock-market operations, where psychological factors play an important role as is the case of **herd effect** [5] and others similar. Physics is also in conjunction with other sciences resulting physical chemistry, biophysics, medical physics, mathematical physics, astrophysics, geophysics, engineering physics, sociophysics and already mentioned econophysics with its specific branches, socioeconophysics and psychosocio-econophysics etc. (Fig. 1). The list of interdisciplinary connections for the domains mentioned above (economy and physics) remains open, in the future may appear other interdisciplinary or borderline sciences for these domains.

The economy with all its branches represents a complex system, with a largely unpredictable or even chaotic evolution due to the close interactions with human beings whose decisions or actions are not always the most appropriate or good sense. However despite these human interventions, the practical economy is governed by certain rules that result from practice and obviously can always be improved or optimized. Most economic domains interact with each other, so in the end the economic system emerges as a unitary but very complex system. The study of such a complex system, composed in the form of a conglomerate or cluster of sub-domains that interact with each others, may be subject to complexity sciences [6-9]. Thus, all distinct economic domains may be considered as an ensemble of networks which intermingle and interact in a complex system of neural networks type [6,8]. Mathematicians and physicists have at their disposal different mathematical calculation and analysis approaches of such neural networks.

Political economy, which studies the economic phenomena and processes in close interaction with society, is considered to be part of the social sciences. On the other hand, the empirical or deterministic economic laws, in many cases, present certain regularities similar to those encountered in physics or other exact sciences. For example, excluding subsistence economy supported by rudimentary means, the modern economy is evolutionary type, i.e. it develops ascendant, presenting an amplification effect of initial investments. As it can be seen in the 4.1 section of this paper, such process of the economic development can be

described by amplification phenomenon from electronics or applied physics [26]. Similarly, the share prices in the stock markets, that evolve over time, tend to increase in the long term or sometimes even in the medium term. In the latter case, when the ascendant growth trend is broken abruptly we can speak of a stock-market's crashes that usually occurs in situations of economic crisis, i.e. takes place under the abnormal development of the economy when we are dealing with the recession or "negative economic growth" phenomena. Considering such economic laws or regularities similar to those encountered for example in physics, we are now turning to the question if the economic science can be regarded or not as an exact science as physics, mathematics or chemistry? The answer may be **Yes** but only with a certain caution and only for certain branches of economic science, namely for econophysics, econometrics or even for economic statistics, if the latter cannot be considered as a distinct branch of mathematics and if the econophysics cannot be considered like a distinct branch of physics and so to be included in the curricula of physics faculties from universities or colleges.

3. Statistical econophysics and phenomenological econophysics

The researchers in economics are working mostly with economic data series measured or derived from practical work, using them through mathematical methods – in this case the mathematical statistics – in order to elaborate econometric models or equations etc. Thus, the economic statistics is highly developed and together with the econometrics they gave good results in the economic research. This domain's extension using also the methods of statistical physics including quantum statistics has led to the emergence of statistical econophysics. This name comes from the fact that, when we are dealing with a large number of events, states or variable parameters from the economic practice, which can be considered to have a collective-type behaviour, and therefore they can be described and analyzed with the laws of statistical physics or statistical mathematics. To this fact have reached first the physicians who analyzed economic conditions or processes involving a large number of constituents as the shares on the capital markets (stock-markets), analysis of income distribution, money, wealth of individuals, GDP, the number of companies

and their distribution by size, wages distribution, number of employees, the distribution of material or human resources etc. (see for example [10-24]). That explains why most studies and works published or communicated to scientific conferences or symposiums refers to such phenomena, events or objects etc., which are explored using statistical physics or statistical mathematics through this giving birth to a new interdisciplinary research that direction we can call **statistical econophysics**.

The studies in the domain of statistical econophysics had a great development, especially in the last two decades (after the years 1995-2000), especially in the domain of stock markets analysis, which made some researchers define econophysics as the borderline science for the study of stock markets. But within the frame of the statistical type econophysics, there have also been and are being studied other economic processes or phenomena such as: global or individual income distributions [12,15], companies distributions by size [14,16], social phenomena (demographics etc.), the distribution of money [13], the distribution of resources (gold, oil etc.) or products etc. In such studies, researchers turned to more types of distributions as: normal Gauss distributions, logarithmic, exponential or power law distribution (PLD) [17], as well as to some distributions of quantum statistics as Boltzman-Gibs, Fermi-Dirac or Bose-Einstein distributions (see for example [13,18,20,21,24]).

On the other hand, as we pointed out in a previous paper [25], econophysics also implies the inclusion in its area of research of other domains of physics (not only statistical physics), especially from phenomenological or fundamental physics, as chapters of electricity, solid state physics, thermodynamics, nuclear or optical physics etc. Indeed many researchers included in their papers some econophysics models based on analogies between the economic phenomena or processes and laws or processes from different domains of physics other than statistical physics (see for example [25-28]). In this way we can talk about a new face of econophysics named **phenomenological econophysics** [25]. In Figure 1 we show a classification of the different econophysics branches or directions, which according to the research methods (statistical or from phenomenological physics) can be included either in statistical econophysics or in phenomenological econophysics. As we already stated, both the econophysics types and directions are equally useful for modelling of the economic processes or phenomena, resorting to the laws of general (phenomenological) physics or especially to the statistical physics in the

frame of the statistical econophysics [25]. In the next section we give some example of econophysics models belonging to the phenomenological econophysics which we have been early proposed and analyzed in our previously published papers [26-28].

4. Approaches and models of phenomenological econophysics

In this section will be mentioned in brief a few models in the framework of phenomenological econophysics proposed by us in some of our previously papers or communications at international conferences.

4.1. Economic Amplifier [26]

As mentioned in the section 2 the modern economy has an uptrend, i.e. shows an amplification effect of initial investments. So, the amplification phenomena from physics are more suitable to describe the outgrowth of economic processes because the economic development means the amplification of value of utilized and processed resources. Based on this analogy, in our studies was proposed an econophysics model structured on amplification phenomenon concept from applied physics (electronic physics and semiconductor physics etc.) named **economic amplifier** [26].

One of the most important parameter of an electronic amplifier from physics (or electronics) is the amplification factor, sometime noted with β , which is defined by equation [29,31]:

$$\beta = I_{out} / I_{inp} = Output / Input. \quad (1)$$

where I_{inp} and I_{out} represent the input and respectively output current from active electronic device in electronic amplifier structure.

For economic amplifier, we have proposed a similar amplification factor [26]:

$$\beta_{economic} = Income / Investments, \quad (2)$$

or for financial organizations (banks, mutual funds, leasing corporations, insurance corporations etc.) as:

$$\beta_{bank} = Financial\ income / Initial\ capital. \quad (3)$$

It must be observed that the economic amplification defined by the ratio between total incomes and investments (see rel. (2)):

$$\beta_{ec} = \frac{Income}{Investments} = \frac{V}{I}, \quad (1')$$

coincides with the investment multiplication factor k from the famous model developed by Keynes [30]:

$$k = \frac{\Delta V}{\Delta I} \quad (4)$$

where ΔV represents the increase of income and ΔI the increase of investments.

The economic amplifier model can be very well applied for modelling the economic development based on the initial investments both at the micro and the macroeconomic levels. So, for the electronic amplifier with the bipolar transistor in common emitter configuration or with the integrated circuits (Fig. 2), the amplification factor β is defined as (see eq. (1) and [31]):

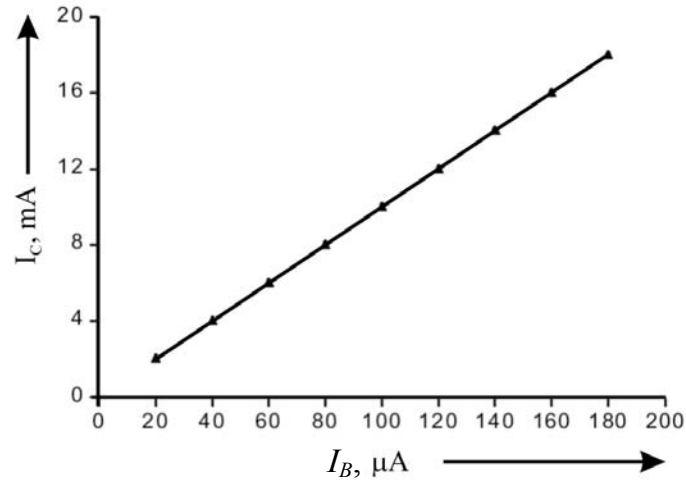
$$\beta = \frac{I_{out}}{I_{inp}} = \frac{I_C}{I_B} \quad (5)$$

where I_C represents the collector current of the output (final) transistor and I_B represents the input current through the base of the first transistor from the first stage of electronic amplifier [31].

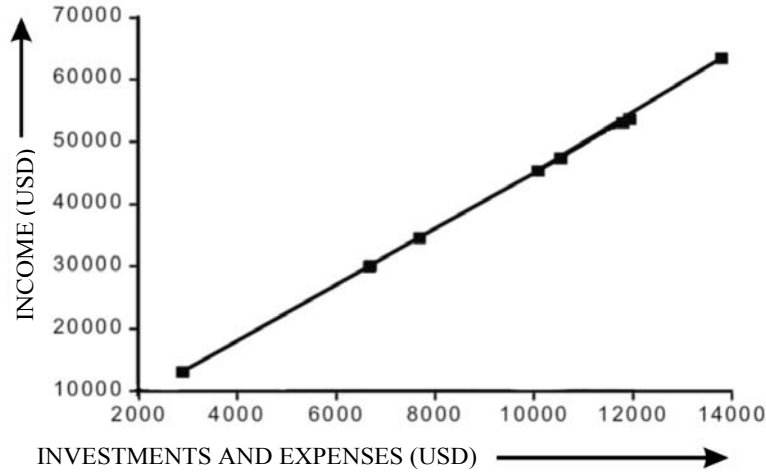


Figure 2. Simplified representation of an electronic amplifier with transistors or integrated circuits.

The dependence of the output or collector current I_C (mA) = I_{out} as a function of input current, I_B (μA) = I_{inp} of an electronic amplifier, therefore, β , given by Eq.(5), have a linear shape resulting a constant value for β (Fig. 3,a).



a)



b)

Figure 3. a) $I_C = f(I_B)$ dependence represents a straight line; b) Income representation depending of investments and expenses for a small manufacture.

Indeed, the Eq.(5) can be written as:

$$I_C = \beta I_B \quad (6)$$

representing a straight line (when $\beta = \text{const}$) intersecting the origin of the coordinate axes (Fig. 3,a).

Under normal economic conditions and economic policies, by applying the economic amplifier model for the investments analysis, one may see that the output's income as a function of input total expenses (investments, materials etc.) has also a linear or near linear dependence (Figs. 3,b and 4) justifying the econophysics model we have proposed.

Indeed, for $\beta_{ec} = \text{constant}$, the equation (1') can be written in the form (equation (6)):

$$V = \beta_{ec} I \quad (5')$$

which is verified in practice both at the microeconomic (Fig. 3,b), as for the macroeconomic level (Fig. 4).

An example of applying of the economic amplifier model at manufacture level (microeconomic level) is given in figure 3,b, where the total income as a function of initial and annual investments and expenses are represented. As it can be seen from figure 3,b, the ratio between the output total income and the input total expenses (including investments), meaning, economic β , has a monotonous rising dependence, near a straight line.

The economic amplifier model can be also very well applied on the macroeconomic level. A good example is given in figure 4 where the dependence of the Gross Domestic Product (G.D.P.) of Romania as a function of the capital accumulation between 1990-2004 years is represented. As it can be seen from figure 3, the resulting function has a near linear dependence. The medium value of 5.19 for the economic β at national level for Romania for above mentioned period was calculated.

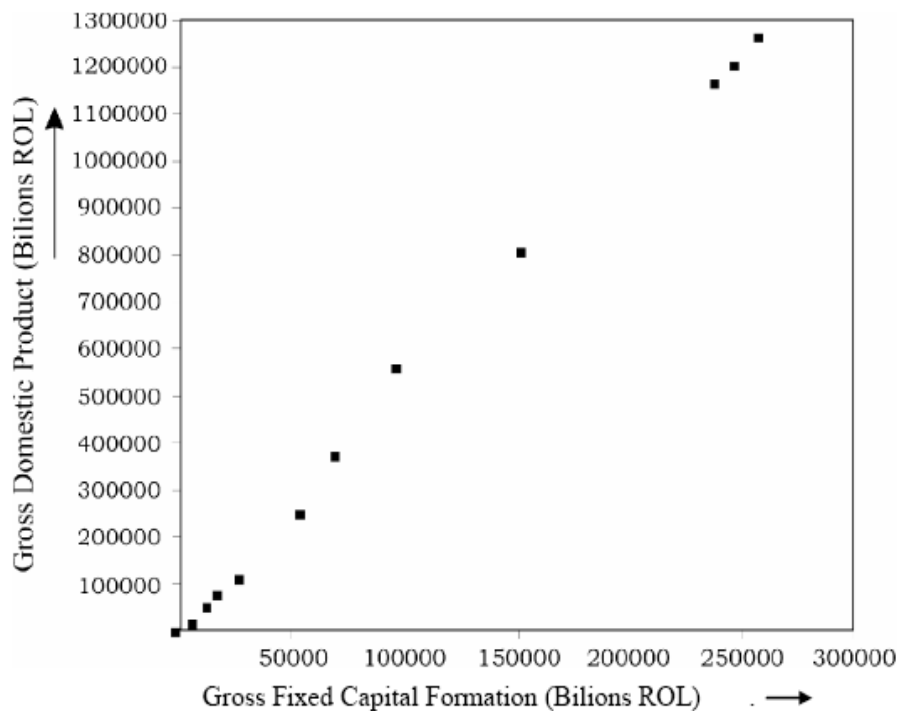


Figure 4. Gross Domestic Product of Romania vs. Gross Capital Formation for 1990-2004 period.

For more details on Economic Amplifier see the paper: *Economic Amplifier a New Econophysics Model* by Ion Spanulescu and Anca Gheorghiu published in [arXiv:0707.3703](https://arxiv.org/abs/0707.3703) [pdf] (2009).

4.2. The entropy law and the economic processes¹

As we already mentioned, in the late middle of 20th century, the applied mathematics and statistical physics have been mostly used for analyzing economic processes.

Based on natural sciences such as physics or chemistry, with stable laws, some economic phenomena and processes can be better explained, especially the macroeconomic processes. We appreciate that among the natural sciences, physics is the only one that can be accessed for good understanding of the economic phenomena and processes.

The Romanian scientist N. Georgescu-Roegen was one of the parents for applying thermodynamics in analyzing economic processes, especially for the development of ecological economics. In his research, N. Georgescu-Roegen used as the main starting point the second law of thermodynamics and also the entropy law, which is applicable to irreversible processes such as real processes from nature, economy or society etc.

Based on the second law of thermodynamics, the entropy of the isolated system, which evolved through irreversible processes, is growing during the transformation of the systems. The transformations of the real physical processes and systems are irreversible so, their entropy increases in every moment.

The isolated systems cannot come back alone in their initial stages with lower entropy because this evolution contradicts the second principle of thermodynamics.

L. Boltzmann has used statistical calculation and the thermodynamic probability of the gaseous system's microstates to discover the well known formula:

$$S = k_B \ln W \quad (7)$$

where k_B represents the Boltzmann's constant. This equation link the entropy S of a system with the thermodynamic probability of its state, W , and represents the statistical interpretation of the entropy.

¹ This is the title of the N. Georgescu-Roegen's book that appeared in Harvard University Press, Cambridge, 1971

Starting with Boltzmann's ideas, the physicists have considered the entropy as a measure of disorder in nature or in the structure of things.

The entropy law applied for the technical and operational activities proves that all human practical activities have the effect of useful energy consumption, energy waste increasing and pollution, which is characterized by a complete disorder in things' structure. From this point of view N. Georgescu-Roegen has firmly stated that the natural resources are limited and also that the contemporary economic activities generate pollution and this can result in the destruction of civilization.

N. Georgescu-Roegen was one of the first contemporary scientists which pointed out some similarities between the economic and natural (physical) phenomena or processes.

4.3. An Econophysics model for the migration phenomena [27]

The migration phenomena have many reasons, but the economic reasons are very important. Usually, the mass movements of the people from one place to another (region, country etc.) are motivated by the economic attraction for the attraction centres or the richest regions, with the highest level of society's development.

In the case of modelling of **the migration phenomenon** from economic and social causes, we resorted to an electrostatic model using Coulomb's formula [29]:

$$F_e = \frac{q_i}{4\pi\epsilon_r} \frac{Q_j}{R^2} \quad (8)$$

where F_e represents the electrical attraction force between electrical charges q_i and Q_j [29].

For modelling the phenomenon of migration from poor neighbour regions (countries) i to rich regions (countries) j , with a powerful attraction characterized by a high socio-economic status (big material resources and capital, developed logistics, information superstructures, banking, commercial or educational etc.) we will appeal to the notion of **migration field** (similar with the electric or electrostatic field) E , which is determined by the ratio of the electrical force (from electricity) F_e of the an attractor and the charge q_0 on which acts the field produced by the attractor [29]:

$$E = \frac{F_e}{q_0} \quad (9)$$

where F_e is electrical attraction force defined by (8).

For the migration field, E_m , we have introduced an analogous expression:

$$E_m = \frac{F_a}{q_i} \quad (10)$$

where F_a is attraction force exercised by the rich region (country) j symbolized by notation A_j on the population q_i from the poor region (country) i noted by A_i (Figure 5).

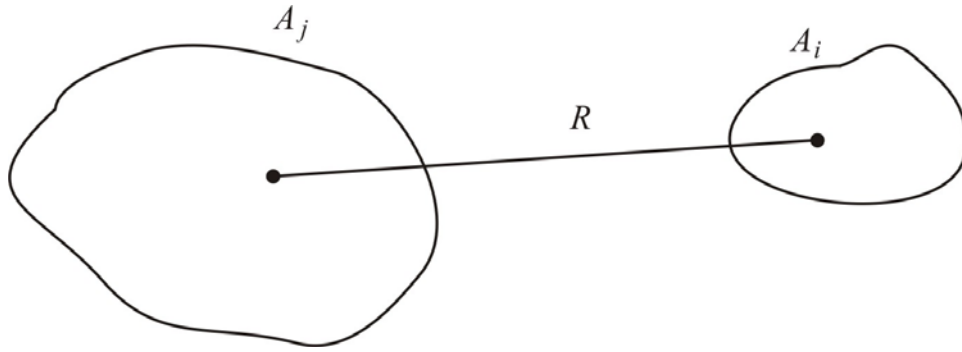


Figure 5.

Similarly with the equation (8) one can define the migration attraction force F_a as [27,29]:

$$F_a = \frac{q_i}{4\pi\epsilon_m} \frac{K_j \sum_{j=1}^n q_j}{R^2} = \frac{q_i Q_j}{D_{ij}} \quad (11)$$

where:

$K_j \sum_{j=1}^n q_j = Q_j$ – represents the “economic power” of the rich region

(country) j , with the population $\sum_{j=1}^n q_j$;

K_j – represents the wealthy factor and:

$D_{ij} = 4\pi\epsilon_m R^2$ – represents the economical distance (transportation cost, accommodation, documents cost etc.) between two regions, R being the physical distance between regions (countries) A_i and A_j [27].

In the expression (11) ε_m represents the “environment’s permissiveness”² of the environment between regions i and j [27].

We can make a similarity with the attraction forces of electrostatics if we consider the poor region (country) i as a region with “negative” sign (as “negative charge”) and the rich region (country) j as a region with “positive” sign (as a “positive charge”) (see Fig. 5).

Calculating the force of attraction on a variable q_i symbolizing a single emigrant from the region (country) i , we have from (10):

$$F_a = q_i E_m \quad (12)$$

or (see equations (10) and (11)):

$$F_a = \frac{q_i}{4\pi\varepsilon_m} \frac{Q_j}{R^2} = q_i E_m. \quad (12')$$

From equations (12) and (12') we can find the expression of the migration field E_m :

$$E_m = \frac{Q_j}{4\pi\varepsilon_m R^2} = \frac{Q_j}{D_{ij}} \quad (13)$$

whose intensity is proportional to the economic power Q_j of the region (country) j and inversely proportional to the economic distance D_{ij} between the two regions (countries).

Knowing the intensity of the attraction forces (see eq. (12')), we can calculate the net migration flow given by migrant’s mass M_{ij} from the poor (“negative”) region (country) i , to the rich (“positive”) region (country) j :

$$M_{ij} = C_o \cdot F_a = C_o \frac{q_i Q_j}{D_{ij}} \quad (14)$$

where: Q_j – symbolizes the economic power of the rich region (country) j ,
and:

C_o – represents the proportionality coefficient which depends also of the number of emigrants from the region (country) i , to the region (country) j .

² Term proposed by the authors, by similiary with the electromagnetic permittivity from physics.

Wealth factor K_j in the equation (11) can be considered in the form of:

$$K_j = a(GDP_j - GDP_i) + b(u_i - u_j) + c(w_j - w_i) \quad (15)$$

where:

GDP_j – represents the gross domestic product of the country j ;

GDP_i – represents gross domestic product of the country i ;

$u_i - u_j$ – the difference between the unemployment rates in the countries i and j ;

$w_j - w_i$ – the difference between the wage rates in the countries j and i .

a , b and c – represent proportionality coefficients.

Taking into account the expression of Q_i from the equation (11), the equation (14) can be written in the form:

$$M_{ij} = C_o \frac{q_i K_j \sum_{j=1}^n q_j}{D_{ij}} \quad (16)$$

where K_j is given by equation (15).

4.4. The Macrostate Parameter, an Econophysics Approach for the Risk Analysis of the Stock Market Transactions [28]

4.4.1. Economic value, simple volatility and normalized volatility

As it was shown in the our previous paper [28], besides its intrinsic economic value, characterized by **utility** value and **trade** value, an **informational** type value which determines the denomination, role and importance of the product or service, can be ascribed to any good, service or product.

The utility value as well as the trade value are tighter tied upon the mass or order concept or things construction, whereas the own information value of a material good is not physically palpable having an immaterial aspect like a wave, therefore a waved (pulsating) aspect: we have or we have not the respective information about the product or service considered. In this vision, in the case in which the number of information is large and concentrated upon some objects or economic “targets” etc., it can be spoken about an informational fascicle (beam) with dual aspect, similar to a photon beam (from physics) or other elementary particles (electrons etc.) characterized by a determined motion mass, impulse etc.

For the stock-markets analysis, the proper instruments of technical analysis which can provide valuable information about the evolution of the various transacted assets are used. Among the instruments used in the technical analysis, the most applied by simple investors are simple graphs to indicate the prices evolution or the volumes transacted, the simple volatility or return, simple averages or Bollinger bands and lesser other indices or stochastic oscillators which are approached by the specialists or broker societies, financial analysts etc.

In our papers, for volatility, usually the equation that expresses the assets price difference at two successive moments is used [28]:

$$Vol = p_t - p_{t-1} \quad (17)$$

where t represents the present time, and $t-1$ is the time at the previous moment, separated from t by the time unity (minute, hour, day, month etc.).

From the stock-markets analysis it is sometimes established that, although some assets with high prices are well appreciated, having an increasing tendency of the price, they are characterized by a diminished liquidity because of smaller transaction volumes, leading to ampler price oscillations, i.e. more risky for investors. That is why for a more complete assessment of the evolution of the assets it is appropriate to take into account the result of multiplying the share price p with the trading volume V estimated by the parameter:

$$a = pV. \quad (18)$$

Thus, for a more complete understanding of the share's evolution from the point of view of the price and transacted volumes, the parameter a given by (18) can be assimilated to the impulse of a information-particle (which symbolize the respective financial information) defined by the product pV similar to the impulse of a material particle defined by equation $p = mv$ from the elementary physics [28]. Such an index can deliver ampler useful information regarding the “inertia” degree or stability of an asset (shares, financial instruments etc.) than the price, p , or the transacted volume, V , taken separately.

Considering the parameter a given as result of multiplying the price p and trading volume V , i.e. $a = pV$, we can define the normalized volatility, Vol_n , as (see rel. (18)):

$$Vol_n = \frac{p_t V_t - p_{t-1} V_{t-1}}{p_{t-1} V_{t-1}} = \frac{a_t - a_{t-1}}{a_{t-1}}, \quad (19)$$

where:

p_t is the closing price from the day t ;

V_t is the number (volume) of transacted shares in the day t ;

V_{t-1} is the number (volume) of transaction shares in the day $t - 1$;

P_{t-1} is the closing price from the day $t - 1$.

4.4.2. The macrostate parameter for the stock-market transactions

As in the proposed model [28], we consider that all the information from the stock-market field can be assimilated with the particles of a gas of impulses $p = mv$, confined in a precinct (“financial boiler”) that is the very stock-market (spot markets, forward markets etc.). In this situation it is plausible enough to apply the same principles, laws and results from thermodynamics, kinetic-molecular or statistical physics to describe the assemble of particles’ states – called microstates – in which the information – particles that symbolise all information about the assets (or other financial instruments) from the virtual precinct which can be exist at various moments. Every “particle-information” contained in the financial boiler (virtual precinct) is characterized by a microstate in which the particles that symbolise all information about the assets (or other financial instruments) from the virtual precinct which can exist at various moments. Every “particle-information” contained in the financial boiler (virtual precinct) is characterized – in a first phase – by the parameter $a = pV$ where p represents the price and V – represent volume of transacted shares as we have seen in the previous section.

After a determined time, as a result of the succession of a numerous microstates which appear because of the agitation and the mixture of the constituent particles, the system reaches an equilibrium state which is a **macrostate** that can be described by measurable macrostate parameters [32].

By financial (or economic) microstate we understand the virtually particles assemble, which represents all information and decisions materialized in the share’s price and the transacted volume for all the day, hour or minute of transaction).

So, if we consider parameter $a = pV$, a microstate for the capital market is given by the price and share’s volume situation assemble at a given moment t . If this microstate is altered by a single transaction of a

single investor, the assemble of microstates will be modified resulting a new picture of the stock-market situation, i.e. a new microstate. These changes are practically infinitely numerous (it can be a big number N of transactions) so the microstates number should be extraordinary big and can be interpreted and statistically evaluated by a similar formula like the one given by L. Boltzmann for the microstates of a thermodynamic system (mix of gases) which defined the entropy of a thermodynamic system (see formula (7) and [32]):

$$S = k_B \ln W. \quad (20)$$

In equation (20), $k_B = 1.380.662 \times 10^{-23}$ J/K represents the Boltzmann's constant, and:

$$W = \frac{n!}{n_1!n_2!n_3!\dots}$$

is the thermodynamics probability to realize a microstate of the system.

Starting from the definition (20) of entropy $S = k_B \ln W$ from thermodynamics, we can introduce a similar parameter named **macrostate parameter**, for the stock-markets:

$$P_M = k_m \ln W_m \quad (21)$$

where W_m represents a probability in succeeding a new microstate of the stock market and k_m is a constant which is specific for that stock-exchange market and for that type of transacted share.

On the other hand, the entropy S is tied to the thermodynamic temperature, T , by a equation like [32]:

$$dS = \frac{1}{T} dQ$$

or for the finite variations, by the expresion:

$$S = \frac{\Delta Q}{T} \quad (22)$$

that is to say that the thermodynamic entropy is proportional to the reverse of the temperature T .

Similarly, for the financial markets, to abstract a proportionality factor ΔQ , the reverse of P_M parameter represents the stock-exchange

market temperature T_m , which is also an important macrostate parameter for the stock-markets analysis:

$$T_m = \frac{1}{P_m}. \quad (23)$$

As it was mentioned before, for the informational precinct (i.e. “financial boiler”) the parameter $a = pV$, is similar to the impulse $p = mv$ of the material microparticles which, in the case of the financial virtual precinct, is generally close tied to the volatility and especially to the normalized volatility Vol_n , defined by (19) equation. So, in our considerations, instead of simple “impulses” of gas particles whose assemble motion determines the temperature of the medium from the precinct, it will be appealed to the normalized volatility defined by (19) expression in order to determine stock-market temperature T_m .

As specified, a microstate of the stock-market is given by the assemble of total prices and trade volumes for a transacted share at a given moment t . The assembly of the share’s information microstates can be represented like an assembly of the impulses of the particles in a gas which gives the dimension of the macrostate, that means, the temperature of the environment or of the precinct which contents the studied “gas”. The “virtual precinct” that we have proposed for the evolution of share’s transaction is a three-dimensional one, with the following coordinates: share’s price, transacted volume and time period t . In other words, for the temporal dimension takes into account, we can determine the microstates of each day (or hour etc.) of transaction and a macrostate parameter representing the sum of all microstates reported to the totality of their number, N , that could be define of the financial entropy P_M .

Consequently, the sum of all microstates, defined by the normalized volatility reported to number of microstates (that means of the total transactions), N , gives dimension of the agitation (disorder) on the market for a given period, as a macrostate parameter:

$$P_M = \frac{\sum \text{normalized volatility}}{N} = \frac{1}{N} \sum_{t=1}^N \frac{a_t - a_{t-1}}{a_{t-1}} \quad (24)$$

where a_t symbolises the product between price and volume at time t (see equation (18)).

Comparing the formula (24) with the expressions (21) and (20) for entropy, we can write also the equality [28]:

$$P_M = \frac{1}{N} \sum_{t=1}^N \frac{a_t - a_{t-1}}{a_{t-1}} = k_m \ln W_m = S_e \quad (25)$$

where S_e represents the financial (or economic) entropy being determined and equal to the macrostate parameter P_M .

In Figure 6, the macrostate parameter P_M and its reverse $1/P_M$ for several Romanian companies transacted at Romanian Stock-Exchange Market in 2004 are represented.

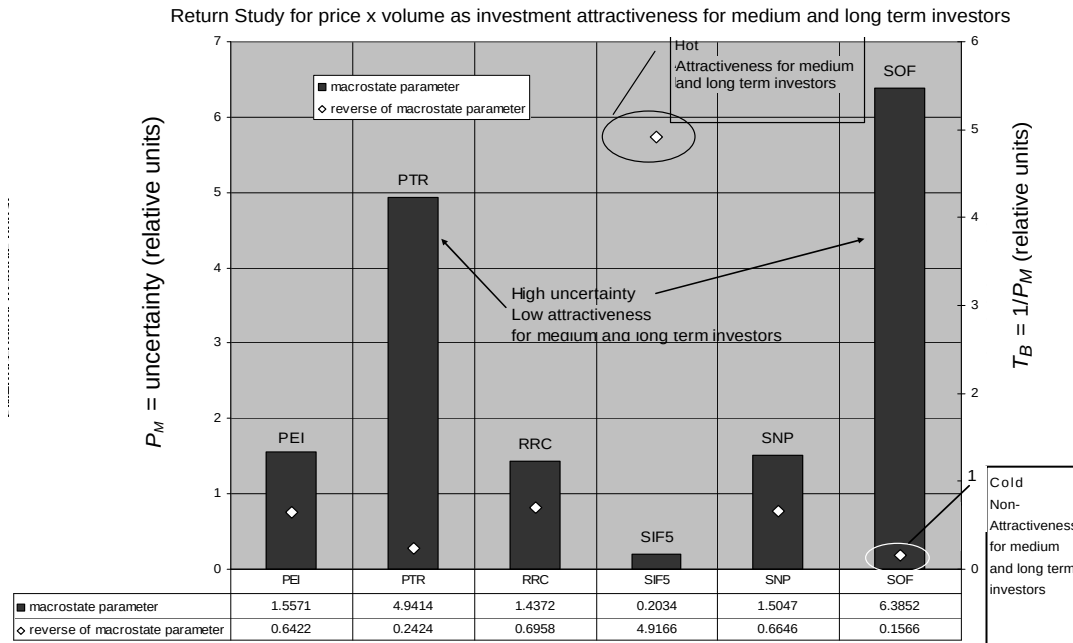


Figure 6. The macrostate parameters P_M and $1/P_M$ for the some companies transacted at Romanian Stock-Exchange Market (BVB) in 2004.

If we look at chart where the diagrams of the macrostate parameter P_M are represented (Fig. 6), we can directly see how it can be used. Its value is showing us the degree of uncertainty for uncertain shares although they have a large volume of trading (see SOF or even PTR cases). We can conclude that for these shares, the macrostate parameter P_m or financial entropy S_e is larger mostly due to chaos induced by the market because of

low prices and large transacted volumes despite of strong uncertainty of company evolution and lowly liquidity.

As it have been in previously paper [28], from what was shown it is seen that, practically the macrostate parameter is a measure of the uncertainty from the economic point of view and a measure of the disorder (entropy) in the stock-markets from econophysics point of view. In other words the economic uncertainty can be measured by the macrostate parameter, which is the entropy equivalent from physics.

Taking in account these considerations, from the above mentioned paper [28] we extended our study on the 40 companies quoted at I and II categories of the BVB (Romanian Stock-Exchange Market) and applying the methodology described above, using of the macrostate parameter, the investment risk scale for the companies enlisted during 2006 year is established (Fig. 7). The financial results of the companies corroborate with their hierarchy on the macrostate parameter value for the 2006 year (Fig. 7) verified the theoretical considerations of foundation of the econophysics model for the risk estimation in the Romanian stock-exchange market [28].

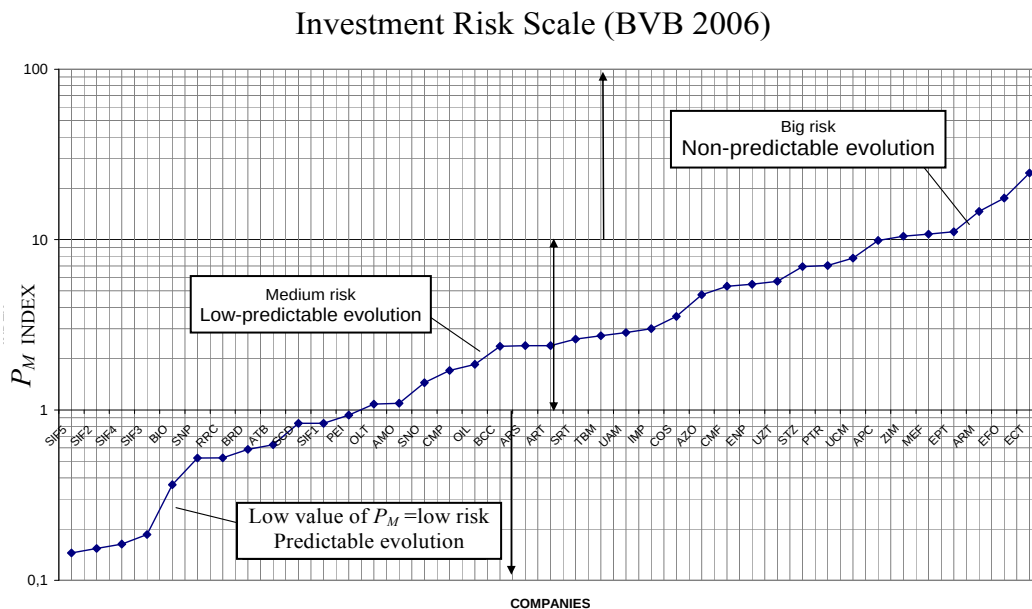


Figure 7. Investment risk scale for the 40 Romanian companies quoted at Bucharest stock-exchange market (BVB) during 2006 year.

5. Conclusions

To investigate the economic phenomena and processes, some methods, theories or models borrowed from other sciences, particularly from the exact sciences (physics, mathematics) or natural and social sciences etc, are widely used. Thus have been born and developed some border sciences as econometry and more recently econophysics, the latter having a variety of branches or subdomains. In this paper we attempted a systematization of different subdomains or branches of econophysics. Thus, all subdomains that use statistical mathematics and statistical physics methods are grouped in the major domain of **statistical econophysics**, while econophysics subdomains and models that use models inspired by phenomena and laws from other domains of physics (other than statistical physics) or from other sciences are grouped in the major domain of **phenomenological econophysics** (see Figure 1).

The phenomenological econophysics models were developed based on analogies between economic processes and laws, and phenomena and laws from fundamental or applied physics (electronics) especially of Electricity, Condensed Matter, Thermodynamics or Engineering (econo-engineering models). The conclusions and the mathematical equations that have been established for substantiation of these models find their applications in economic practice and checks and implicitly justifies the validity of economic laws deducted semi-empirically or based on practical observations. In this paper we gave some examples of such correspondences between the laws or equations found for such phenomenological econophysics models and the economic regularities or models established by different researchers.

In most models of statistical econophysics is presented the **static situation** of laws or state of the economic processes or phenomena, found in the form of the normal distribution laws of Gauss type, exponential, logarithmic, or power distribution law, Boltzmann-Gibbs, Fermi-Dirac or Bose-Einstein distributions etc., especially for the study of stock-markets, of wealth or income distribution, of resources distribution (money, gold, oil etc.) of the different categories of products etc.

Phenomenological econophysics models have the property that based on the analogy between empirical economics phenomena or laws and the laws and phenomena of fundamental physics (other than statistical of Physics) can be developed a model or mathematical equations confirming the practical approaches and the laws from the analyzed economic domain.

As shown in the examples of phenomenological econophysics models mentioned in this paper, mathematical equations established in the each model confirm the economic lawfulness determined empirically from the economic practice. This fact supports the economic laws used in practice, showing that, as have been done so far, are the most appropriate laws for the analyzed economic processes or phenomena.

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COMPETITION BETWEEN TWO INTERDEPENDENT BINARY OPINION NETWORKS: THE ROLE OF OPPORTUNISTS AND CONTRARIANS

Karl E. KÜRTEN*

Abstract. *We study a binary model for the process of opinion formation among agents having the choice between two products. The products A and B are represented by two networks specified by randomly chosen intra couplings within the networks and interdependent inhibitory couplings between the two networks which compete for the choice of the two products. The interactions within the two networks are based on the familiar local majority/minority rules of behaviour. Due multistability, a subtle interplay between opportunists, contrarians leads to dynamical phase transitions which abruptly can change the outcome of the acceptance of one of the two products. "Tie" phenomena stemming from the coexistence of opportunists and contrarians, reminiscent of various recent hung elections, where the systems turn out to be highly unstable with respect to minor local perturbations in the original uncoupled systems, can be successfully overcome by the choice of the initial conditions.*

Keywords: *social networks, opinion spreading, dynamical phase transitions, majority/minority rule, opportunistic-contrarian behaviour.*

1. Introduction

The theoretical study of discrete choice has long been a subject of interest in social and economic sciences. During the last decades, after social interactions, had first been introduced for sociological problems by social scientists, theoretical physicists started to apply methods commonly used in the area of statistical physics to social phenomena such as opinion formation and economic dynamics [1, 2, 3, 4]. Indeed, there is an intimate relationship between ferro- and anti-ferromagnetic models and collective decision making processes. The magnetic moment of a particle can be

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identified with the choice of an agent, spin up could be identified with YES and spin down with NO, respectively. Social interactions of agents are then naturally described by the process of the tendency to align or disalign. Up to now, mostly single isolated networks have been studied in this context. However, social real-world infrastructures usually interact with each other, and their dynamical behaviour depends crucially on the dynamics of various other networks. This gives rise to inter- couplings between networks, which are usually not isolated at all. We consider a system consisting of N agents who discuss the acceptance or refusal of a two competing choices A and B , which are interdependent and exclude each other.

Indeed, almost all real world networks are interconnected and non-trivially depend on each other, since there is a crucial need for mutual activation or inhibition. To give an example, various infrastructures such as water supply, transportation, fuel and power stations are coupled together and depend on each other such that even localized random damage in one network may lead to failures in the interdependent networks and can produce cascades of failures [3]. In this model, each agent i is assigned K randomly chosen agents who try to convince agent i to make a decision, in favour or against with respect to product A or product B . The dynamical decision making process is based on the majority- and minority rule, where opportunists adopt the opinion of the majority, where the contrarians adopt the opinion of the minority with respect to their local neighbourhood. The model thus may also describe how agents from different cultures try to convince each other, in either their or in the opposite direction.

In particular, we study the effects of mixed interactions between opportunists and contrarians based on only two simple behaviour schemes expressed by simple threshold rules which in the mixing case are able to generate rather complex behaviour. One focus of this study is the determination of critical network parameters, where the network dynamics undergo transitions from the existence of two attractors, the YES and NO attractor, to one unique stable attractor [5, 6].

2. Two interdependent networks

The system is made up of two coupled networks A and B , each of which consists of N interacting agents described by binary variables $x_i^A(t)$

and $x_i^B(t)$, respectively. Within network A and network B the nodes are randomly connected via intra couplings c_{ij} , where each agent i is influenced by exactly K randomly chosen agents $j_1(i), \dots, j_K(i)$ of its own network. We assume further that each agent i of network A interacts only with one and only one single agent j_i of network B . Agent j_i can be chosen at random or could be its counterpart in the competing network ($j_i = i$). The inter coupling between the two networks can be chosen bi-directional in contrast to the intra-links within the individual networks which are usually uni-directional. In principle, network A and network B could be identical such that agent i votes for the choice A and the choice B in the two networks [2].

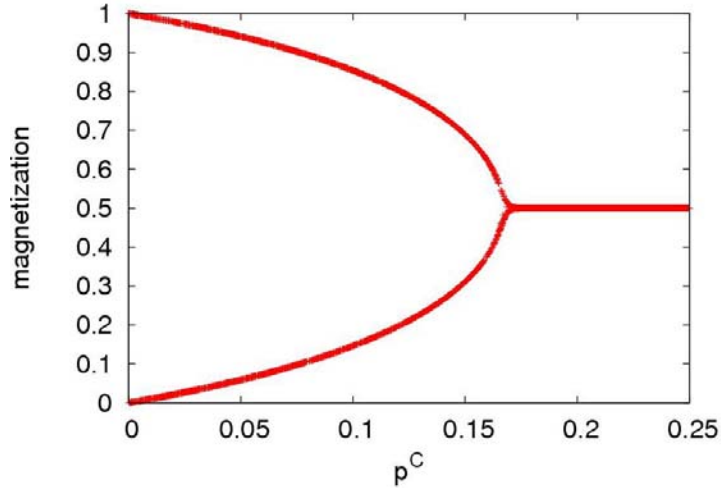


Figure 1. Asymptotic behaviour for an uncoupled network.

Following the lines of the majority/minority principle the intra couplings are chosen as $c_{ij} = 1$ with probability p^O and $c_{ij} = -1$ with probability $p^C = 1 - p^O$ for all $j = 1, \dots, N$, where i is fixed such that all incoming stimuli to unit i are either excitatory (ferro-) or inhibitory (anti-ferromagnetic). Note that we restrict p^C to small values, since the fraction of contrarians is usually small and they are by far in the minority. The time dependent variables $x_i^A(t)$ and $x_i^B(t)$ define the YES (1) and NO (0) state of agent i for choice A and for choice B , respectively. For simplicity we will further concentrate on K odd where always exists a majority in favour of one of the two choices. Opportunists follow the majority opinion in their

local neighbourhood and obey the local majority rule, while the contrarians, who always adopt the opinion opposite of that of the majority, obey the local minority rule.

Starting with initial values $x_i^A(0)$ and $x_i^B(0)$ at time $t = 0$ we define the dynamical time evolution in terms of a linear generalized threshold rule widely used in models of neural and genetic networks [7, 8].

$$x_i^A(t+1) = (1 - x_i^B(t)) \Theta \left(\sum_{(j)} c_{ij}^A \left(x_j^A(t) - \frac{K}{2} \right) \right) \quad (1)$$

and

$$x_i^B(t+1) = (1 - x_i^A(t)) \Theta \left(\sum_{(j)} c_{ij}^B \left(x_j^B(t) - \frac{K}{2} \right) \right) \quad (2)$$

where the threshold value $\frac{K}{2}$ is adapted to the majority/minority rule. The inter-coupling product terms $(1 - x_i^B(t))$ and $(1 - x_i^A(t))$ imply that an agent cannot vote for both choices at the same time. The index (j) runs over K randomly chosen neighbours of agent i . The theta function is specified by $\Theta(x) = 1$ for $x \geq 0$, and $\Theta(x) = 0$ for $x < 0$. The sum in the theta function represents the individual stimulus of unit i received from the elements of its own network.

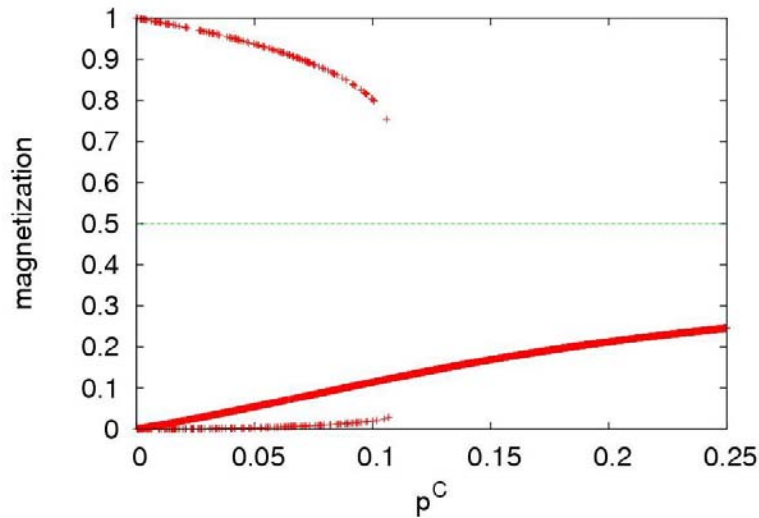


Figure 2. Asymptotic behaviour for two coupled networks.

A suitable order parameter, the public opinion at time t , which defines the degree of acceptance of the YES or NO state, can be defined by the total magnetizations:

$$m^A(t) = \frac{1}{N} \sum_{j=1}^N x_j^A(t) \quad \text{and} \quad m^B(t) = \frac{1}{N} \sum_{j=1}^N x_j^B(t) \quad (3)$$

the average magnetization of the two networks.

3. Analytical results

In the thermodynamic limit of asymptotically large N , statistical predictions for the time evolution of the magnetization $m(t)$ Eq. (4) and Eq.(5) can be derived [5]. The time evolution of the magnetization or public opinion with respect to the YES state $m(t+1)$ is a linear superposition of all contributions to the YES state. Eventually it takes the form:

$$m_A(t+1) = (1 - m_B(t)) ((1 - 2p^C) (3m_A^2(t) - 2m_A^3(t)) + p^C) \quad (4)$$

$$m_B(t+1) = (1 - m_A(t)) ((1 - 2p^C) (3m_B^2(t) - 2m_B^3(t)) + p^C). \quad (5)$$

Figure 1 (upper) depicts the asymptotic magnetization m^* for an uncoupled network as a function of the concentration of the contrarians p^C . If only opportunists are present in the uncoupled model ($p^C = 0$), the competing states YES (1) or NO (0) are monotonically approached after a short transient, i.e. the only stable states are the fully ordered ones. With increasing values of p^C we have two equally probable attractors which define a state of high and low demand. They are reached depending on which product is favoured in the initial condition. For $p^C = \frac{1}{6}$ we have a

backward bifurcation and for $p > p^C$ the tie state $m^* = \frac{1}{2}$ is reached independent of the initial condition. This second order phase transition, where one spin flip implies a cascade of flips of other agents leads to a chaotic state. Note however, that the macroscopic state, the magnetization $m^* = \frac{1}{2}$ is a stable attractor. We recover the familiar uncoupled network if

we set $x_i^B = 0$ in Eq. (4) and simply ignore Eq. (5). The tie phenomenon, a pure symmetry effect, since the rules are symmetric, was first reported by Galam in his original model [4, 5].

For the coupled system, depicted in Figure 2, the situation is similar. Only for $p^C = 0$ we have polarisation, i.e. fixed points $(m_A^*, m_B^*) = (1,0)$, $(m_A^*, m_B^*) = (0,1)$, and $(m_A^*, m_B^*) = (0,0)$ which are all stable.

For $p^C \neq 0$, in marked contrast to the uncoupled model we have three potential states of equilibrium of high, middle and low demand, however the symmetry is. The two fixed points, which signal a more or less clear decision for product A or B, are not symmetric any more. In analogy to the uncoupled system there is a critical $p^C \approx 0,107$, where the two fixed points become unstable. However in the coupled case the phase transition is first order and two branches bifurcate discontinuously into a unique fixed point (m_A^*, m_B^*) with $(m_A^* = m_B^*)$. The third fixed point with $(m_A^* = m_B^*)$ signals a tie situation at a rather low level of acceptance for both products. It is stable over the whole range $p > p_C$ and could be interpreted as an important fraction of non-voters. Provided that the number of the initial acceptance of product A and B are both high the two networks compete strongly for the votes and they mutually reduce their acceptance, since the agent is not allowed to vote for A and B simultaneously.

The stable and unstable solutions of Eq. (4) can be solved graphically by the following two curves crossing in the (m_A^*, m_B^*) – plane defined by

$$m_B = f_A(m_A) = 1 - \frac{m_A}{(1 - 2p^C)(3m_A^2 - 2m_A^3) + p^C} \quad (6)$$

$$m_A = f_B(m_B) = 1 - \frac{m_B}{(1 - 2p^C)(3m_B^2 - 2m_B^3) + p^C} \quad (7)$$

where the function $f_B(m_A)$ is the inverse of $f_A(m_A)$. The long time behaviour is governed by the basins of attraction of the stable fixed points of the system presented in Figure 3 and Figure 4. Preferentially, initial conditions, with m_A small and m_B large, guarantee a clear victory for A or B. The boundary line which separates the basins of attraction of the tie situation and the two states of high and lower acceptance can be approximated by the superelliptical curve specified by the equation

$$\left(\frac{m_A}{a}\right)^\alpha + \left(\frac{m_B - 1}{b}\right)^\alpha = 1 \quad (8)$$

with $\alpha < 2$, where the unshaded areas within the superelliptic shape specify the (m_A, m_B) space, where we have $m_A^* \neq m_B^*$. In this areas the product with more favourable initial condition for the YES always wins. In the shaded area the time evolution ends up with $(m_A^* = m_B^*)$, the tie situation.

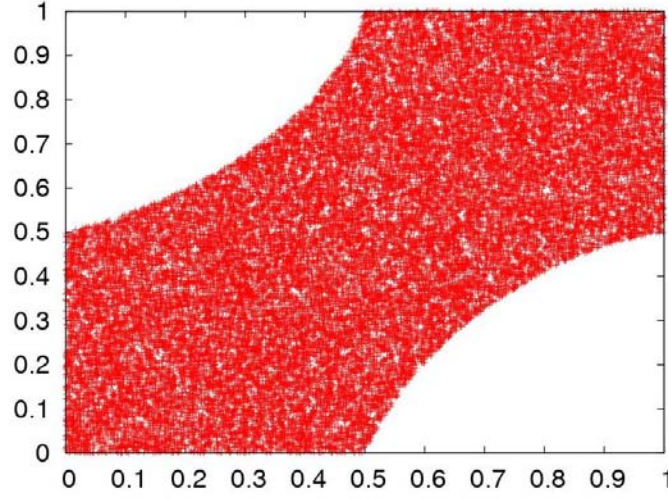


Figure 3. Basin of attraction in the (m_A, m_B) – plane for $p_c^O = 0$ with $\alpha = 1.46$, $b = 0.5$, $\alpha = 0.5$.

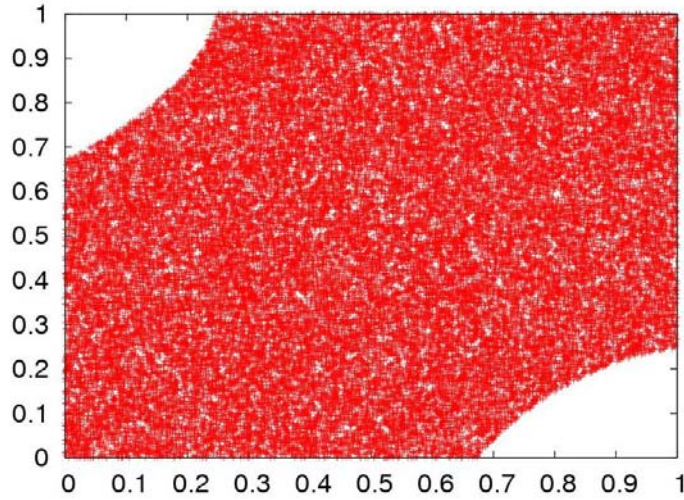


Figure 4. Basin of attraction in the (m_A, m_B) – plane for the near critical $p^O = 0.106$ with $\alpha = 1.4$, $b = 0.325$, $\alpha = 0.248$.

4. Summary

We have presented two coupled networks which compete for the vote of two choices via inhibitory interdependent interactions. The agents are described by two prototypes of opposite characters in order to study the subtle balance of opportunistic and contrarian behaviour in the dynamics of opinion spreading. Due to multistability it is eventually only the initial condition which decides about winning, loosing, or the tie situation which prevails. With increasing fraction of the contrarians the basin of attraction for a clear victory of one of the two choices becomes smaller and eventually vanishes at a critical concentration of the contrarians $p_c^C \approx 0.107$, where, independent of the initial conditions, we have a tie situation with a relatively low rate of votes for the acceptance state. At lower concentrations of the contrarians we find two stable fixed point configurations signalling a more or less clear YES or NO majority. Beyond the critical point p_c^C we find a unique stable fixed point which corresponds to the tie situation independent of the initial condition.

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MATHEMATICAL MODELING OF WAVE PROPAGATION IN THE FINITE HOMOGENEOUS LINES

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Abstract. *We propose mathematical modeling of wave propagation in the finite homogeneous isotropic lines under the so called “expo functional” influences. Spatial and temporal coordinates vary in arbitrary finite intervals. Analytical study bases on the explicit solution of the corresponding boundary problem in the specific case of the general wave equation caused by the symmetrical differential Maxwell system.*

Keywords and phrases: *mathematical modeling, wave propagation, finite coordinate boundary problem, general wave equation, symmetrical differential Maxwell system.*

1. Introduction

In spite of diversity of computer numerical programs, requirement of effective mathematical modeling and analytical study in modern electrodynamics remains nowadays urgent too [1, 2]. Such scientific direction concerns also phenomena of wave and/or signal propagation in the guide systems including various types of lines. Mathematical modeling here is based on the symmetrical differential Maxwell system [3] that describes the so called “expo functional” influences in terms of those functions’ kernels [4]. Solvability criterion of this matrix problem in the meaning of its equivalence to the general wave PDE (partial differential equation) was proved completely in [5]. Such equation contained all scalar components of the unknown electromagnetic field intensities, and investigated medium was isotropic linear and homogeneous. Moreover, only ordinary, non generalized functions were taken into account.

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Though the given general spatial case of (x, y, z, t) was very important, specific statement of (x, t) remains practically required as well. It is quite natural, since electrodynamics processes are considered here not in the waveguides, but in the lines, whose mathematical representation can not be got by direct simple reduction of (x, y, z, t) to (x, t) . Confirmation of this fact is shown in the next section when the symmetrical Maxwell system appears.

Turning again to the aforesaid solvability criterion, it should be noted that its existence allows formulating relevant electrodynamics phenomena analytically in terms of the boundary problems regarding the general scalar wave PDE. It is clear that such approach is incomparably easier than dealing with the original matrix/vector version. Hence, quite a lot of respective electrodynamics processes can be studied effectively using those boundary statements as their mathematical simulation. Thus the wave propagation under “expo functional” influences for the semi-infinite isotropic homogeneous lines and arbitrary finite time gaps was explicitly investigated in [6].

Unfortunately, rather important case of the same problem for arbitrary finite lines was not considered yet. That is why the goal of the present paper is mathematical modeling and constructive study of wave propagation in arbitrary isotropic homogeneous finite lines with various finite time gaps.

2. Mathematical modeling in terms of Maxwell system

First of all, let the symmetrical differential Maxwell system be given for homogeneous isotropic linear media in the presence of “expo functional” influences when their kernels are studied

$$\begin{cases} \mathbf{rot} \vec{H} = (\sigma \pm \lambda \varepsilon_a) \vec{E} + \varepsilon_a \partial_0 \vec{E} + \vec{j}^{OS} \\ -\mathbf{rot} \vec{E} = (r \pm \lambda \mu_a) \vec{H} + \mu_a \partial_0 \vec{H} + \vec{e}^{OS}. \end{cases} \quad (1)$$

In (1): the unknown vector functions $\vec{E}, \vec{H} = \vec{E}, \vec{H}(x, y, z, t)$ with scalar components $E_k, H_k = E_k, H_k(x, y, z, t)$ ($k = \overline{1,3}$) represent electric and magnetic field intensities; positive constants $\sigma, \mu_a, \varepsilon_a$ are the specific conductivity, absolute and dielectric permeability of the medium

respectively; vector functions $\vec{j}^{OS}, \vec{e}^{OS} = \vec{j}^{OS}, \vec{e}^{OS}(x, y, z, t)$ are known and describe the outside current sources and intensities. Their scalar components look like $j_k^{OS}, e_k^{OS} = j_k^{OS}, e_k^{OS}(x, y, z, t)$ ($k = \overline{1,3}$). Parameter of the signal exciting medium is $\lambda = \text{const} > 0$. Sign reversal in front of λ corresponds to the absorption of signal for “+” and activity of the medium for the “-“. Theoretical constant $r > 0$ is assumed only at the current research stage. It is responsible for the system symmetry and simplification of the further mathematical computation. At the end, it can be omitted not influencing the original problem statement and final numerical calculation. Partial differential temporal operator and classical rotor definition look like

$$\partial_0 = \frac{\partial}{\partial t}, \quad \text{rot} = \det \begin{bmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial_1 & \partial_2 & \partial_3 \\ F_{i1} & F_{i2} & F_{i3} \end{bmatrix}, \quad \text{where} \quad \partial_1 = \frac{\partial}{\partial x}, \partial_2 = \frac{\partial}{\partial y}, \partial_3 = \frac{\partial}{\partial z}.$$

Functions $F_{ik} = F_{ik}(x, y, z, t)$ ($i = 1, 2; k = \overline{1,3}$) designate scalar components of the appropriate vector electromagnetic field intensities $\vec{F}_1, \vec{F}_2 = \vec{F}_1, \vec{F}_2(x, y, z, t); \vec{F}_1, \vec{F}_2 = \vec{E}, \vec{H}$.

Mathematical simulation of the specific version of (1) in the case of wave propagation through the excited homogeneous isotropic lines with expo functional influences, is written below

$$\begin{cases} \partial_1 H = (\sigma + \varepsilon_a \partial_0^*) E + j^{OS} \\ -\partial_1 E = (r + \mu_a \partial_0^*) H + e^{OS}. \end{cases} \quad (2)$$

In (2), all symbols are of the same meaning as it was introduced in (1), and new partial differential operator looks like $\partial_0^* = \partial_0 \pm \lambda$. Here, in comparison with (1), electromagnetic field functions E, H, j^{OS}, e^{OS} are not vectors, but scalars and belong to one and the same ordinary differentiated functional class that is determined by the structure of (2). Later, this class can be modified taking into account the particular boundary problem conditions.

As it was said earlier in the section 1, system (2) is really the specific case of (1). It is completely explicable because one-dimensional rotor operation does not exist. So, the direct pure reduction of (1) to (2) is impossible without detailed additional study in the suggested particular statement of (x, t) .

3. Preliminary results

Rewriting (2) in the matrix form we get

$$MF = f, \quad M = \begin{bmatrix} -C & \partial_1 \\ -\partial_1 & -D \end{bmatrix}, \quad (3)$$

where: $C = \sigma + \varepsilon_a \partial_0^*$; $D = r + \mu_a \partial_0^*$ – are the partial differential operators;

$$F_1 = E, F_2 = H; \quad f_1 = j^{OS}, f_2 = e^{OS}; \quad F = \begin{bmatrix} F_1 \\ F_2 \end{bmatrix}, f = \begin{bmatrix} f_1 \\ f_2 \end{bmatrix} \quad - \text{ are the}$$

aforesaid electromagnetic field functions.

Application to (2) of the inverse matrix operator M^{-1} regarding (3)

$$M^{-1} = (\det M)^{-1} \begin{bmatrix} -D & -\partial_1 \\ \partial_1 & -C \end{bmatrix}, \quad \det M = \partial_1^2 + CD, \quad (4)$$

reduces (2) to the general wave PDE [6]

$$(\tilde{\partial}_0^2 + \partial_1^2)F = \tilde{f}. \quad (5)$$

In (4), (5): $\det M$ – is the determinant of (3); $(\det M)^{-1}$ – is the inverse scalar operator with respect to $\det M$;

$\tilde{\partial}_0^2 = CD = (\sigma + \varepsilon_a \partial_0^*)(r + \mu_a \partial_0^*) = \varepsilon_a \mu_a (\partial_0^*)^2 + (\sigma \mu_a + r \varepsilon_a) \partial_0^* + \sigma r$ – is the operator differential polynomial;

$$\tilde{f} = \begin{bmatrix} \tilde{f}_1 \\ \tilde{f}_2 \end{bmatrix} = \begin{bmatrix} -Df_1 - \partial_1 f_2 \\ \partial_1 f_1 - Cf_2 \end{bmatrix} - \text{ are the known functions, and operator}$$

“power” is understood in its usual meaning as the consecutive operator action.

Inverse application of (3) to (5) transforms this wave scalar equation backwards to (2). Analysis of those conditions while $\det M \neq 0$, carries out investigation of existence of (4) using square operator polynomial $\tilde{\partial}_0^2 + \partial_1^2$ in terms of ∂_0^* . Thus, the required necessity and sufficiency of the inverse matrix operator construction are proved, and the following theorem is true:

Solvability criterion of (2): the specific case (2) of symmetrical differential Maxwell system (1) is solved explicitly in the meaning of its equivalence to the general scalar wave PDE (5) iff conditions:

$$\left\{ \begin{array}{l} \partial_1^2 > \left(\frac{1}{2} (\sigma \sqrt{\mu_a / \varepsilon_a} - r \sqrt{\varepsilon_a / \mu_a}) \right)^2 \\ \partial_1^2 \leq \left(\frac{1}{2} (\sigma \sqrt{\mu_a / \varepsilon_a} - r \sqrt{\varepsilon_a / \mu_a}) \right)^2 \\ \partial_0 \neq \mp \lambda - \frac{1}{2} \left((\sigma / \varepsilon_a + r / \mu_a) \pm \sqrt{(\sigma / \varepsilon_a - r / \mu_a)^2 - 4 \partial_1^2 / (\mu_a \varepsilon_a)} \right) \end{array} \right. \quad (6)$$

are valid, and only ordinary classical, not generalized functions are taken into account.

Sign reversal in front of λ in (6) is independent of the sign value near the square root.

Here, we should like to remind that (2), as the particular case of symmetrical differential Maxwell system (1), has to be studied separately since the one-dimensional analogy of the classical **rot** operation does not exist. Moreover, the main virtue of the given criterion is essential simplification simulating mathematically signal and/or wave propagation in radio engineering and telecommunications. Namely, relevant boundary problems describing respective phenomena can be expressed in terms of PDE (5). The last fact cannot be even compared with the original system (2) by its new obvious scalar version. It is quite natural, because in general, corresponding correct boundary problem statement appears completely ambiguous in the matrix / PDEs' system form.

4. Boundary problem solution

Moving to the concrete mathematical modeling of the wave propagation in the finite homogeneous isotropic lines with arbitrary finite time gaps, we introduce the relevant boundary problem that is written below:

$$\left\{ \begin{array}{l} (\tilde{\partial}_0^2 + \partial_1^2)F = \tilde{f}, \quad x \in [0, a], \quad t \in [0, T]; \\ F(x, 0) = g_1(x); \\ F(x, T) = g_2(x); \\ F(0, t) = g_3^*(t); \\ F(a, t) = g_4^*(t). \end{array} \right. \quad \begin{array}{l} 0 \text{ --- } a \text{ --- } x \text{ --- } \rightarrow \\ t \in [0, T] \end{array} \quad (7)$$

In (7): $g_j(x)$ ($j=1,2$), $g_k^*(t)$ ($k=3,4$) – are the known functions existed in the corresponding intervals and required functional classes.

Explicit solution of (7) is done by means of the Fourier finite integral sine transform [7] application to the spatial variable x along the interval $[0, a]$ and considering temporal argument t as the main one. Hence, integrating by parts twice

$$\begin{aligned} \frac{\pi}{a} \int_0^a \partial_1^2 F(x, t) \sin\left(n \frac{\pi}{a} x\right) dx &= -\frac{\pi^3}{a^3} n^2 F_n(t) + \frac{\pi^2}{a^2} n((-1)^{n+1} F(a, t) + F(0, t)) = \\ &= \left(\frac{\pi}{a}\right)^2 n \left(-\frac{\pi}{a} n F_n(t) + (-1)^{n+1} g_4^*(t) + g_3^*(t)\right) \end{aligned}$$

and using this last expression we reduce (7) to the boundary problem with respect to the Fourier integral sine transforms. Namely,

$$\left\{ \begin{array}{l} \left(\frac{d^2}{dt^2} + a \frac{d}{dt} + b \right) F_n(t) = f_n^*(t), \quad t \in [0, T]; \\ F_n(0) = g_{1n}; \\ F_n(T) = g_{2n}, \end{array} \right. \quad (8)$$

where:

$$a = \sigma/\varepsilon_a + r/\mu_a \pm 2\lambda, \quad b = \lambda^2 \pm \lambda(\sigma/\varepsilon_a + r/\mu_a) + \left(\sigma r - \left(\frac{\pi}{a}\right)^3 n^2 \right) / (\mu_a \varepsilon_a)$$

– are the constant coefficients;

$$g_{jn} = \frac{\pi}{a} \int_0^a g_j(x) \sin\left(n \frac{\pi}{a} x\right) dx \quad (j = 1, 2);$$

$$F_n = F_n(t) = \frac{\pi}{a} \int_0^a F(x, t) \sin\left(n \frac{\pi}{a} x\right) dx; \quad \tilde{f}_n(t) = \frac{\pi}{a} \int_0^a \tilde{f}(x, t) \sin\left(n \frac{\pi}{a} x\right) dx;$$

$$f_n^* = f_n^*(t) = \left(\tilde{f}_n(t) - \left(\frac{\pi}{a}\right)^2 (-1)^{n+1} g_4^*(t) + g_3^*(t) \right) / (\mu_a \varepsilon_a) \quad - \quad \text{are the}$$

corresponding Fourier sine transforms whose lower index n means transformation operation.

Solving linear inhomogeneous ODE (ordinary differential equation) with constant coefficients from (8) by means of the well-known technique [8] we get the sought for transforms of electromagnetic intensities as the general solution of this mentioned equation.

Really, performance equation of ODE from (8) is written below:

$$\omega^2 + a\omega + b = 0. \quad (9)$$

The roots ω_j ($j = 1, 2$) and discriminant D of (9) look like:

$$\sqrt{D} = \omega_1 - \omega_2, \quad \omega_j = \left(-a + (-1)^{j+1} \sqrt{D} \right) / 2 \quad (j = 1, 2),$$

$$D = (\sigma/\varepsilon_a - r/\mu_a)^2 + 4 \left(\frac{\pi}{a} \right)^3 n^2 / (\mu_a \varepsilon_a) > 0. \quad (10)$$

Turning to (10), it is easy to notice that both roots are real. Therefore, the general solution $F_{0n} = F_{0n}(t)$ of the homogeneous ODE regarding original one from (8) has the following structure

$$F_{0n} = \sum_{j=1}^2 C_j^* e^{\omega_j t}, \quad \forall C_j^* = \text{const} \in \mathbf{R}. \quad (11)$$

It is well known [8] that the general solution $F_n = F_n(t)$ of the original ODE from (8) is the sum of (11) and particular solution $F_{pn} = F_{pn}(t)$ of the same inhomogeneous ODE from (8):

$$F_n = F_{0n} + F_{pn}. \quad (12)$$

Basing on the classical theory of linear ODEs [8] function F_{pn} is looking for as the functional sum:

$$F_{pn} = \sum_{j=1}^2 C_j(t) e^{\omega_j t}, \quad C_j(t) - ? \quad (13)$$

The unknowns $C_j(t)$ ($j = 1, 2$) in (13) are found from the differential system [8]:

$$\begin{cases} \sum_{j=1}^2 C_j'(t) e^{\omega_j t} = 0 \\ \sum_{j=1}^2 C_j'(t) \omega_j e^{\omega_j t} = f_n^*, \quad C_j'(t) = \frac{dC_j(t)}{dt} \quad j = 1, 2 \end{cases}$$

and are described by the general formula:

$$C_j(t) = \frac{(-1)^{j+1}}{\sqrt{D}} \int e^{-\omega_j t} f_n^* dt = \frac{(-1)^{j+1}}{\sqrt{D}} s_j(t) \quad j = 1, 2. \quad (14)$$

Substitution of (14) into (13) together with (12) and (11) gives:

$$F_n = \sum_{j=1}^2 \left(C_j^* + \frac{(-1)^{j+1}}{\sqrt{D}} s_j(t) \right) \exp(\omega_j t), \quad \forall C_j^* = \text{const} \in \mathbf{R}. \quad (15)$$

Implementation of the initial conditions from (8) allows determining C_j^* ($j=1,2$) from the following system:

$$\begin{cases} \sum_{j=1}^2 C_j^* = g_{5n}^*, & g_{5n}^* = g_{1n} + \frac{1}{\sqrt{D}} \sum_{j=1}^2 (-1)^j s_j(0) \\ \sum_{j=1}^2 C_j^* e^{\omega_j T} = g_{6n}^*, & g_{6n}^* = g_{2n} + \frac{1}{\sqrt{D}} \sum_{j=1}^2 (-1)^j s_j(T) e^{\omega_j T}. \end{cases} \quad (16)$$

The known functions $s_j(t) = \int e^{-\omega_j t} f_n^*(t) dt$ ($j=1,2$) at first appeared in (14), and required constants C_j^* ($j=1,2$) are found from (16):

$$C_j^* = \frac{(-1)^{j+1} (g_{6n}^* - g_{5n}^* \exp(\omega_{j+(-1)^{j+1}T}))}{(\exp(\omega_1 T) - \exp(\omega_2 T))}, \quad (j=1,2). \quad (17)$$

Substitution of (17) into (15) gives the required solution of boundary problem (8) in terms of Fourier transforms. Thus, we get:

$$F_n = \sum_{j=1}^2 (-1)^{j+1} \left(\frac{g_{6n}^* - g_{5n}^* \exp(\omega_{j+(-1)^{j+1}T})}{\exp(\omega_1 T) - \exp(\omega_2 T)} + \frac{s_j(t)}{\sqrt{D}} \right) \exp(\omega_j t), \quad (18)$$

and functions g_{5n}^*, g_{6n}^* are denoted in (16).

Application of the inverse Fourier finite sine transform [7] $\frac{2a}{\pi^2} \sum_{n=1}^{\infty} \sin\left(n \frac{\pi}{a} x\right)$ to (18) leads to the desired solution of the original boundary problem (7), i.e.

$$F(x, t) = \frac{2a}{\pi^2} \sum_{n=1}^{\infty} F_n \sin\left(n \frac{\pi}{a} x\right) =$$

$$\frac{2a}{\pi^2} \sum_{n=1}^{\infty} \sum_{j=1}^2 (-1)^{j+1} \left(\frac{g_{6n}^* - g_{5n}^* \exp(\omega_{j+(-1)^{j+1}T})}{\exp(\omega_1 T) - \exp(\omega_2 T)} + \frac{s_j(t)}{\sqrt{D}} \right) \exp(\omega_j t) \sin\left(n \frac{\pi}{a} x\right). \quad (19)$$

The last final formula represents constructive result of the original problem statement, and it means that the goal of the present paper is completely attained.

Furthermore, the next identity:

$$e^{\omega_1 T} - e^{\omega_2 T} = e^{\frac{a}{2}T} 2\text{sh}\left(\frac{\sqrt{D}}{2}T\right)$$

reduces (19) to the equivalent expression:

$$F(x, t) = \frac{2a}{\pi^2} \sum_{n=1}^{\infty} \sum_{j=1}^2 (-1)^{j+1} \left(\frac{g_{6n}^* e^{\frac{a}{2}T} - g_{5n}^* e^{(-1)^{j+1} \frac{\sqrt{D}}{2}T}}{2\text{sh}\left(\frac{\sqrt{D}}{2}T\right)} + \frac{s_j(t)}{\sqrt{D}} \right) e^{\omega_j t} \sin\left(n \frac{\pi}{a} x\right). \quad (20)$$

Further analysis of absolute functional series' convergence [9] in (19) = (20) with respect to $x \in [0, a]$ is supported by the following inequality:

$$\begin{aligned} \frac{2a}{\pi^2} \sum_{n=1}^{\infty} \left| F_n \sin\left(n \frac{\pi}{a} x\right) \right| &\leq \frac{2a}{\pi^2} \sum_{n=1}^{\infty} |F_n| = \\ &= \frac{2a}{\pi^2} \sum_{n=1}^{\infty} \sum_{j=1}^2 (-1)^{j+1} \left| \left(\frac{g_{6n}^* e^{\frac{a}{2}T} - g_{5n}^* e^{(-1)^{j+1} \frac{\sqrt{D}}{2}T}}{2\text{sh}\left(\frac{\sqrt{D}}{2}T\right)} + \frac{s_j(t)}{\sqrt{D}} \right) e^{\omega_j t} \right|. \end{aligned}$$

The last depends on those coordinate, medium's parameters and given functions that are responsible for description of studied wave propagation.

5. Concluding remarks

First of all, coming to the shortcomings of the given paper, the lack of concrete numerical computation can be noticed. It means that just at this moment, present investigation has only theoretical analytical research tendency.

Nevertheless, explicit solution of (7) that is provided by the last expressions (19), (20) in Section 4, is easily calculated for various numerical values of $T, a, \sigma, \varepsilon_a, \mu_a, \lambda, r$ and corresponding functions $g_j(x)$ ($j=1,2$), $g_k^*(t)$ ($k=3,4$), j^{OS}, e^{OS} from formulae (7), (2). So, it is clear now that the next computing and experimental verification is not only supported, but essentially simplified already because of (19) = (20) as the explicit solution of the original problem (7). Hence, the further numerical results are the corollaries of the suggested exact formulas (20), (19), (16), (8), and are obtained easier in comparison of existing approximate computing procedures [1, 2].

Taking into account all aforesaid information, it can be mildly concluded that proposed here mathematical analytic method has its own virtues basing upon obvious generalization to the bigger dimensional systems of PDEs. The latter are used as mathematical simulation not only in electromagnetic field theory, but in other various aspects of applied / industrial problems.

Moreover, turning to [6], it is easy to find apparent similarity between (20) and final result from [6] when $x \in [0, \infty)$ and t remains the same as in the present paper. Actually, the main difference bases on the interval variation of x and consists of the finite integral sine Fourier application instead of the continuous one in [6]. Detailed theoretical and numerical analysis of interrelations between those two cases proposed in [6] and in the present paper is planned to be studied in the nearest future. This challenge looks interesting and important as from the analytical, as from the applied engineering viewpoints.

At the very end, clarifying the last mentioned information, the simple table is proposed here. It shows evident interconnections between objects in the given article (they are located on the left) and their analogies from [6] (they are placed on the right). Namely, index of Fourier transform $n \mapsto$ becomes index of Fourier transform α ; $g_3^*(t) \mapsto g_3(t)$; $g_4(t) \mapsto 0$;

$$g_{6n}^*, g_{5n}^* \mapsto g_{5\alpha}, g_{4\alpha}; \quad \text{in } D \quad \text{instead of} \quad \left(\frac{\pi}{a}\right)^3 n^2 \mapsto \alpha \quad \text{appears};$$

$$E, H \mapsto H, E;$$

$$f_n^* = f_n^*(t) = \left(\tilde{f}_n(t) - \left(\frac{\pi}{a}\right)^2 ((-1)^{n+1} g_4^*(t) + g_3^*(t)) \right) / (\mu_a \varepsilon_a) \mapsto$$

$$f_\alpha^* = f_\alpha^*(t) = -(\tilde{f}_\alpha(t) + \alpha g_3(t)) / (\mu_a \varepsilon_a);$$

$$\begin{aligned}\tilde{f}_1 &= \tilde{f}_1(x, t) = -Dj^{OS} - \partial_1 e^{OS} \mapsto \tilde{f}_1 = \tilde{f}_1(x, t) = -\partial_1 j^{OS} + Ce^{OS}; \\ \tilde{f}_2 &= \tilde{f}_2(x, t) = \partial_1 j^{OS} - Ce^{OS} \mapsto \tilde{f}_2 = \tilde{f}_2(x, t) = \partial_1 e^{OS} + Dj^{OS}, \quad \text{and} \quad \text{all}\end{aligned}$$

other symbols remain the same in both cases.

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FROM GEORGESCU-ROEGEN'S BIOECONOMICS TO THE META-ANALYSIS OF THE SOCIOECONOMIC AND ENVIRONMENTAL METABOLISM

Raluca I. IORGULESCU*, Mariana BALAN*

Abstract. *Implementing the bioeconomic program proposed by Georgescu-Roegen led to the meta-analysis construct for the socioeconomic metabolism subject to the laws of thermodynamics.*

This paper presents the essence of Georgescu-Roegen's criticism of the neoclassical economics theory that led him to formulate the bioeconomic paradigm as an alternative to standard welfare economics.

We discuss the extension of Georgescu-Roegen's idea regarding the utility associated to leisure, extension done by Giampietro and Mayumi, to a method for multi-scale integrated analysis of the socioeconomic metabolism. According to Herman Daly, the adoption of the bioeconomic paradigm requires extremely important changes in the way the 'building blocks' of economics are assembled: the 'entropic flow diagram' replaces the 'circular flow diagram' and 'the natural resources and the environment' become the main point for the development of the theory. Therefore, the idea of 'continuous growth' would cease to be the main objective of economic policy while the progress of 'technology' is aimed to increase the efficiency of entropy flows. When the entropic conceptual framework is considered, improving or eliminating 'poverty' cannot be achieved without redistribution (only through growth), while the current model of 'development and modernization' associated with increasing and intensifying production and consumption must be replaced by a model that promotes maintaining the entropic flow, flow monitored by an index measured in the system of national income accounts.

Last but not least, the importance of institutions for the socioeconomic metabolism is contrasted to the theoretical foundations of welfare economics guiding current economic policies for development and poverty elimination.

Keywords: *socioeconomic metabolism, bioeconomics, Georgescu-Roegen.*

JEL Classification: B25, Q57.

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1. Introduction

Georgescu-Roegen is known, among many notable contributions, for the application of the second law of thermodynamics, the law of entropy, to analyze the economic process [1]. His visionary idea to build a sort of meta-economic analysis associated with the concept of socioeconomic metabolism subject to the laws of thermodynamics, led him to develop the flow-fund model and to sketch a bioeconomic program (having the role of transforming current human economy from destructive, at the level of the global integrated ecosystem, to long-term sustainable). Although during his lifetime (he died in October 1994) his bioeconomic program did not fully come to life, in the past fifteen years, his student Kozo Mayumi (Professor at Tokushima University, Japan) together with Mario Giampietro (Professor at Universitat Autònoma Barcelona, Spain) have developed a method for meta-analysis of economic, societal and ecosystem metabolism (Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism MuSIASEM) based on the ability of the bioeconomic concept “to integrate the representation of monetary flows with matter and energy flows. In this way, it provides a bridge between economic, ecologic, social and demographic analysis”. [2]

Georgescu-Roegen insisted on the conceptual difference between agricultural and industrial processes that cannot operate according to the same economic laws [3]. He conceived “the difference between the philosophy of the industrial town and that of the agricultural village” [4] in relation to two types of constraints, one corresponding to the “living Nature” impacting on *Homo agricola*, and the second one corresponding to the “inert matter” impacting on *Homo faber*. Consequently, in order to be appropriate, economic analysis should discriminate between the economic processes at a village level and at the urban, industrial level.

Unfortunately, the economic theory has embedded in its core the inaccurate assumption “that the peasant ...behaves irrationally” [5]. Almost fifty years ago, Georgescu-Roegen explained how, being guided by utility theory and rational-choice profit functions, economists came to this conclusion. Recent studies in the field of economic anthropology and other disciplines brought scholars to understand the importance for the economic process of institutional specificities in various societies (rural or urban, developed, transitional, or developing).

A simple example could prove to be thought-provoking about the implications of such a theoretical correction. In Romania, compared to 23% average EU-27 rural population [6], 45% of country’s population [7]

lives in rural areas (Table 1) and 35% of it is working for private agricultural businesses in rural areas compared to only 28% in 1989 [8].

Table 1.

Rural and urban population in Romania 2007-2011

	2007	2008	2009	2010	2011
% urban population	55%	55%	55%	55%	55%
% rural population	45%	45%	45%	45%	45%

For 2008, 2009 and 2010 data at July 1st, while for 2011, at January 1st.

Source: CNS-Statistical Yearbook of Romania 1990. The National Commission for Statistics.

The rest of the paper is organized as it follows: Section 2 lists some of the pervasive technicalities of the standard economic theory that invisibly guided the development of a global unsustainable and destructive lifestyle. Section 3 presents the transition from Georgescu-Roegen's flow-fund model, representing the economy as a metabolic system, to a new type of socioeconomic – environmental meta-analysis. Section 4 introduces the Georgescu-Roegen's sketch for a bioeconomic program conducive to a sustainable society; it also lists what would change in basic economic theory if that bioeconomic program would be adopted. Section 5 emphasizes that urban and rural economic processes do not have the same nature and their treatment in economic theory should be different to promote a safe and sustainable development. Section 6 concludes.

2. Goergescu-Roegen's critique of standard economic theory

In his introduction to *The Entropy Law and the Economic Process*, Georgescu-Roegen argued that the fundamental flaws involved in standard economic theory are the concepts of *Homo economicus* and the mechanistic structure of economics:

No science has been criticized by its own servants as openly and constantly as economics. The motives of dissatisfaction are many, but the most important pertains to the fiction of *homo economicus*. The complaint is that this fiction strips man's behaviour of every cultural propensity, which is tantamount to saying that in his economic life man acts mechanically. This is why the shortcoming is ordinarily exposed as the mechanistic outlook of modern economics [5].

Mechanics knows only locomotion, and locomotion is both reversible and quality less. The same drawback was built into modern economics by its founders, who, on the testimony of Jevons and Walras, had no greater aspiration than to create an economic science after the exact pattern of mechanics. [4](p. 1)

For half a century, Georgescu-Roegen produced sophisticated critics within the neoclassical theory and provided an outline of alternatives to standard welfare economics. He insisted on the importance of drawing explicit relevant analytical boundaries for the purpose of specific studies. Standard economics has been criticized for its *arithmomorphism*, meaning the characterization of economic behaviour as having a one-to-one association to the real numbers set. The alternative he proposed is to use what he calls the *dialectical* representation. Georgescu-Roegen argued that we need both concepts, arithmomorphic and dialectical, to study the economic process: some phenomena require a quantitative analysis, and others can only be understood using a qualitative approach, while others require them both.

In contrast with the approach of the new welfare economics (new welfare economics NWE) based on the laws of classical mechanics, Georgescu-Roegen [9] advocated a progressive approach based on the laws of thermodynamics. He pointed out that the economic process is one of qualitative change characterized by discontinuous leaps rather than by marginal changes:

The usefulness of the analytical models that represent similes of actual processes (divested, however, of any qualitative change) cannot be denied. But what matters most in the case of evolutionary structures is the emergence of novelties, of qualitative changes. For these aspects we have no other solution than that of a dialectical approach, involving in particular structural changes. This means to use *words*, instead of numbers, for truly qualitative changes cannot be represented by an arithmomorphic model. [9] (p. 325)

3. The connection Georgescu-Roegen's bioeconomics — socioeconomic meta-analysis

Giampietro and Mayumi, based on Georgescu-Roegen's idea of utility associated to leisure, have built a socioeconomic metabolism meta-analysis method. As a starting point they use the concept of metabolic systems [10]:

Systems able to use energy and material flows to maintain, reproduce and improve their own existing structures and functions. ... Human beings, societies and ecosystems are all metabolic systems. For this reason, the availability of energy and resources, together with know-how and technology, are key factors determining the feasibility and desirability of patterns of societal metabolism (p. 261).

Metabolic systems are a sub-class of the class of dissipative systems [11]. Moreover, life is characterized by self-organization of evolving dissipative systems in relation to multiple hierarchical levels and for different scales of space-time. Interpreting the economy at a macro-level, nationally and internationally, as a metabolic system, Georgescu-Roegen questioned the micro-foundation idea for macroeconomics. His mentor, Joseph Schumpeter (quoted by Georgescu-Roegen, [9], p. 326) states: “It is therefore misleading to reason on aggregative equilibrium as if it displayed the factors which initiate the change and as if disturbance in the economic system as a whole could arise only from those aggregates.” Consequently, the thermodynamic approach for economic processes involves describing the macro-economy using different time scales and interacting hierarchical levels of analysis. Figure 1 presents how the hierarchical meta-analysis can be represented for the socioeconomic metabolism (for simplicity, we do not include the environment):

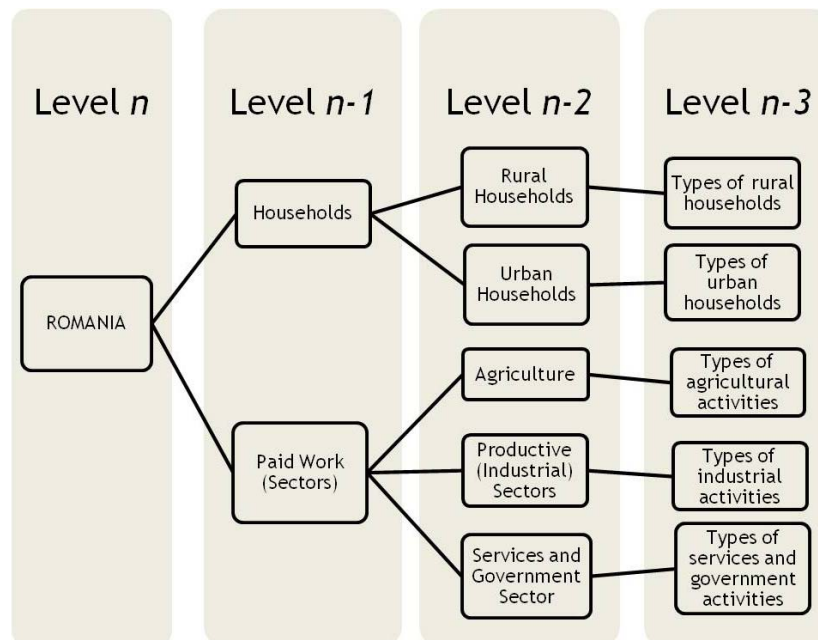


Figure 1. MuSIASEM levels.

Envisioning socio-economic systems as metabolic systems allowed Georgescu-Roegen to create the 'flow-fund' model. The components of the model are 'funds' (elements whose identity remains unchanged during the economic process are defining the system in the model) and 'flows' (produced or consumed during the economic process; are defining the interactions of the system in the model). Flows are, among other, money, energy and materials flows. Related to the concept of 'funds', Giampietro, Mayumi and Sorman give more details: “model fund elements are metabolic converters; they must be able to maintain and reproduce themselves in order to keep their original identity. Thus fund elements entail (1) an overhead, for their maintenance and reproduction, (2) a definition of what should be considered as an admissible input – their identity entails that they can only metabolize a specified type of inputs – and (3) a set of biophysical constraints on the relative pace of conversion of metabolized flows. Their identity can be associated to an expected power level and efficiency of conversion.” ([2], p. 384)

Although the limited extent of this paper prevents us from presenting in more detail the structure and operation of the MuSIASEM model of meta-analysis, it is extremely important to introduce the basic terminology.

Table 2 presents a selection of the most important MUSIASEM intensive variables.

Table 2.
MuSIASEM Intensive Variables

INTENSIVE VARIABLE	NAME	DESCRIPTION	UNIT
EMR _{SA}	Exosomatic Metabolic Rate for Societal Average	Amount of energy used per hour of human time for the whole society	MJ/hr; TET/THA
EMR _{HH} , EMR _{PW} (EMR _{AG} , EMR _{PS} , EMR _{SG})	Exosomatic Metabolic Rate for compartments (sectors) households and paid work (agriculture, industrial sectors, services and government)	Amount of energy used per hour in each sector	MJ/hr; ETi/HAi
ELP _{SA}	Economic Labour Productivity	Amount of value-added produced per hour of human time for the whole society	Lei/hr; GDP/THA

ELP_{PW} (ELP_{AG} , ELP_{PS} , ELP_{SG})	Economic Labour Productivity for Paid Work compartment sectors (agriculture, productive sectors, service and government)	Amount of value-added produced per hour of work spent in each sector	Lei/hr; GDPi/HAi
EI_{SA}	Energy Intensity Societal Average	Energy Consumed per unit of value-added generated	J/Lai; TET/GDP
EI_{PW} (EI_{AG} , EI_{PS} , EI_{SG})	Energy Intensity for Paid Work compartment sectors (agriculture, productive sectors, service and government)	Energy Consumed per unit of value-added generated for each sector	J/Lai; ETi/GDPi
EE_{SA}	Energy Efficiency Societal Average	Economic productivity measured in energy terms	Lei/J; GDP/TET
EE_{PW} (EE_{AG} , EE_{PS} , EE_{SG})	Energy Efficiency for Paid Work compartment sectors (agriculture, productive sectors, service and government)	Amount of value-added produced per unit of energy consumed in each sector	Lei/J; GDPi/ETi

Source: FP7-SSH-2007-1 SMILE. (2009). Report of the Romanian case study, Deliverable 9, WP 3, pp. 6-7 online <http://www.smile-fp7.eu/deliverables/-SMILE%20D9%20Romanian%20case%20study%20report.pdf>

Exosomatic energy is the energy used by man outside his body (in the socioeconomic and environmental metabolism). The external metabolism complements the **endosomatic** metabolism that is associated with the energy processed within the human body.

Human Activity: is a set of *extensive variables* introduced by [13] to represent the number of hours the population under consideration consumes for performing tasks (**HAi**). Starting with the 'flow-fund' model, the MuSIASEM approach is centred on expressing quantities used *per hour* of human activity and not *per person* as in standard economic theory. Productive activities, consumption and leisure occupy all 8760 hours available to each person during a year (24 hours * 365 days). Multiplied by the number of people in a country is the national fund of available time for one year. **Total Human Activity (THA)** corresponds to the entire

population (*level n*). At the next level (*level n-1*), time is divided between paid employment (HA_{PW}) and household activities (HA_{HH}). At the third level (*level n-2*), the time paid is divided between activities in different sectors: agriculture (HA_{AG}), industrial production (HA_{PS}) and business and government (HA_{SG}). Time allotted to paid activities in each sector is the product of the number of workers in each sector and the number of hours worked per year:

THA = Population * 8760 (hours)

HA_i = Persons in sector/type of household i * number of hours per week corresponding to that activity * number of weeks per year.

Saturation Index of Human Activity (SI_{HA}): is the share of total human activity (THA) spent for paid activities (HA_{PW}):

$$SI_{HA} = HA_{PW}/THA.$$

Energy Throughput: set of *extensive variables* indicating the exosomatic energy (in **Joules/year**) consumed at each level (ET_i). For level n , entire country, **Total Exosomatic Throughput (TET)** represents the final energy consumption (in Joules/year).

Saturation Index of Exosomatic Energy Throughput (SI_{ET}): is the share of total exosomatic throughput (TET) consumed for paid activities (ET_{PW}):

$$SI_{ET} = ET_{PW}/TET.$$

Exosomatic Metabolic Rate (EMR): is the exosomatic energy consumed for one unit of human activity. At level n , Exosomatic Metabolic Rate on Average for Society (EMR_{AS}) is the ratio between TET and THA. Exosomatic Metabolic Rate for compartment/sector i (EMR_i) for lower levels – $n-1$, $n-2$ and others – is the ratio between ET_i și HA_i .

This set of variables is extremely important since it allows for comparisons among various hierarchical levels of the same system or for the same level but for systems of different sizes. For example, it is possible to compare EMR_{AS} for USA to that of Cyprus, or among the EMR_i for different types of households, villages, or provinces independently of the relative size of the systems they belong to [14].

$$EMR_{AS} = TET/THA$$

$$EMR_i = ET_i/HA_i$$

The concept of bio-economic pressure (PBE) gives access to the complex meta-analysis of societal evolution using MuSIASEM type scenarios based on:

The existence of a link between changes in the economic performance of an economy and changes in the metabolic pattern of society. An increase in the monetary flows within the economy having the goal of increasing the “enjoyment of life” of the members of a society induces, as a side-effect, an increase in the intensity of the throughputs of matter and energy per hour of labour in the “productive sectors” of the economy. The label “productive sectors” includes the primary sectors (agriculture, forestry, fisheries, energy and mining) plus the secondary sector (building and manufacturing). In plain terms this means that a richer society will demand more services and will work less because of ageing, increased education and leisure time. Facing these changes the productive sector must be able to supply a larger amount of products, energy and materials to the rest of society using only a very limited amount of work hours. ([2] p. 382)

4. Georgescu-Roegen’s bioeconomic program

MuSIASEM – complex meta-analysis method for the economic process – is extended and improved by its creators Mario Giampietro and Kozo Mayumi [16] [17] [18] [2] [10] and an increasing number researchers, from all continents, apply it. As a result, economic thinking and practice constantly advance bringing to reality the bioeconomic program proposed by Nicholas Georgescu-Roegen more than 35 years ago.

Georgescu-Roegen’s ‘minimal’ bioeconomic program is presented, among others, by Gowdy and Mesner [18]:

1. The complete prohibition of weapons productions, thereby releasing productive forces for more constructive purposes;
2. Immediate aid to underdeveloped nations;
3. Gradual decrease in population to a level that could be maintained only by organic agriculture;
4. Avoidance, and strict regulation if necessary, of wasteful energy use;
5. Abandon our attachment to “extravagant gadgetry”;
6. “get rid of fashion”;
7. Make goods more durable and repairable;

8. Cure ourselves of workaholic habits by rebalancing the time spent on work and leisure, a shift that will become incumbent as the effects of the other changes make themselves felt. (p. 151)

In his essay-obituary for the death of Georgescu-Roegen, Herman Daly [20] details what should be changed in introductory economics textbooks to be in line with the new paradigm proposed in *The entropy law and the economic process*. Daly's answers are another impetus for further analysis.

- (1) The '*circular flow diagram*' "representing the economic process as an isolated circular flow from firms to households and back again" should be substituted "with a different pre-analytical vision: namely, a diagram showing the entropic throughput in bold solid lines as a one-way flow from environmental sources, through firms and households, and back to environmental sinks. The circular flow would be depicted as a faint dotted loop from firms to households and back again. No economy can conceivably exist without the entropic flow, while it is easy to conceive of an economy with no circular flow – e.g., an economy of self-sufficient peasants engaging in no exchange." (p. 151)
- (2) "In the revised text the special topic chapters on *natural resources and environment* (usually tacked at the end of the book) would probably not exist because no longer be "special topics", but would be integrated into the very centre of economics." (p. 152)
- (3) On '*continuous economic growth (in real GNP)* as the norm of a healthy economy, and the main goal of economic policy' "The circular flow can theoretically grow forever because abstract exchange value (debt, purchasing power) has no physical dimension. But growth in the entropic flow encounters the physical barriers of depletion, pollution, and ecological disruption... in the new paradigm increasing depletion and pollution become expected, necessary consequences of economic growth, not surpassing externalities as viewed from the circular flow paradigm." (p. 152)
- (4) "*Technologies* that squeeze more welfare (more life enjoyment) out of a given entropic flow become more interesting than technologies that simply increase the volume of throughput. Our chapter on Technology will stress the point that the former

- technologies benefit the future as well as the present, while the latter benefit the present at the expense of the future.” (p. 152)
- (5) *Poverty* “In addition to highlighting *intergenerational conflicts*, our chapter on distribution would point out that the “miracle of compound interest” can no longer be appealed to as the way to grow everyone in the present generation out of poverty. *Growth* cannot for ever substitute for redistribution and population control in fighting poverty.” (p. 153)
 - (6) “...not hold out the vision of *development* as a worldwide generalization of the U.S. standard of living. ... The new concept of development would not be virtually synonymous with growth in real GNP as it is today, but would emphasize population control, limits to inequality in distribution, and production for sufficiency in basic needs. The idea that poor countries can simply grow their way out of poverty and debt by spinning their circular flows of exchange ever faster would itself be retired from circulation, along with other Ponzi schemes.” (p. 153)
 - (7) “National income accounting... would be expanded to include some measured index of the entropic flow.” (p. 153)

5. Institutions and economics

Georgescu-Roegen [1] also insisted that economics is one of the social sciences and the economic process cannot be understood outside the social and institutional context, while the general equilibrium framework of neoclassical welfare economics was borrowed from classical [9]. Moreover, Georgescu-Roegen [6] pointed out that trying to build economics in a manner similar to classical mechanics has led to ignoring the endogenous nature of preferences:

It is all right for physics to trust only what is amenable to sense-perception, i.e., only observables, because that is the sole contact we have with the outside world. It is equally understandable for physics to treat as fiction and view with mistrust the unobservable it had to invent in order to unify into one picture disparate observables and thus simplify its logical foundation. But there is absolutely no reason for economics to treat as fiction the very springs of economic action – wants, beliefs, expectations, institutional attitudes etc. For these elements are known to us by immediate acquaintance, that is, more intimately than any of the economic “observables” – prices, sales, production, and so forth. (p. 119) [14] The

obvious conclusion is that if economics is to be a science not only of “observable” quantities but also of man, it must rely extensively on dialectical reasoning. [14] (p. 120)

Georgescu-Roegen believed that neoclassical economics was formulated to describe the behaviour of Western cities and is not universally applicable. Therefore, development policies should be adapted to the situation. Even if his criticism was made, more than fifty years ago, targeting both Marxist and neoclassical economic theories [4], it is still accurate. None of these theories have taken into account the institutional differences between capitalist and non-capitalist (peasant) economies.

Development economics, making the best use of the standard economic toolbox to address the differences between developed and developing countries and to seek practical ways to enable and support the growth of the latter in order to raise the standard of living for so many people in need. After decades of efforts, the results are not as good as expected while the flaws in the theory can explain it.

One simpler but thought-provoking example is in Figure 2 – depicts the major structural changes that took place in Romania over the past eighty years. Only one variable is presented, the share of total population working in agriculture, industry, and services and government.

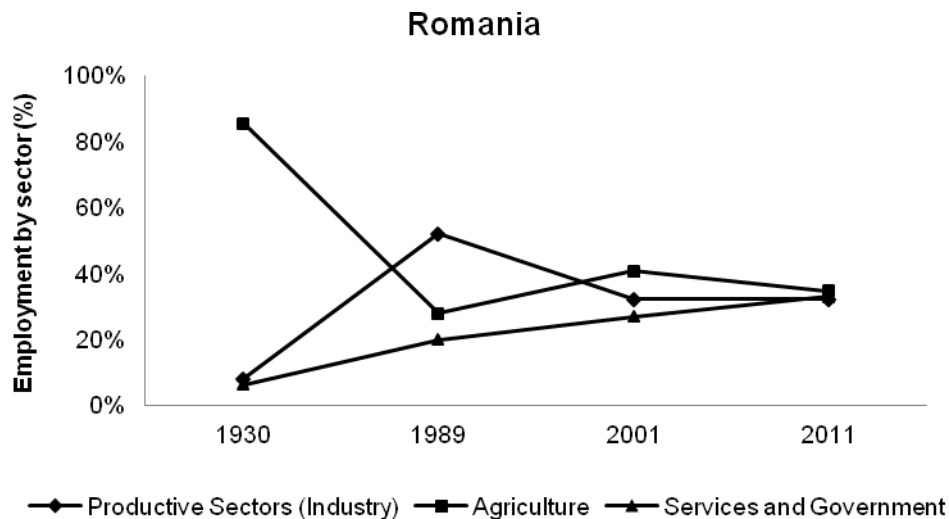


Figure 2. Occupied population by sector in Romania 1930-2011.

Source for 1930-2001 data: Polimeni, R. I. & Polimeni, J. M. (2007). Multi-Scale Integrated Analysis of Societal Metabolism. *The International Journal of Interdisciplinary Social Sciences*, 2 (2), pp. 41-52

Source for 2011 data: Statistics on the labour force survey in households (AMIGO).

Currently, one of the most politically charged issues, and not only in Romania but for the whole European Union, is rural development. Romania is only one of the Member States with a large and extremely vulnerable rural population. European Union basic principles such as promotion of social justice and protection, sustainable development, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment, cannot be achieved if policies are designed based on a theory that is not universally applicable. Only perpetual post-factum policy corrections can be employed and no real pro-active policies.

6. Concluding comments

Georgescu-Roegen's thermodynamic paradigm shift in economics gave birth to a new method of socioeconomic and environmental meta-analysis. The paper introduced the rationale and presented a brief overview of the related conceptual framework. The bio-economic paradigm promoted by Nicholas Georgescu-Roegen and the related method of multi-scale integrated analysis of societal and ecosystem metabolism (MuSIASEM) are presented. Also, it is argued why the concept of 'institution' (which at the macro-level becomes 'culture') is extremely important for the bioeconomic meta-analysis unlike for standard welfare economic theory that guided economic development and poverty eradication policies.

As a consequence, the discussion regarding household's (viewed as one of society's basic institutions) vulnerability, its evolution (and not only for the case of Romania) and the possible solutions could be centred on the socioeconomic and environmental meta-analysis integrating multiple aspects which are (or are lacking from) the foundation of economic theory that led to the modern lifestyle.

Unfortunately, modern lifestyle fights against nature and it is out-of-balance due to over-production and excessive consumption to conspicuous (useless) consumption. Moreover, the unsustainable socioeconomic system threatens to completely replace the traditional society that is sustainable, durable and provided during history a balanced and healthy way of life.

One outcome of the thermodynamic approach to economy is, among other things, the development of a society that encourages an agriculture integrated and in balance with the rest of the ecosystem (producing a minimal amount of waste) combined with the encouragement through education of a lifestyle that promotes a good health.

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ANALYSING LANGUAGES AS CO-OCCURRENCE NETWORKS A COMPARISON OF TRANSLATIONS OF “AENEID”

Elena Tea RUSSO, Feo V. KUSMARTSEV*

Abstract. *We have put a correspondence between a text written in different languages and complex network. Then the networks obtained have been analysed with the use of the complex network theory. Such an approach, which allowed us to develop new metrics that can uniquely characterise any language, has been applied to several European languages. As specific text we have analysed the Aeneid, the well known poem written originally in Latin and six of its translations (written in modern or old European languages). The networks have been built up from the texts taking words as nodes. The words are linked according to a few different principles as neighbours or in general as their co-occurrence in sentences forming the texts. We studied both static and dynamic properties of these networks, searching for quantities that could uniquely represent languages. Indeed we found such a new metric, which based on the network structures of a text and that has been then compared with well-known linguistic metrics, as those representing language families through their evolution or those representing syntactical or grammatical properties.*

Studying the dynamic evolution of the co-occurrence texts networks we have also found that the Average Path Length in this network could lead to a good metric also uniquely representing languages together with other important syntactical/grammatical features. We find out that parameters of network associated with specific texts such as the nodes load and degree distribution comprise a consistent valuable metric, which can be superposed to the linguistic ones. Using this metric we revise the Indo-European tree of the languages expansion discovering at the same time new information about their topological structure.

Keywords: *languages analysis, networks, complex systems, linguistic, indo-european tree.*

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1. Introduction

In the last years *comparative philology* tried to build the Indo-European language tree [1] through lexical comparisons [2] of languages. However the languages are not just a set of words. They serve to provide an information flow. In any message words are organized into sentences and phrases. Whole those sentences and phrases are composed into a text which carries a piece of information. The information theory provides very sophisticated tools to estimate the amount of information or entropy which contain a specific text or a particular message. However an efficiency of a language to provide the required information flow has not been yet addressed. In each sentence the words are creating a chain and are following each other. So they may be connected as one by one next. When we connect these words in many sentences we reveal a web. In such web a majority of words will have only two links, one is incoming while the other one is outgoing. However they will appear words which have many links. These words appear in many sentences and they are popular words. As noted in the Ref.[1], these popular words form an active part of the language associated with a real time when the language is used. Thus the popular words form key nodes-hubs which effectively connect other words and obviously play also a key role in such network of words structure. Such type of networks may also reflect the way how the words are *organized* in phrases and sentences. This may be revealed in a network in which we will connect all words in each sentence or a phrase. Thus for each text we may put in a correspondence a network which may have a few different structures, that will reflect different properties of this network. Thus we may see that each language has a well defined network *structure*.

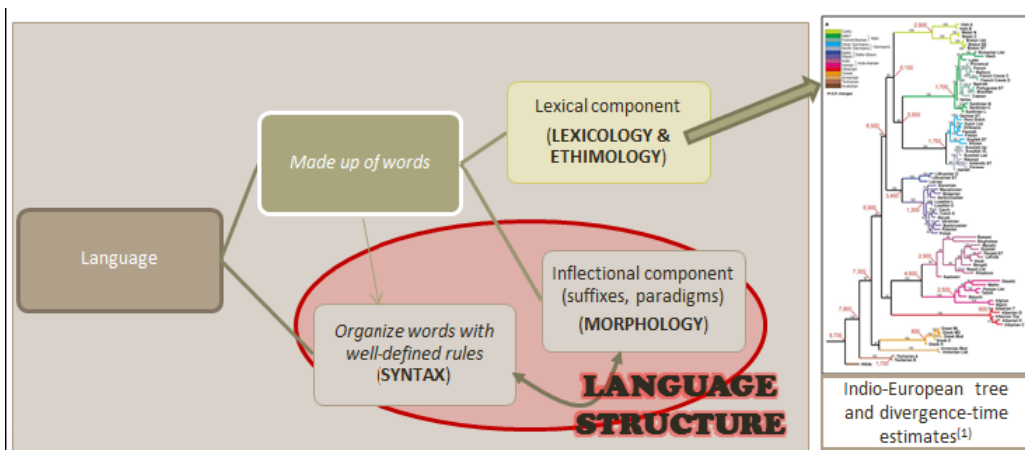


Figure 1. Scheme illustrating language's features.

In this paper we have investigated the language proximities, their similarities and their other characteristics by analyzing the associated network structure, without any regard on the lexicon: this has been done by considering different texts as networks of words. We focused attention on a particular type of language networks, namely “co-occurrence networks”(3) : in this case, words are connected each other if they appear in sequence in a sentence, or, generally, in a speech or in a written text; such a definition appears natural since human spoken and written language consists of linear strings of “words”.

2. Theoretical foundation of basic concepts

The main theory of network is wonderfully exposed in Albert-Laszlo Barabasi’s article “Statistical mechanics of complex networks”[4]. Here we will just briefly introduce basic concepts needed for our results obtained and their interpretation.

We define a **network** as a set of generic entities (*nodes*) that may be connected to each other (via *edges*, or *links*). Links can be *directed* (the link is an oriented relationship, and all those of a node are specified by the nodes to which its links are directed) or *undirected* (the relation that connects the two nodes is symmetrical). Links can all be considered equivalent, or each can have its specific *weight*.

The degree of a node i, k_i , is defined as the number of links that start from or terminate on it: obviously we will consider separately the degree of inbound links ($k_{i,in}$) and that of outbound links ($k_{i,out}$), the sum of which gives the ‘total’ degree: $k_{i,in+out}$. In cases where links are undirected, only the total degree is definable, called simply k_i . In case links possess also a weight, the degree may be in turn weighed so as to give greater value to most important links.

We can, then, introduce the concept of *degree distribution*, $P(k)$, which represents how links are distributed among nodes. It is important to cite the fact that real networks usually shows distributions with a scale-free behavior, and it can be reconducted to a power law such as $p(k) = k^{-\gamma k}$.

Similarly we can introduce the *load distribution*, $P(b)$, where the load (or *betweenness*) of a single node i is defined as $b_i = \sum_{m \neq i \neq n} \frac{path_{mn(i)}}{path_{mn}}$, where the $path_{mn}(i)$ represents the number of shortest paths to go from m to n passing through i , while $path_{mn}$ represents the number of all possible

shortest paths going from m to n . This measure represents how much the node is “loaded”: e.g., in a network representing streets of some city, if we consider streets as links and crossroads as nodes. A highly loaded node is a crossroad which will probably have a high traffic. It has been shown that if a network has a power law degree distribution, also its load distribution has a power law behavior [5], and we can write it as $P(b) = b^{-\gamma_b}$. Furthermore, it has been shown that for scale-free networks, especially for the real ones, the following relation holds [5]: $b_i \sim k_i^\eta$ with $\eta = \frac{\gamma_{k-1}}{\gamma_{b-1}}$. Thus, the value η represents the relationship between the two distributions.

Another important network quantity is the *average path length* l , which is defined as the average of minimum length of paths, computed for all pairs of nodes.

We can then distinguish a *static approach*, i.e. the study of a graph with nodes and links defined once for all so that do not vary with time, and a *dynamic approach*, where we consider graphs where links, nodes, or both can be added or removed with time. For example, when talking about *co-occurrence language networks built from written texts*, we can think of them as evolving networks: while reading, we encounter more “new” words, which may be really new or already encountered during our reading. Each new word generate a new node in the network, while at each “reading step” we build new connections among words: thus, the language network is growing.

However, to establish a language network model we need to define exactly what a node of this network is, i.e. what is meant by “word” and which relationships between words are considered relevant. The first problem is to decide when two sequences of characters are the same word: for example, when they are identical character by character (leaving aside their case), or when they share the *stem* differing only by the *ending* – which is not necessarily always the same?

Another question to be answered is whether it is correct to consider space always as a separator of words: in many languages, in fact, binary structures are used (e.g., phrasal verbs, like get in, go out, break out, get off ... in English; venir meno, buttar gia, ... in italian) which, although separated by a space, have a precise meaning if and only if they are used together. And yet, how to deal with punctuation, compound words using hyphens, or those contracted by apostrophes? Once defined the element “word”, it is possible to study the frequency of words and their distribution – and this was historically the first stage in the study of languages. From

Zipf's law revealed, which has evolved in Simon's model [6] and has been often revised and tried to be improved. In a principle any relationships among "words" may be viewed as links and that allows considering the associated text as a network, which can be studied by the basic concepts and definitions which have been presented in this section.

3. Analysis of the language network structure

3.1. Aeneid

The text analyzed in this study is the **Aeneid**, with some of its *translations in different languages*.

To choose a fixed text and to analyze its translations was a decision led by the idea to analyze the same quantity and kind of information (Aenea's story) delivered by using different human languages.

The Aeneid is an *epic poem*, divided in **12 books**, written by Virgil between 29 and 19 BC in Latin [7]. Because of its historical and literary importance in the Latin and European survey of literature, it has been translated in a wide quantity of languages and, especially, it has been translated several times through the centuries by several translators from the same country or language. This means that its translations, all together, offer a quite well detailed picture of the European languages through "the time and the space".

In addition, it is well known that Latin influenced the development of European languages, and some of them (such as Italian, French, Spanish) are considered its direct descendants [1].

Six translations of Aeneid, together with its original version, have been considered in this study¹: this in order to span through different languages and different times, expecting to see differences coming from different ages and different geographical areas.

¹ **Old English** (translation by **John Dryden**, XVII century)
retrieved from http://en.wikisource.org/wiki/Aeneid_%28Dryden%29
New English (translation by **A. S. Kline**, XXI century)
retrieved from <http://www.poetryintranslation.com/PITBR/Latin/VirgilAeneidI.htm>
Old Italian (translation by **Annibal Caro**, XVI century)
retrieved from <http://it.wikisource.org/wiki/Eneide>
New Italian (translation by **Cesare Vivaldi**, XX century)
retrieved from <http://trucheck.it/epica/7048-tutta-la-traduzione-dell-eneide.html>
Spanish (translation by **Rafael Fontan Barreiro**, XIX century)
retrieved from http://es.wikisource.org/wiki/La_Eneida
Russian (translation by **Sergey Osherooff**, XX century)
retrieved from http://tapirr.narod.ru/texts/poetry/vergiliy_eneida.html

3.2. Co-Occurrence Networks

In this study the element *word* will be defined as a *string of characters divided by a space*, independently from uppercase – i.e. there is no difference between “Her” and “her”. A definition of “*space*” is needed too, strictly related to the approach to punctuation. Thus: punctuation may be simply ignored, or may be considered as integrant part of the analysed text; in this case, it has been decided to ignore *any* punctuation symbol, *except* “.”, “!” or “?” which defines the conclusion of a sentence. Any punctuation mark different from the ones listed above will be considered, in this case, *as a space*: this means that hyphens and apostrophes are “removed”, and the two parts of the word considered as two separate words. (e.g.: “*he’s well-known in his university*” is considered as “*he’ s well known in his university*”). There is no difference if between two words there is one “space” (or punctuation mark) or more; in addition, any formatting special character as tabulations or new paragraphs has been considered as a space too.

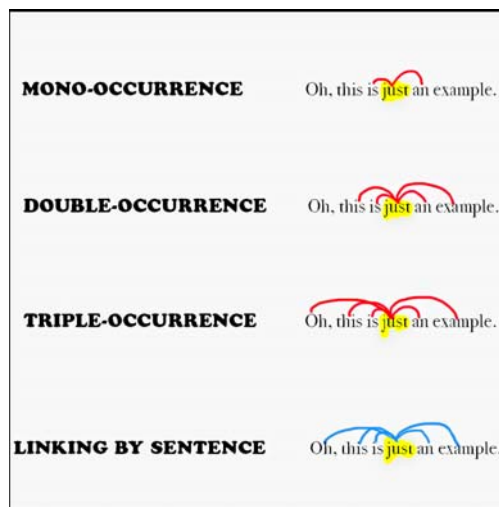


Figure 2. Image explaining how a word (“just” in this example) in a sentence is connected with the others. Links are undirected. It can be seen that sometimes different linking rules may produce similar links, as, in this example, “triple occurrence” and “linking by sentence”.

When building a co-occurrence network from a written text, it is necessary to define the “**linking rules**”, i.e. the criterion which links a word to another one. Different linking rules will build different networks from the same text. Our goal is to consider both the correlations between individual words as well as their correlations within the sentences.

Therefore, in this study 4 different linking rules (see, the Figure 2) have been used. These rules are linking both neighboring words and all words in the sentences and therewith produce a good variety of complex networks. These are their precise **definitions**:

“mono occurrence” := two words are linked each other if and only if they appear in a sequence.

“double occurrence” := two words are linked each other if they appear in a sequence in a sentence or if only one word divides them

“triple occurrence” := two words are linked each other if they appear in sequence or if one or two words divides them in the same sentence

“linking by sentence” := two words are linked each other if they are in the same sentence.

In order to analyze such a big quantity of texts as Aeneid, it is essential to routinise the analysis process. In particular, a computer program able to transform a written text into a network by following given linking rule and therefore a precise word definition is needed, as we have already defined.

These programs have been written by using the C language. First of all, a subroutine, which able to read properly the words has been built up. The main operations of this subroutine is to convert all the uppercase characters in lowercase and to find the end of the document; it returns a single word or a single punctuation mark to the main program, which will process it and then build up the network with respect to the linking rule desired.

In order to get a coherent analysis of the considered languages, it has been decided to analyze the texts in a “dynamical” way, i.e., to consider the networks built up from the firsts 25, 50, 75, 100 ... 1000, 1025 ... words (in steps of 25 words) of the analyzed text. In this way, it was possible to see how the networks and the networks’ parameters evolve, as the quantity of text increases. The aim of this approach was to identify which was the most adequate amount of text to analyze, and to find if there was some particular behavior in the dynamical evolution of the language network.

The C program, thus, analyzed texts of 25; 50; 75... $N + 25$ words; for each of these networks. The particular network parameters such as the Average Path length the Clustering Coefficient or the ratio nodes/links have been computed and a controlled .net² file has been written: this last artifice allowed to run the main programs only once.

² a .net file represents a network, and several computer programs made for analysing networks can read it: for example, Pajek (<http://pajek.imfm.si/>) or Igraph.

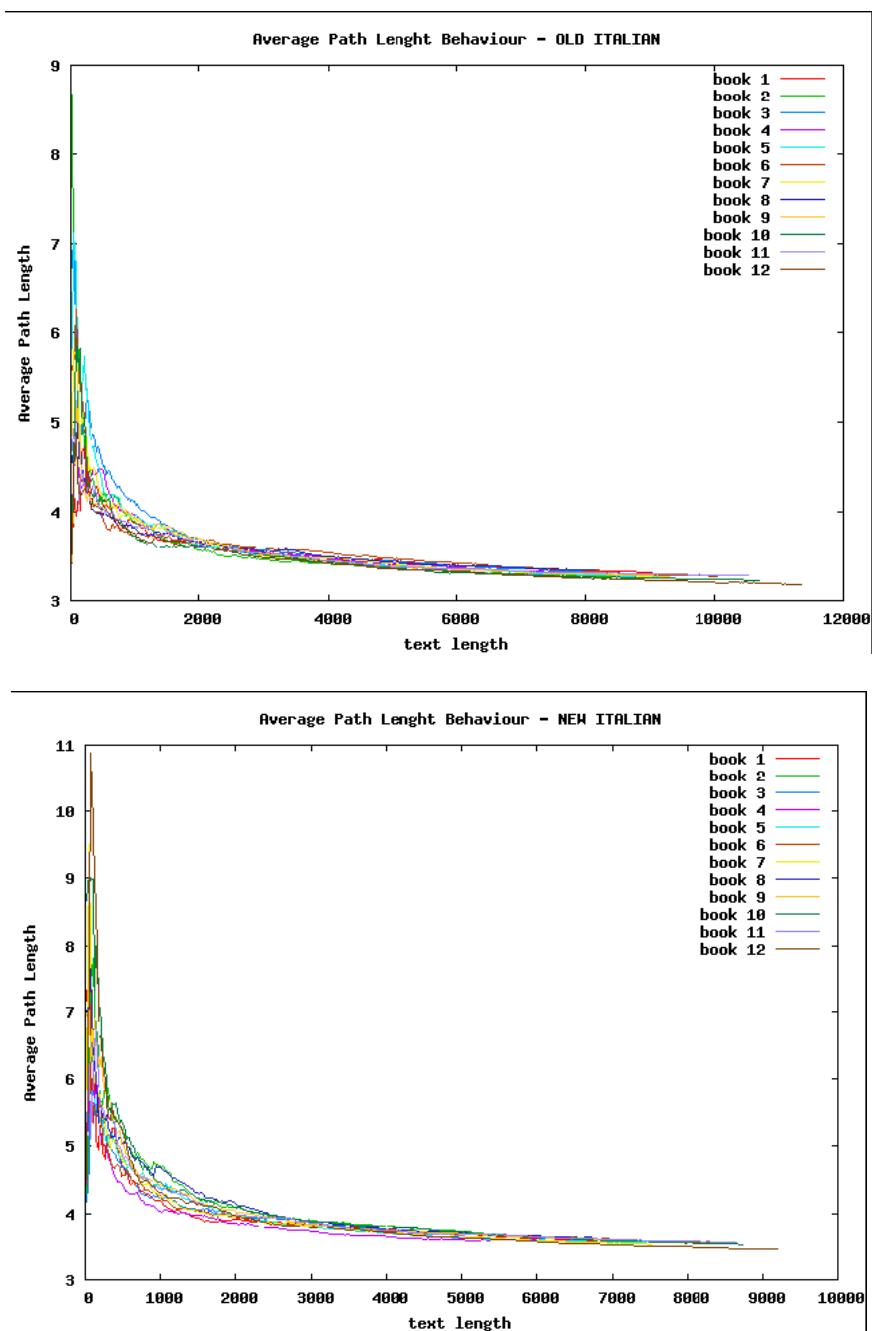


Figure 3. (a) Old Italian (b) New Italian.

Average path length evolution. Here two different languages are shown: Old and New Italian respectively. In each plot, different colors represent different books. It can be seen that for “short texts” (shorter than 1000 words) avg path len behavior appears to be chaotic, while for sufficiently long texts, it stabilized on a slow decrease when the size of the text increases. Linking rule used is mono-occurrence.

In order to have an easier managing of the networks itself and to have pre-built algorithms able to compute properly the networks parameters required, it has been used the igraph C library³.

Table 1.
Equi-informative text lengths, language by language

Translation / Language	Book 1 length	Text Length chosen	Length Interval
<i>Latin</i>	4910 words	3700 words	[3200:4200]
<i>New Italian</i>	7125 words	5300 words	[4900:6500]
<i>Old Italian</i>	9025 words	6800 words	[5900:7700]
<i>New English</i>	7575 words	5700 words	[4900:6500]
<i>Old English</i>	8690 words	6500 words	[5600:7400]
<i>Russian</i>	5960 words	4400 words	[3800:5000]
<i>Spanish</i>	7975 words	6000 words	[5200:6800]

When we analyze a book, we need to choose a well-defined text length. Since networks built up from texts should be strictly connected to the information carried in it, we focused our attention on **texts long as 75% of the first book**. This quantity varies language by language. Static analyses have been conducted on this text quantity (column 3). Dynamical analyses (where the text length must be variable) have been conducted on an interval ranging from 60% to 80% of length of first book, so as to remain in a “safe” zone (column 4). All these quantities have been rounded to step length, usually 25 or 100 words.

In order to have a good statistics on the text analyzed (the Aeneid), and then to identify with enough precision the networks characteristics depending on the translation considered (avoiding misleading coinci-

³ Igraph (<http://igraph.sourceforge.net/>) is a library built up in order to help the networks analysis. Its main features, used in this study, are:

- implementation of “graphs” as variables, made up of “vertices” and “edges”, directed or undirected, weighted or not;
- the possibility to operate on graphs adding, removing vertices and edges;
- implementation of dynamic vectors and sparse adjacent matrices for associated graphs;
- possibility to write and read networks as .net files (readable by Pajek and many other network’s analysis softwares);
- a system of attributes for vertices and edges - for example, vetices names;
- a big set of ready-to-use algorithms to be used in the computation of networks’ quantities, such as the Average Path Length or Clustering Coefficient;

dences) it is necessary to divide it in different pieces. From the information extracted from preliminary dynamical simulations, it has been decided to work on subtexts long as from 3000 up to 8000 words (see, Table 1). In particular, the 12 books of the Aeneid have from 4000 up to 10000 words (depending on the chapter and the translation considered), and thus satisfy the conditions for the text length derived above. It has been decided, then, to split the full text in these 12 subtexts, in order to analyze them separately by using the dynamical approach. In addition, it is important to notice that a single Aeneid book has the same quantity of information independently from the translation considered. When necessary to perform fits or to plot graphs, we used ROOT or Gnuplot⁴ (which both perform fits using a Chi-Square minimisator).

The following analysis has been done:

- **Average Path Length evolution:** chosen a particular translation, the average path length in the ranges defined in the table has been fitted with a first grade polynomial in the form of $y = a + bx$, where y represents *average path length* and x *text length*. In the (a,b) space, the fitting parameter was plotted, with the fitting errors associated.

- **Vocabulary Growth:** we can roughly define it as the increase of the number of nodes (different words appearing in the text, that is, the size of the analyzed network) with respect to the increase of the text's quantity analyzed. In the log-log scale, this quantity appears to be a straight line – i.e., we have a relation like $y = ax^b$, where y represents the number of *different nodes* and x is the *texts' length*. Thus, with a linear fit in the log-log scale, $\log(a)$ and b have been evaluated.

- **Power Law Distributions Fit:** we fitted degree and load distributions of the text networks by using a power law ($P(k) \sim k^{-\gamma_k}$ or $P(b) \sim kb^{-\gamma_b}$). Only two linking rules show a well-fitted power law (i.e. mono and double occurrence): in this case γ_k and γ_b have been put in relation, in order to obtain a complete language representation in the bi-dimensional (k,b) Cartesian Space. Then we evaluated, in both situations, the respective value of $\eta = \frac{\gamma_k - 1}{\gamma_b - 1}$ for all languages.

⁴ Cern's ROOT official homepage: <http://root.cern.ch/drupal/>; Gnuplot official homepage: <http://www.gnuplot.info/>

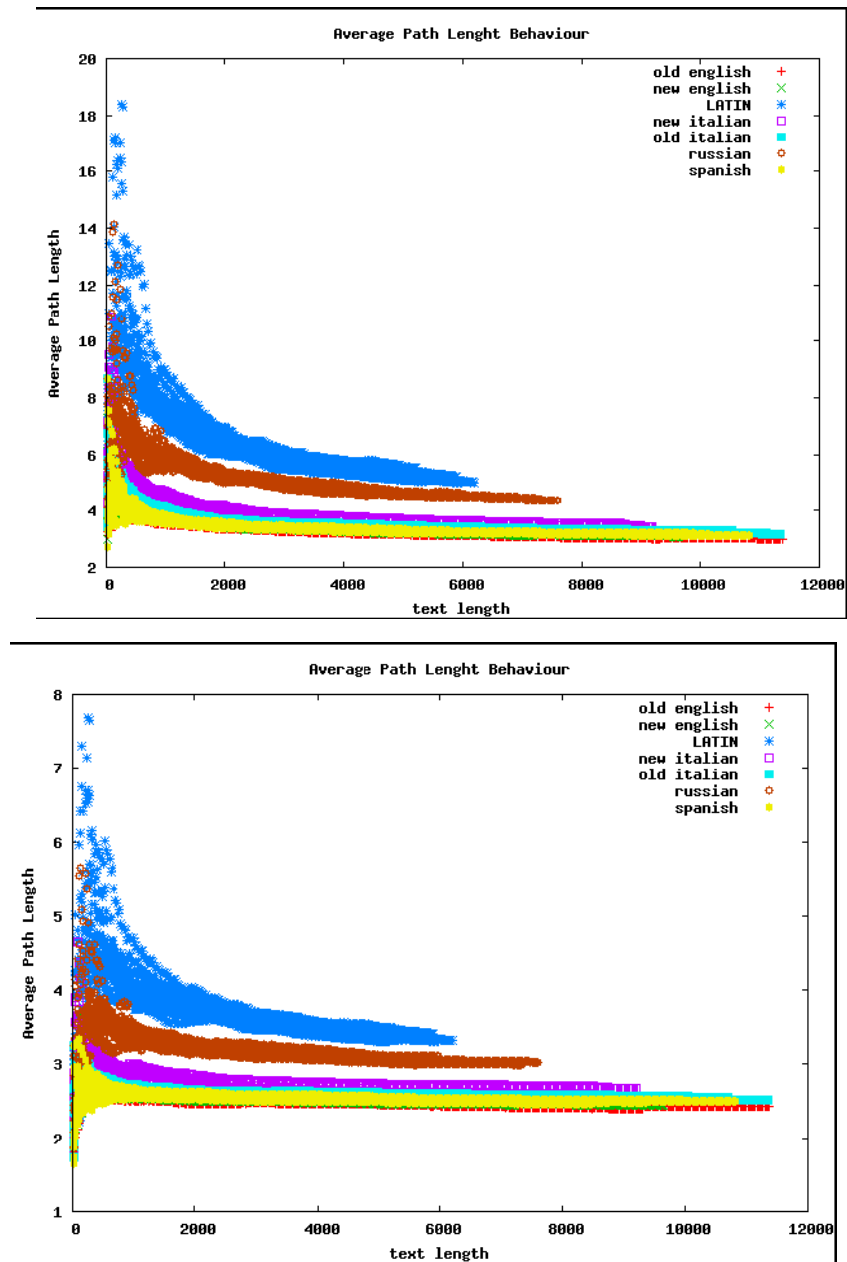


Figure 4. (a) Mono-Occurrence (b) Triple Occurrence.

Average Path Length Evolution, language by language: for each language, the twelve books have been analyzed separately, and here plotted together: the color defines the language/translation they belong to. These pictures show how, independently from the book, the average path length for a long text quantity fluctuates around a common value, depending on the language/translation analyzed. Two examples are reported here, showing how the linking rule used influences only the mean value, while the languages remain distinguishable each other.

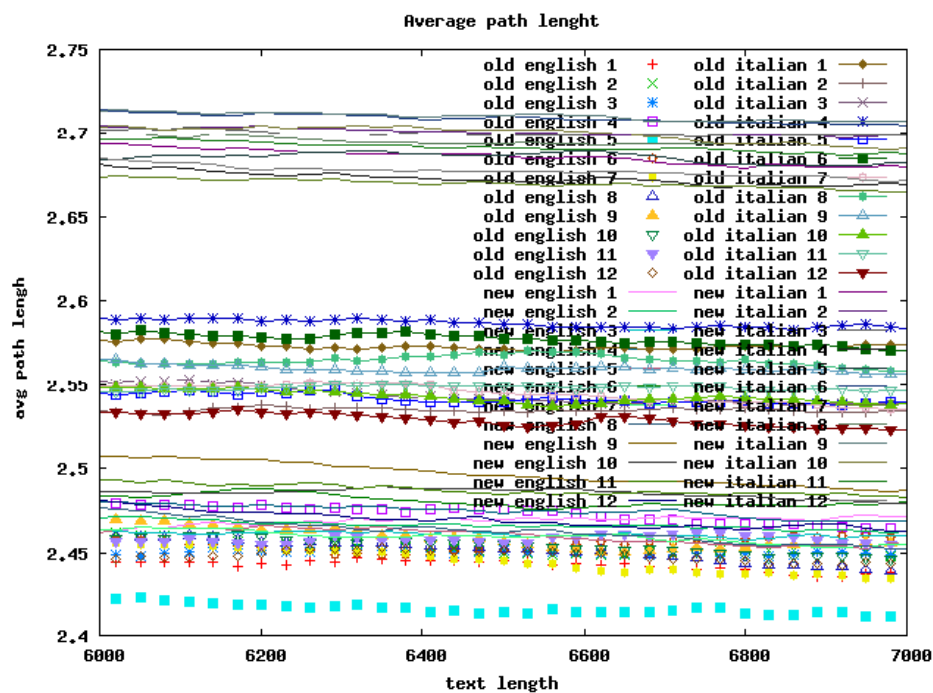


Figure 5. Examples of Average Path Length evolution behavior in a fixed text length interval (from 6000 to 7000 words). Different “streams” may be seen, made of data from all 12 books, belonging each to a different language. In order from the top here are shown New Italian (line), Old Italian (line with dots), New English (line), Old English (only dots). Linking rule used: mono occurrence.

4. Results

Our first result is the behavior of the Average Path Length evolution through texts which words quantity increases: after a first chaotic progress the values stabilize on a soft decrease, as seen, fitable with a linear function (see, Figures 4). The most interesting result is the fact that, by analyzing separately the twelve books, books belonging to the same translations stabilizes their decrease around a common mean value: visually, we have “streams” (see, Figure 5) of graphs belonging to the same translation, which often appears to be separated each other. Since the average path length is a network parameter which depends on the network structure, it may be said that its evolution depends on the language structure itself: thus, such visualization allows us to see how languages may have

structures which difference is appreciable. For what concerns the language evolution, from Figure 5 we may say that the New Italian translation is more different from the Old Italian One with respect to the New English and the Old English ones, which appear so close to superpose their “average path length evolution streams”.

Going back to the language analysis through their occurrence networks, we were focused on searching quantities which representation on a Cartesian plane could lead to a unique language characterization and then to a language distance definition. Here, the term “distance” has been used as a Euclidean distance estimated on the introduced Cartesian plane. In this way, it was named as a language *metric*.

Thus, our main fitting parameters are (a,b) , which were found from the average path length evolution fit (see, Figure 6). These parameter values found from the vocabulary growth fit (see, Figure 7) can be presented on $(a, \log(b))$ plane, and finally the (γ_k, γ_b) plane is used to present the power law exponents extracted from the degree and betweenness distributions for network built up with the use of the mono and double occurrence linking rules, there the respective value of η has been estimated, too. This also shows separation of the considered languages into two main groups: The Russian and Latin in one and all other in the second one.

Our main result is that the most of the metrics found showed that languages are clustered due to their structural similarities. In particular, we may almost always see two or three different clusters: one grouping the modern or semi-modern European languages (Old and New English, Old and New Italian, Spanish), then Latin and Russian, which sometimes appears grouped; while no one metrics appeared to show clusters connected to the languages evolution. On this last consideration, from some metric we may say that Old/New English and Old/New Italian appears close each other, but such a consideration may be judged incorrect as we see that, by changing the metric, the respective positioning in the “European languages” cluster may vary widely. However, when considering the average path length evolution, we can say that Old/New Italian are more different than Old/New English.

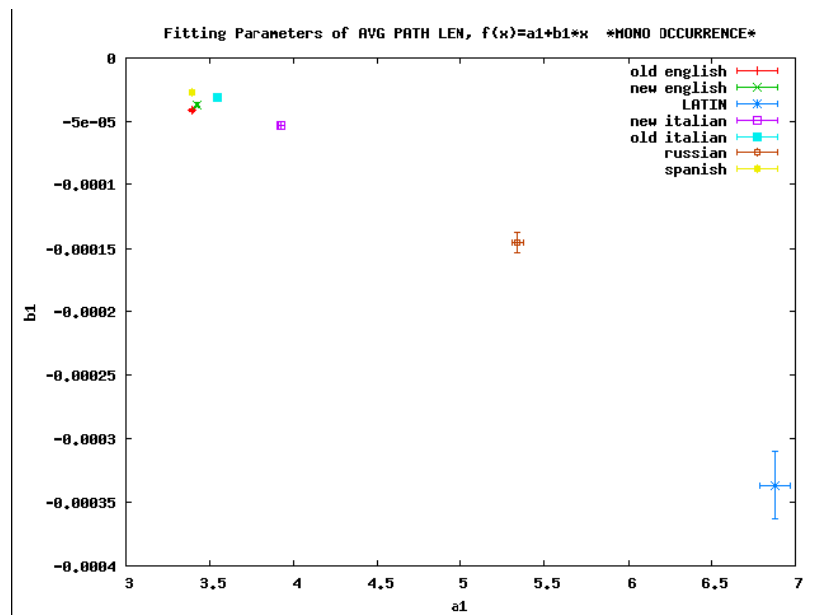


Figure 6.1. Mono-Occurrence.

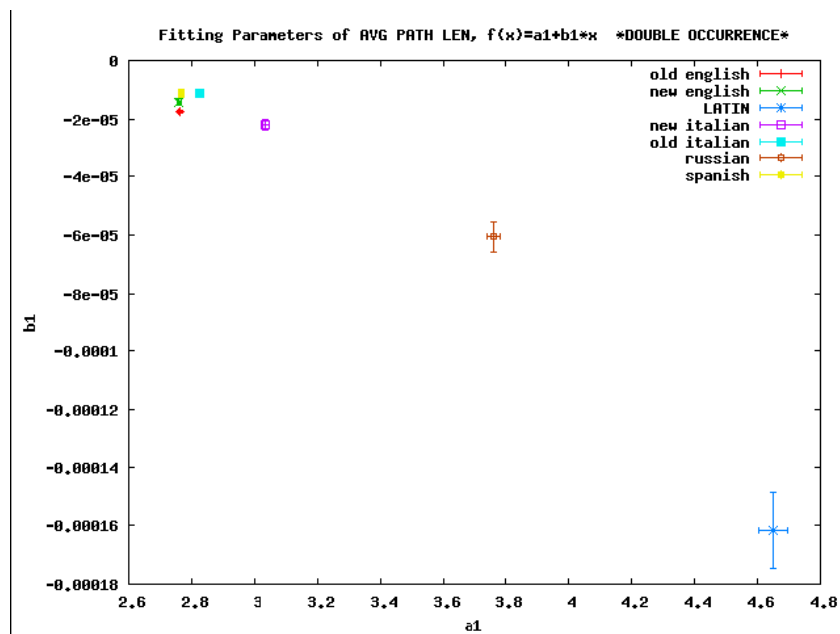


Figure 6.2. Double-Occurrence.

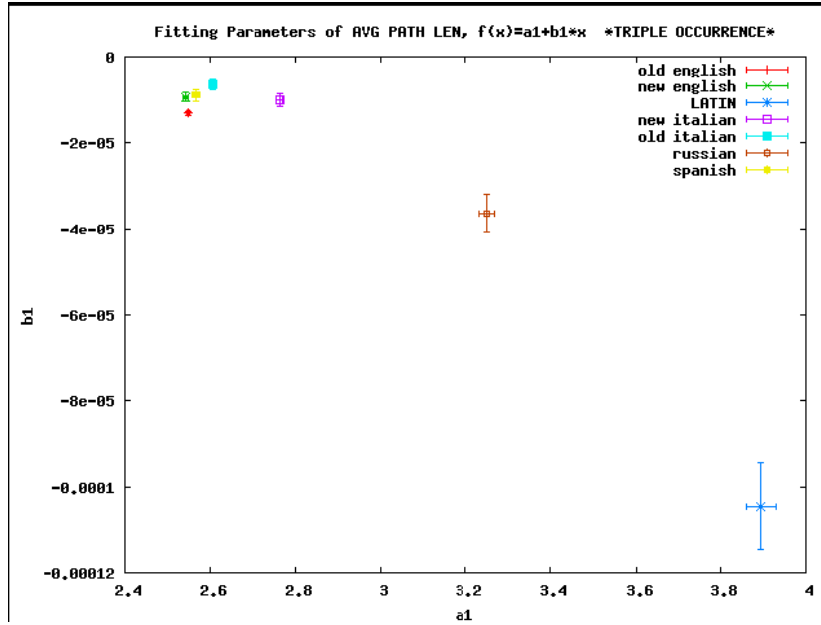


Figure 6.3. Triple-Occurrence.

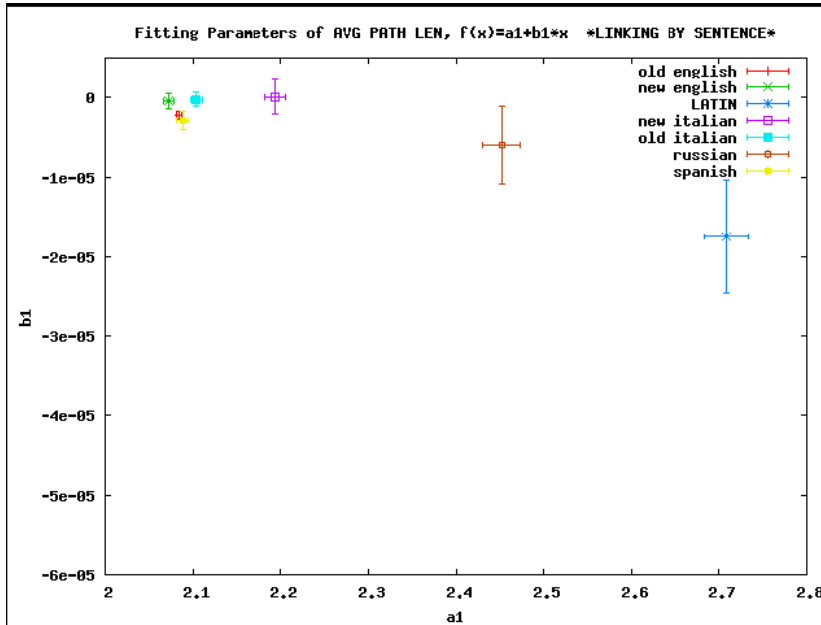


Figure 6.4. Linking By Sentence.

Figure 6. Fitting Parameters for the average path length evolution (fitted with the equation, $y=a+bx$) for equi-informative texts, where the fit has been conducted on the previously defined text lengths (see. table 1); languages are represented in the (a, b) plane (here written as a_1 and b_1). Note that here each point corresponds to the different language: Old and New English, Old and New Italian, Spanish, Latin and Russian.

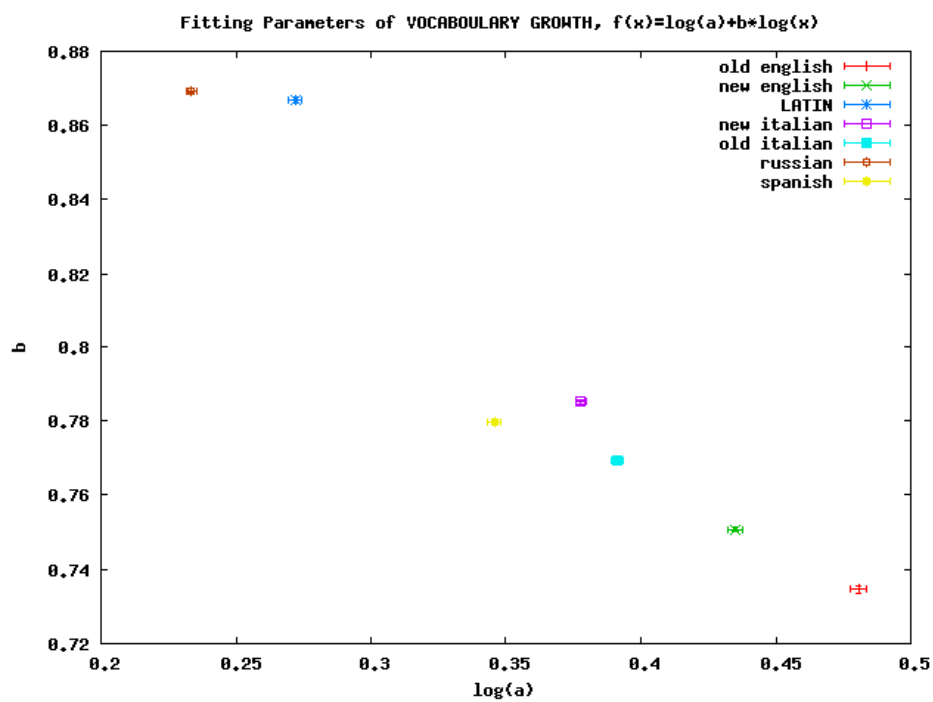
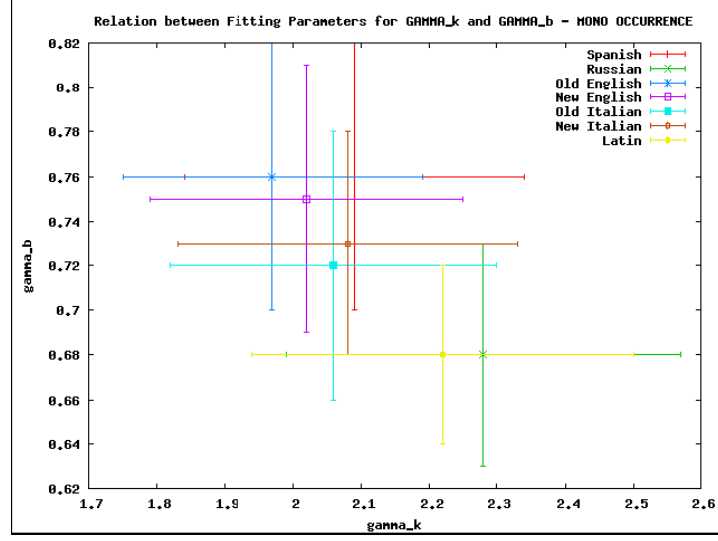
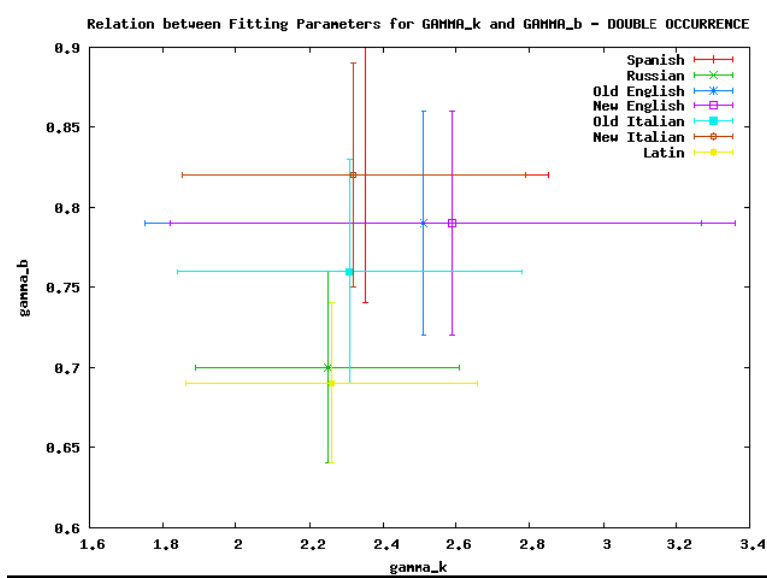


Figure 7. Fitting parameters for vocabulary growth (fitted using $y = ax^b$, where y represents the *number of different words*, while x represents the *total number of words*), represented in the $(\log(a), b)$ space. Here each point corresponds to a different language.



a)



b)

Figure 8. Language positioning in the (γ_k, γ_b) plane created from the fitting parameters of the power law distributions obtained with the use of the mono-occurrence (a) and double-occurrence (b) linking rules for the text networks considered here. For these two linking rules it was possible to fit the degree and load distributions with a power law: $P(k) \sim k^{-\gamma_k}$ and $P(b) \sim b^{-\gamma_b}$. For each language we analyzed, separately, each book, evaluating its gamma's via a chi-square minimization fit (performed with ROOT), and then we calculated a weighed mean among all the twelve books belonging to that particular translation. Finally we reported the values in the (γ_k, γ_b) space.

5. Conclusions and Further Work

The analyses we conducted seems to give us a quantitative representation of languages structures: thus, these kinds of studies can actually give us new information about languages, and help us to build an improved version of the Indo-European language tree (see, Figure 1 and 9). Moreover, measures and criteria found are not affected from lexicon, so that we have a totally alternative kind of philological analysis from the traditional one, which focuses on lexicology rather than syntax and grammar.

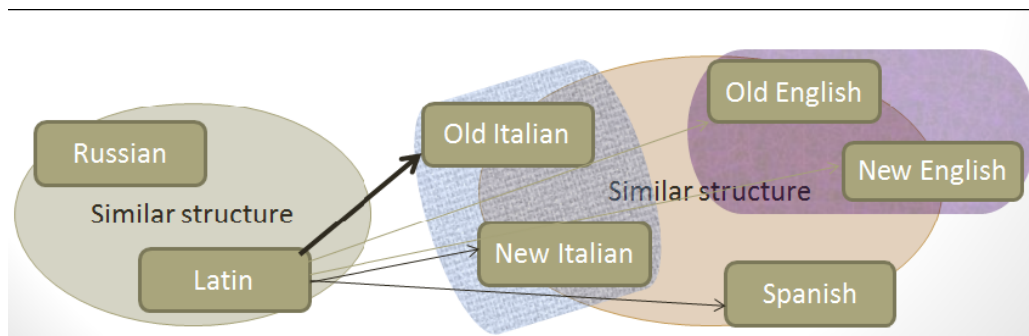


Figure 9. A multi-layer representation of the connections among the languages analysed; a flat tree is not enough, maybe a multidimensional representation could suit better a relationship between languages in order to understand their history and the history of the ancient peoples and nations motion. Circles shows groups of languages with similar structures, while patches shows groups of directly descendant languages (Old and New Italian/English). Arrows shows well-known relationships among Latin and its descendants: it is Old Italian, New Italian and Spanish ancestor (black arrows), but it also influenced English.

This study can be classified as a preliminary work, which opens a door for a broader, systematic language analysis. The C programs written – whose writing has required considerable time and effort – are capable to analyze any plain text written in any standard ASCII code. Thus, they are ready to analyze other Aeneid translations or any other text, and convert them in occurrence networks using the four linking rules previously explained. Moreover, it is easy to define and implement new linking rules, for example, taking into account different roles or types of words forming a sentence.

In order to understand better the languages' structure by using the tool of co-occurrence networks, several analyses may be lead. First of all, it is necessary to work on a larger set of Aeneid's translations. Then we should focus on new possible distributions fits, especially for the "triple-occurrence" and "linking by sentence" linking rules. Another important analysis is to study the behavior of highly connected and loaded nodes, which from our data appeared to be syn-semantic words or common nouns (such as "Enea" or "Turnus") in the analyzed text. The relationship among a node degree and its betweenness, here investigated evaluating η , may be studied with direct methods, such as performing a direct comparison node by node.

From our representation of a language as networks, especially when analyzing "mono-occurrence" data, it should be interesting to focus our attention on couples of nodes connected each other with many links (that is, we could say that they have highly weighted links). These couples of nodes represents texts' *binary structures*, i.e. those words which very often comes together, so that they are meaningless (ore have different meanings) alone but acquire new meaning when in couple (for example, in English those binary structure may be *phrasal verbs*). But similar things may happen with other linking rules showing different "substructures" which may, in a further study, made us reconsider and change our definition of the term, "word". The built networks revealed a very subtle structure, which uniquely characterizes a language. Such structure exists independently on the vocabulary capacity of the language, and much more stably to any perturbations. Therefore the presented analysis may shed light on the very ancient movement of people and nations. Many different kind of analysis, on the whole, may be conducted from the networks we have built up, and they will probably lead to a better quantification and comprehension of languages' structure and very dark our ancient history.

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EMPIRICAL DISTRIBUTIONS OF NIFTY RETURNS FROM 1991 TO 2010

Faiz MOHAMMAD*, Valeed A. ANSARI

Abstract. *Black-Scholes option pricing model's normality assumption that the stock returns are normally distributed has long been disputed by the empirical data. In this paper we investigate in detail the return distributions of NIFTY, JKSE, STI, and S&P500 index of the Indian stock market in different time intervals for the period 1st January 1991-31st December 2010. Firstly, for daily stock returns the null hypothesis of normality is clearly rejected for $\alpha = 0.05$, in all the four markets. This result is in accordance with the Central Limit Theorem which says that the longer the time interval for which returns are computed, the more the resulting distribution should conform to the normal distribution. Secondly, we fit the Student's t -distribution to the daily return distribution and find that the shape parameter ν has similar value as obtained for the developed markets.*

Keywords: *stock return distribution, non-normality, NIFTY, market inefficiency.*

1. Introduction

The financial market is an open and complex system where a large number of elements interact non-linearly. Information on the underlying dynamics of the market that drives the asset prices can be obtained through the study of the shape and scaling of the asset return distribution. Therefore, the distribution of returns of stock prices and market indices has been one of the active areas of research in mathematical finance and econophysics; returns distribution not only provides information on the dynamics of the financial market but is essential to risk management and option pricing.

In classical models of asset prices such as Black-Scholes model (1973) it is assumed that changes in the logarithmic returns are independent and identically distributed (iid) and follow normal distribution. However, Mandelbrot (1963) and Fama (1965) first reported that

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the empirical return distribution deviates from normality, especially in the tail region.

It is now well established that the empirical distributions of daily returns have peaks and fat tails and the extreme price movements occur more frequently than predicted by a normal distribution.

It has also been reported that asset return series have some additional empirical features that are counter to the hypothesis that asset returns are independently and identically distributed (iid) and follow the normal distribution. For example asset distributions are found to be skewed Kon (1984). Furthermore, the standard deviation of Monday's return is found to be higher than those of other weekdays Fama (1965). French (1980) reported a statistically significant difference in the mean return of Mondays compared to those of other weekdays. In addition, bimodality in the return distribution of the individual stocks has also been occasionally observed. These observations suggest that the process that generates returns might be complex and non-linear and the returns are likely to be dependent.

Although empirical characteristics of asset returns are now well established, there is no unanimity on the model that best describes the return distribution. Several models have been proposed to describe the behavior of return distribution. Mandelbrot (1963) studied the return of cotton prices and found that price changes are described by Levy stable distribution with the characteristic exponent less than 2, better than a normal distribution. Using 30 stocks of DJIA Fama (1965) confirmed Mandelbrot's observations.

However, the Levy stable distribution has infinite variance and the usual descriptive statistics may be misleading if returns follow Levy distribution. For example, the sample standard deviation exhibits a very erratic behavior and as the sample size increases, it does not converge to any value. So in a Levy stable market, the sample standard deviation cannot be used as a measure of risk. This fact led many researchers to test other distributions for asset returns.

Several other distributions have been fitted to asset returns. Grey and French (1990) and Pena (1994) fitted the logistic distribution, Blattberg and Gonedes (1974) fitted student's t-distribution. Kon (1984) fitted mixtures of several normal distributions. Mu and Zhou (2010) reported that the q -Gaussian distribution better characterizes the distribution of security returns in the Chinese security market.

Return distributions of Indian stocks have only been studied in the tail region. So, this paper studies the distribution of Nifty Index (India) returns. Return distributions of JKSE (Indonesia), S&P 500 (USA) and STI

(Singapore) indices have also been studied to find if there is any difference in the return distribution of the developed and developing markets.

Rest of the paper is organized as follows- in section 2 details of the data are presented, in section 3 we present the empirical results and finally in section 4, we conclude our findings.

2. Data

In this paper we study the return distribution of the indices of four markets- NIFTY (India), JKSE (Indonesia), STI (Singapore) and S&P 500 (USA). Daily closing values of these indices were downloaded from Yahoo finance website. The sample period of NIFTY, FTSE AND S&P 500 is from January 1st, 1991 to December 31st, 2010. However, for JKSE it is from July 1st, 1997 to December 31st, 2010. The closing values of these indices are corrected for dividends and stock splits.

3. Empirical results

3.1. Descriptive Statistics

The descriptive statistics of daily log returns of the four indices are presented in Table 1. We find that the mean of returns is positive for all the four indices. However, the standard deviation of returns for the developing markets (India and Indonesia) is higher compared to that for the developed markets (USA and UK). Kurtosis for all the four markets is found to be higher than that for the normal distribution. The skewness is positive only for the Indian market, for the other three markets the skewness is negative. Furthermore, the range of returns for the developing markets is lower than that for the developed market. Similar results were found by Aparicio and Estrada () for European markets.

Table 1.
Descriptive statistics of daily returns of indices of different countries

Index	Mean	Standard Deviation	Kurtosis	Skewness	Minimum	Maximum	Sample size (days)
nifty	0.00063	0.01812	8.68698	0.11256	-0.13054	0.18901	4704
sti	0.0002	0.01324	8.00692	-0.00988	-0.09216	0.12874	5010
jkse	0.00049	0.01815	6.42544	-0.13291	-0.12732	0.13128	3279
sp500	0.00027	0.01179	9.05395	-0.20255	-0.0947	0.10957	5040

3.2. Departure from normality

Figure 1 presents the distribution of daily returns for all the four markets. The normal distribution was fitted to each of the four data sets. The results are shown in Figure 1 and the fit parameters are presented in Table 2. From the table we observe that the value of χ^2 degrees of freedom (dof) for each data set is much higher than the critical value of χ^2 degrees of freedom at 5% significance level. Thus, the normality assumption of daily returns is clearly rejected for all the four markets. Figure 1 shows that the empirical daily returns distributions for all the four markets have high peaks and fat tails and deviate significantly from the normal behavior in the tails region.

Table 2.

Parameters of the fit of normal distribution to the empirical daily return distributions.

Index	NIFTY	JKSE	STI	S&P500
Sample size (days)	4704	3279	5010	5054
Mean	0.00088	0.00043	0.00034	0.00053
Sigma	0.01454	0.01721	0.00994	0.00881
X2/dof	195.0/40	221.6/43	299.2/40	353.7/33
Critical value	55.7/40	59.3/43	55.7/40	47.4/33

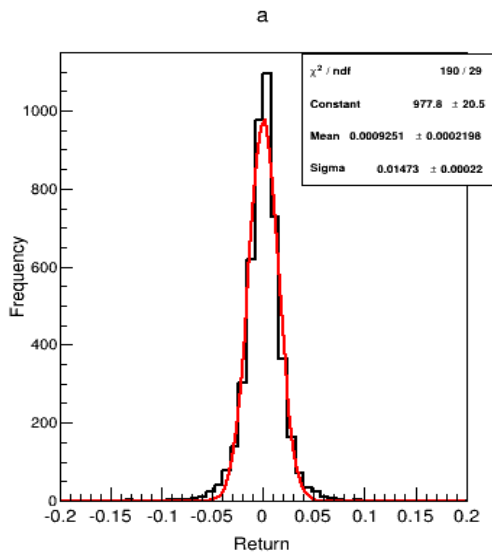


Figure 1(a). Distribution of daily returns of Nifty (India) with a Gaussian fit.

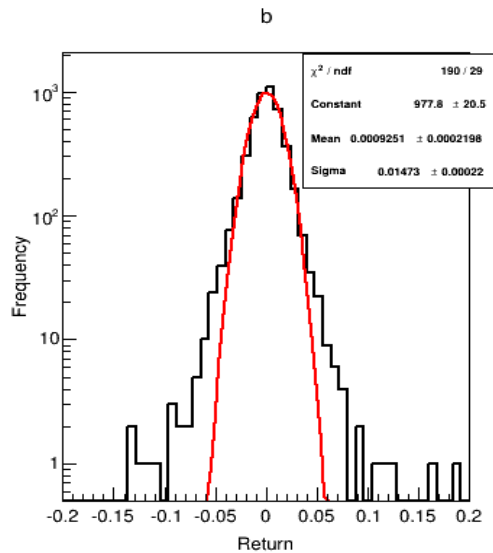


Figure 1(b). The same distribution with frequency plotted on log scale.

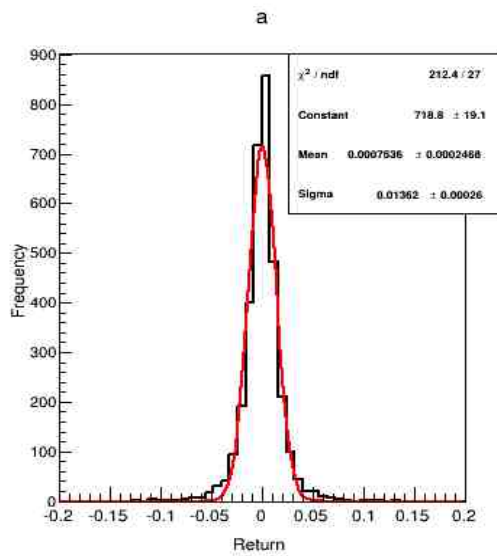


Figure 2(a). Distribution of daily returns of JKSE (Indonesia) with a Gaussian fit.

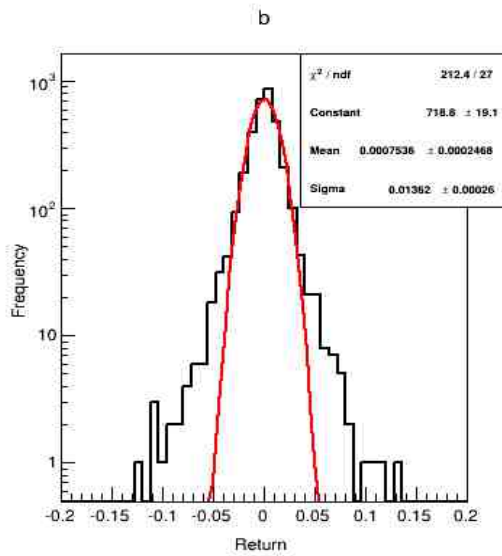


Figure 2(b). The same distribution with frequency plotted on log scale.

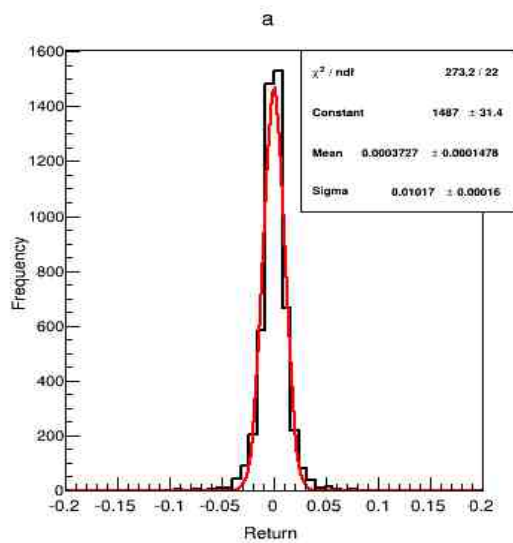


Figure 3(a). Distribution of daily returns of STI (Singapore) with a Gaussian fit.

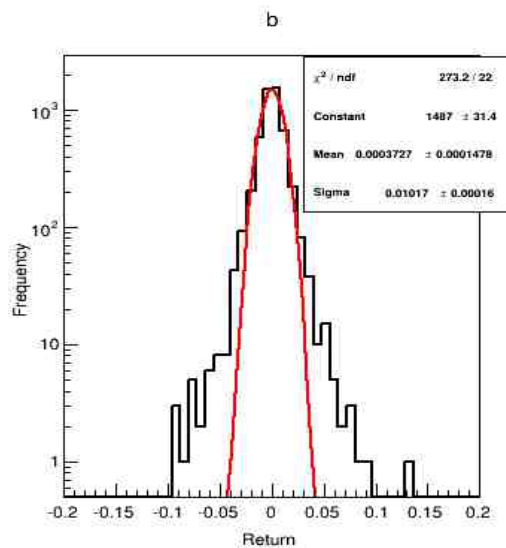


Figure 3(b). The same distribution with frequency plotted on log scale.

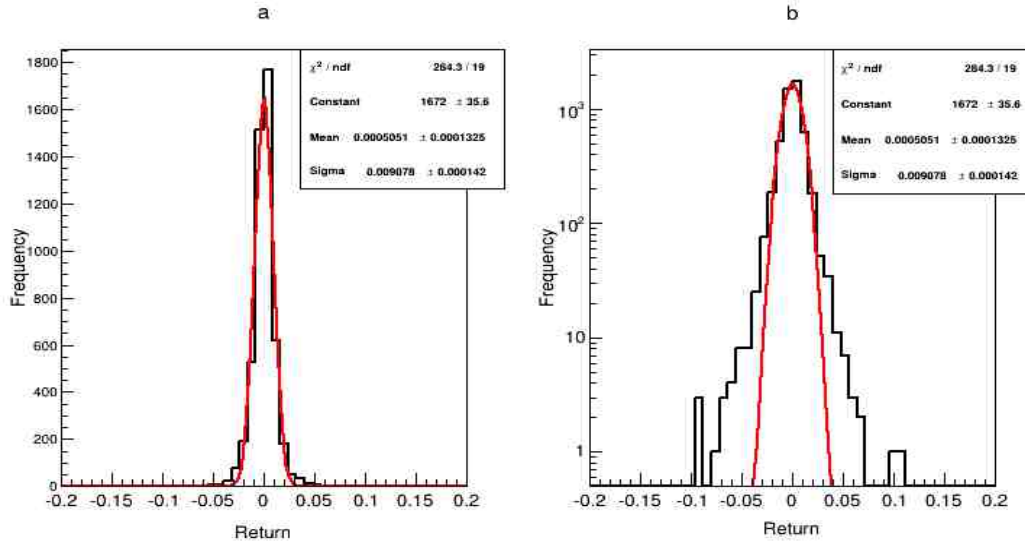


Figure 4(a). Distribution of daily returns of S&P500 (USA) with a Gaussian fit.

Figure 4(b). The same distribution with frequency plotted on log scale.

3.3. Student's *t*-distribution

The density function of the student's *t*-distribution can be written as:

$$P(x | \sigma, \mu, \nu) = \frac{\Gamma\left(\frac{\nu+1}{2}\right)}{\Gamma(\nu/2)\sqrt{\pi(\nu-2)\sigma^2}} \left[1 + \frac{(x-\mu)^2}{(\nu-2)\sigma^2}\right]^{-\frac{\nu+1}{2}} \quad (1)$$

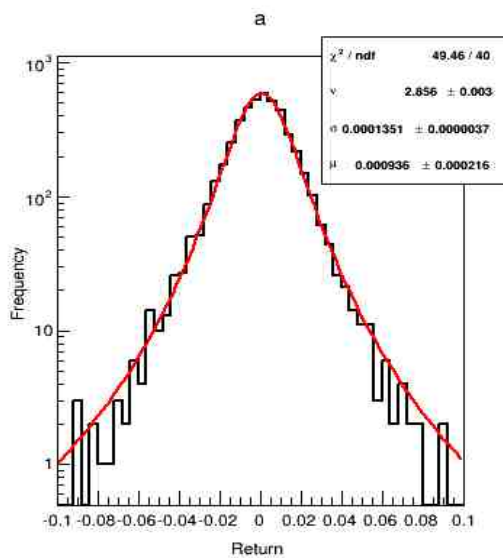
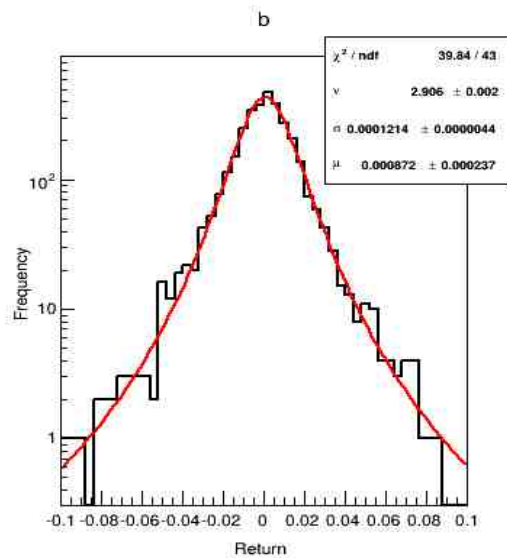
Compared to the normal (Gaussian) distribution, the Student's *t*-distribution is more peaked at the centre and has fat tails. However, for large ν (>15) it has no peaks and fat tails and almost behaves like a normal distribution.

As all the four empirical return distributions under study have peaks and fat tails, we fit student's *t*-distribution to the empirical daily return distributions of all four indices. For this purpose we divide the range of daily return into 50 equal and non-overlapping intervals and the range of the fit is set as $-0.1 < x < 0.1$. The fit parameters are presented in Table 3. Values of χ^2/dof indicate that student's *t*-distribution cannot be rejected in any of the four markets at 5% significance level. Our results are consistent with the results reported for other markets, although for a different sample period [Grey and French (1990)].

Table 3.

Parameters of the fit of student's t distribution to the empirical daily return distributions

Index	NIFTY	JKSE	STI	S&P500
Sample size (days)	4704	3279	5010	5054
$\bar{X}$ -mean	0.00093	0.00087	0.00027	0.00058
σ	0.00013	0.00012	0.00007	0.00005
ν	2.856	2.906	2.894	2.905
X^2/dof	49.4/40	39.8/43	49.2/40	44.4/33
Critical value	55.7/40	59.3/43	55.7/40	47.4/33

**Figure 5(a).** Distribution of daily returns of Nifty (India) with a Student's- t distribution fit.**Figure 5(b).** Distribution of daily returns of JKSE (Indonesia) with a Student's- t distribution fit.

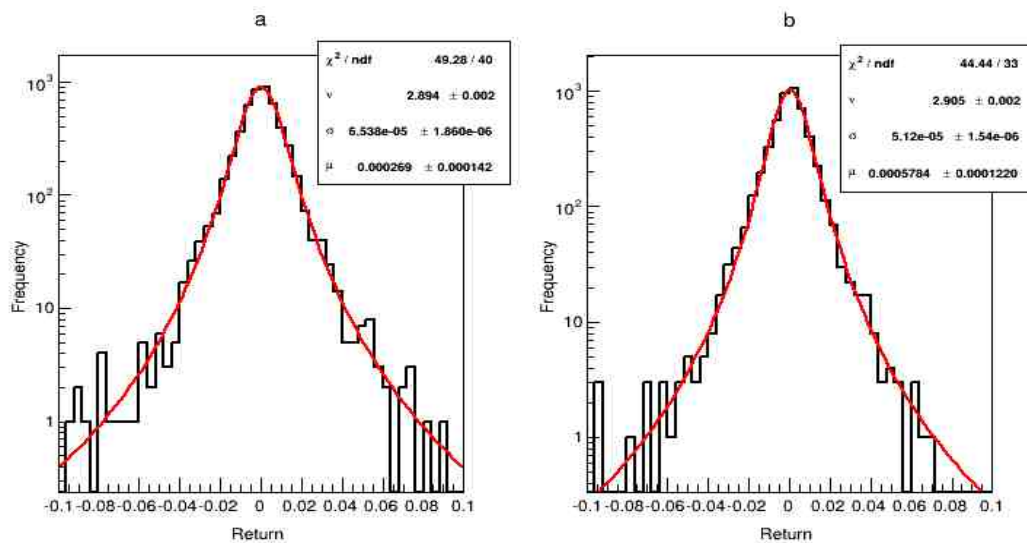


Figure 6(a). Distribution of daily returns of STI (Singapore) with a Student's- t distribution fit. **Figure 6(b).** Distribution of daily returns of S&P500 (USA) with a Student's- t distribution fit.

4. Conclusions

In this paper we studied the empirical disturbance of returns of two developing markets- India and Indonesia and two developed markets Singapore and USA. We tested the normality hypothesis and clearly rejected it. The empirical return distribution of all four markets exhibit central peaks and fat-tails. So, we fitted t -distribution and found that at 5% significance level, it fits all the four empirical distributions of returns. The fitted value of the dof parameter ν is found to be same for all the four markets, both developing and developed markets (around 2.9). Fitting Student's t -distribution can also be justified on theoretical grounds, Praetz (1972) shows that when a Brownian motion is modified by assigning a prior distribution to an unknown parameter, to account for the changing variance of returns, the resulting distribution is a Student's t -distribution,

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NEW ECONYOMY Section

PUBLIC MANAGER IN THE MUNICIPALITY IN THE ERA OF THE ECONOMIC CRISIS (EXEMPLIFIED BY THE SIEDLECKI SUBREGION)

Wioletta WEREDA*

Abstract. *The beginnings of the twenty-first century show that one of the most important signs of a well-functioning organization is to provide public services with high quality, moving away times when the recipient of public services meant nothing. Currently, in the centre of a well-functioning public organization is the client. That is why each unit should operate in an efficient, transparent way and with considered needs that are reported by customers. Unfortunately, the actual functioning of the offices has been seen a little differently. Often there are heard opinions of the poor quality of services provided by the public authorities, about information noise and long waiting period during working hours, what as a consequence causes the frustration on the client side.*

According to the above arguments, public organizations are trying to introduce modern management methods to support the internal organization of work and the process of the provision of services in the context of a greater focus on the customer. The purpose of this article is to show the role of customer orientation in contemporary public organizations on the example of the Office in the local government unit.

Keywords: *New Public Management, managerial skills, intelligent municipality, changes in local public units.*

1. Introduction

Implementing leadership and public management changes in a municipality is a long-term process which requires skills to surmount resistance of numerous interest groups and parties. Local public managers operating in the local territory have to demonstrate a political talent,

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possess the attributes of a strategist and the capability to sense the interests of a range of parties and to find a middle ground¹.

Possessing numerous competencies, qualifications and personal characteristics and following specific rules and moral norms is essential. What is equally important in the realizing and accomplishing given goals and assumptions is the work experience and aptitude in dealing with problems which may arise during fulfilling daily duties. People in power in the institutions of the public sector must set working for the society as their target that is they should have the ability to solve the society's problems and to fulfil people's needs in the era of transformations and economic and political turbulences. It is thus easily noticeable that modern public managers must be people of multifaceted personalities due to the fact that over the last two decades public administration had to undergo certain modifications in order to find its ground and adjust to the new situation and transformations into more market oriented economy, especially in the era of economic crisis.

The main objective of this article is an attempt to verify the posture (characteristics, skills and educational background) of public managers in the process of management of territorial self-government units. The scope of research covers municipalities of the Siedlecki subregion. For this purpose the following specific objectives have been identified:

1. Diagnosis of principal managerial features and skills among local mayors in municipalities across the district;
2. Assessment of research on the issues of local managers dealing with changes according to economic crisis conditions;
3. Definition of public managers and an intelligent municipality.

2. Research methodology

Key objectives of this study were defined above and the featured surveys were conducted in all municipalities of the Siedlecki district, thus the selection of research sample was not random.

Siedlecki district lies in the eastern part of Mazowieckie province covering the territories around Siedlce – a city having the rights of a district. The district comprises thirteen municipalities: Domanice,

¹ W. Wereda, *Creating leadership in an Intelligent municipality as an element of competitive advantage of the unit in the subregion* (exemplified by the Siedleckisubregion) [w:] S. Majtan a kolektiv (red.) Aktualne problemy podnikovej sfery, Wydawnictwo EKONOM, Bratislava 2012, p. 627.

Korczew, Kotuń, Mokobody, Mordy, Paprotnia, Przesmyki, Siedlce, Skórzec, Suchożebry, Wiśniew, Wodynie i Zbuczyn. All municipalities used to belong to the former Siedleckie province. Siedlecki district borders with five districts from Mazowieckie province: Garwoliński, Łosicki, Miński, Sokołowski and Węgrowski, two districts from Lubelskie province: Bialski and Łukowski as well as Siemiatycki district from Podlaskie province. There are 82,000 inhabitants, the least inhabitants are in Domanice municipality, the most around the City of Siedlce. An average density of population remains at the stable level for a few years and amounts to 51 persons per km². On the territory of the district there is a solely one town – Mordy having 2,000 inhabitants².

The technique chosen to collect data was based on a prepared questionnaire presented to managers of selected units on personal consults. The population surveyed encompassed merely 12 local mayors because one of the local mayors did not express the intention to participate in the questionnaire survey. The surveys were carried out in June 2011. The persons covered by the survey, as previously mentioned, included public managers holding the office of the local mayor in the territory of Siedlecki district. The questionnaire survey involved personal handing over questionnaires to parties concerned, in one case only the questionnaire was sent electronically by e-mail.

Subsequently, the collected data was analyzed by using basic mathematical and statistical methods of calculations. Methods of induction, comparison and verification were also used in order to draw conclusions from the findings.

3. Public manager – a trial of the identification

The phrase “public management” emerged within the process of advancing public administration. Public management fully supplanted traditional administration in the public sector both in the domain of practice and theory. A new approach to public organization management abandoned a prevailing way of viewing “public administration” as well as its function performed³. Talking broadly about this term it should be pointed out that it is based on different fields as it is mentioned below.

A trend based on public management which entirely replaced traditional public administration was manifested in several countries in

² W. Wereda, *Creating leadership...*, *op.cit.*, p. 643.

³ A. Frączkiewicz-Wronka, (ed.) *Zarządzanie publiczne-elementy teorii i praktyki*, Wyd. Akademii Ekonomicznej, Katowice 2009, s. 27.

varied forms, thus conferring diverse names into a new model of public management:

- New Public Management (NPM);
- Managerialism;
- Entrepreneurial government;
- Market-based public administration⁴.

So many labels denoting the same phenomenon reflects a diverse manner of perceiving ongoing changes by numerous authors in a given field. Among the identified models the most popular and practically evolved public management model is market management, mainly termed as New Public Management (NPM)⁵.

In many countries administrative reform focused on public management has become a priority matter to restore and transform the public sector into a market oriented economy. New Public Management was designed to draw inspiration from the private sector to boost the efficiency of operations in the public sector⁶. According to R.A.W. Rhodes, P. Dunleavy, Ch. Hood the new public management emphasizes "...performance appraisal and efficiency; the disaggregation of public bureaucracies into agencies which deal with each other on a user-pay basis; the use of quasi-markets and contracting out to foster competition; cost-cutting; and a style of management which emphasizes, amongst other things, output targets, limited term contracts, monetary targets and incentives, and freedom to manage" (Rhodes, 1991: 11; Dunleavy & Hood, 1994)⁷.

An attempt to define „public management” was made also by Prof. Barbara Kożuch who holds that “public management is a scholarly discipline committed to studying the manners and the scopes of harmonizing activities that ensure appropriate formulation of objectives by organizations forming the public sphere, and of the optimal use of opportunities provided by organized activities by people, revolving around creating public values and realizing public interest”⁸. People who are

⁴ A. Zalewski, *Nowe zarządzanie publiczne...op.cit.*, p. 26.

⁵ J. Hauser, *Od idealnej biurokracji do zarządzania publicznego*, [In:] *Studia z zakresu zarządzania publicznego*, (ed.) J. Hauser, M. Kukielka, Wydawnictwo AE, Kraków 2002, pp. 62-64.

⁶ W. Wereda, *Creating leadership...op.cit.*, p. 643.

⁷ 1) P. Dunleavy, Ch. Hood, *From Old Public Administration to New Public Management*, "Public Money & Management", no 1/3 (July-September) 1994, pp. 9-16.

2) R.A.W Rhodes, *The New Public Management*, "Public Administration" no 69/1 (Spring) 1991.

⁸ B. Kożuch, *Zarządzanie publiczne. W teorii i praktyce polskich organizacji*, PLACET, Warszawa 2004, p. 10.

performing in public organizations can be broadly called public managers and, for example, L. R. Jones, F. Thompson and W. Zumeta claim that the world in which public managers function is rapidly changing and is vastly different from that contemplated by the early intellectual stalwarts of public administration. Public agencies are expected to collaborate with each other, with nonprofit organizations and with citizen groups and to use modern technology strategically to manage and deliver services. They are under powerful pressures to use resources efficiently as markets and quasi-markets influenced by global forces play a much greater role in structuring service delivery. Within this context public agencies must manage human resources accordingly, yet also humanely and legally⁹.

Continuing, public managers manage people and/or programs that serve the public. Some plan for cities, others educate children, regulate industries, promote public health, and provide security. These managers bring together the participants necessary to pursue and enact their core tasks¹⁰. M. S. Feldman and A. M. Khademian in their later work point out that these managers should perform inclusive public management which has two broad premises:

1. Bringing people from different perspectives together in ways that allow them to appreciate one another's perspectives will enhance the design;
2. Implementation of policies.

Among the potential perspectives, three stand out as foundational: (1) the *political*, (2) the *scientific or technical*, and (3) the *local or experienced-based* perspective. These perspectives are all important in the formulation, adoption, and implementation of plans and programs. Inclusive management requires attention to all three perspectives in the production of effective programs and policies. The second premise of inclusive management is that informed deliberative processes are fundamental to democracy. The public manager as inclusive manager facilitates the practice of democracy by creating a community of participation where people can share information from different perspectives and together work together on problems¹¹.

⁹ L. R. Jones, F. Thompson and W. Zumeta, Public management for the new millennium: developing relevant and integrated professional curricula, on-line version document in pdf format, p. 19.

¹⁰ M. S. Feldman, A. M. Khademian, *To Manage Is to Govern*, "Public Administration Review", no. 62/2002, pp. 529-541.

¹¹ M. S. Feldman and A. M. Khademian, The Role of the Public Manager in Inclusion: Creating Communities of Participation, on-line version document in pdf format, p. 306.

As a result of surveys conducted in Siedlecki District the local public managers themselves indicated the traits which in their viewpoints appear critical to local management. Hence, according to those surveyed a local public manager is an individual who should undoubtedly possess numerous multifarious skills that could create conditions for efficient and effective operations.

Having completed the survey, the profile of a respondent, i.e. of a local public manager in Siedlecki District, was established. As it was mentioned above, 12 people participated in the questionnaire, 11 men and only one woman. The most numerous group of respondents comprised people at the age from 46 to 55 years old, who constituted as much as 50% of all respondents. 34% of the respondents were between 36 and 45 years old and only 8% of all surveyed people were at the age between 25 and 35 and above 55 years old. Asked about the level of their education, all public managers answered that they have higher education. It should not come as a surprise to anyone, as at this kind of posts higher education is an essential requirement. Regarding experience, a vast majority, that is 75% of all respondents, stated that they had more than fifteen years of experience. 17% of those polled had between 6 and 10 years of experience. Only 8% of the respondents admitted that they had little experience. Nobody opted for the 11-15 years of experience variant in the questionnaire. The question concerning the seniority of the managers juxtaposed with the one regarding the age leads to the conclusion that it is highly unlikely for a relatively young person to have such a huge work experience required at the posts of public managers. The most numerous group of respondents comprised people who had been holding the post of a public manager for more than eight years, i.e. 42% of all respondents. 25% of respondents had been at the post for 3 to 5 years and the same number falls in the range between 6 and 8 years. The least numerous group, only 8% of all those polled, are people working less than 2 years at the post. Answering the next and last question regarding the monthly salary received by a public manager, the vast majority of respondents, 58%, indicated a sum between 6,500 and 9,500 zlotys. 25% of the surveyed people earned no more than 6,000 zlotys. The least often variant chosen by the respondents was the salary above 9,500 zlotys, only 17% opted for that option. The above results show that the salaries vary. There is not one fixed sum that a manager employed in a public organization earns. An average public manager is a man at the age between 46 and 55 years old with vast work experience, more than 15 years including managerial experience amounting to 8 years, and with monthly salary between 7,500 and 9,500 zlotys (net pay).

According to the respondents (fig. 1), the most important manager's task is planning and setting goals (29% of all answers). The next most important activity is organizing, which received 24% of all votes. Obtaining funding from the European Union was chosen by 19% of respondents. Subsequently, obtaining external funding was indicated by 12% of the surveyed. 9% indicated the controlling tasks, and the least often marked answers were leadership (4%), innovativeness and introduction of changes (3%).

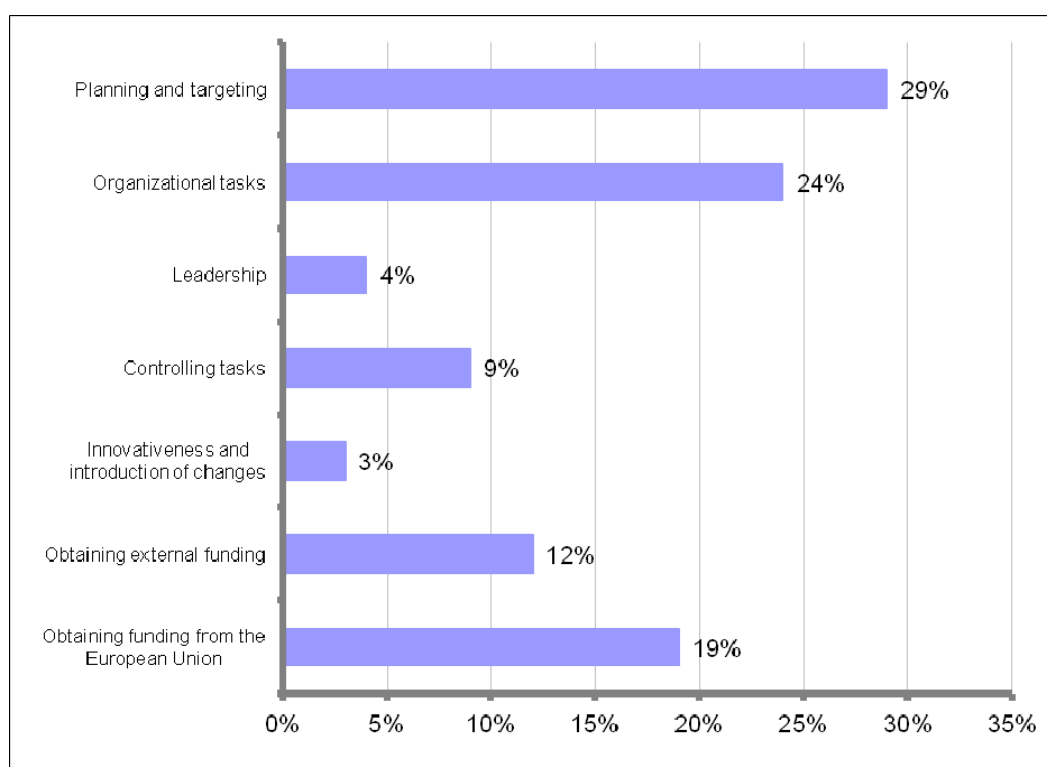


Figure 1. The most important activities of a public manager.

Source: own study based on research.

In the respondents' view, the most important public manager's task is planning and setting goals. Innovativeness and introduction of changes turned out to be less essential.

One of the grounds on which resistance appears among the employees of an organization is the process of implementation of changes. That phenomenon is directly linked with the next question the respondents were asked, the question concerning the phenomenon of resistance among employees in municipality. It appears, on the basis of the conducted

research, that 58% of the respondents claim that they have not encountered any resistance on the part of the employees. The remaining part of the respondents, that is 42%, stated that such a phenomenon took place.

In such a situation one may attempt to put forward two theories, although it is hard to ascertain which one is more true. First of all, public managers have not encountered any resistance on the part of their employees due to the fact that they are highly skilled in using preventive management methods which eliminate resistance at its source, or they do not implement any radical/significant changes in the public organization.

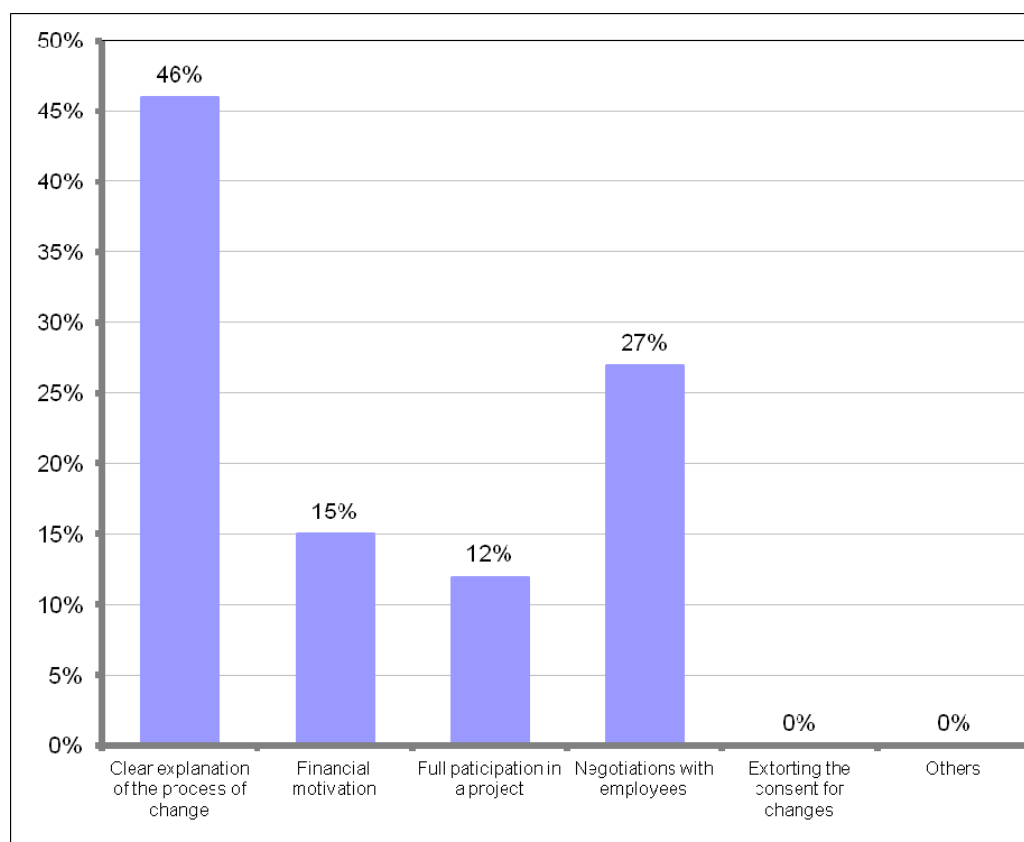


Figure 1. The most common methods used to minimize resistance among employees.

Source: own study on the basis of research.

The most often answer marked and the most commonly used method of minimizing the resistance is the clearest possible explanation of the process of changes, which constitutes 46% of all answers. 27% of all respondents indicated negotiations with the employees. Less frequent were answers such as: financial motivation (15%), fighting against the

employees' resistance by fully engaging members of the organization in the project (only 12% of all answers provided). The option of forcing the employees to give their consent for changes was not marked by any respondents (fig. 2).

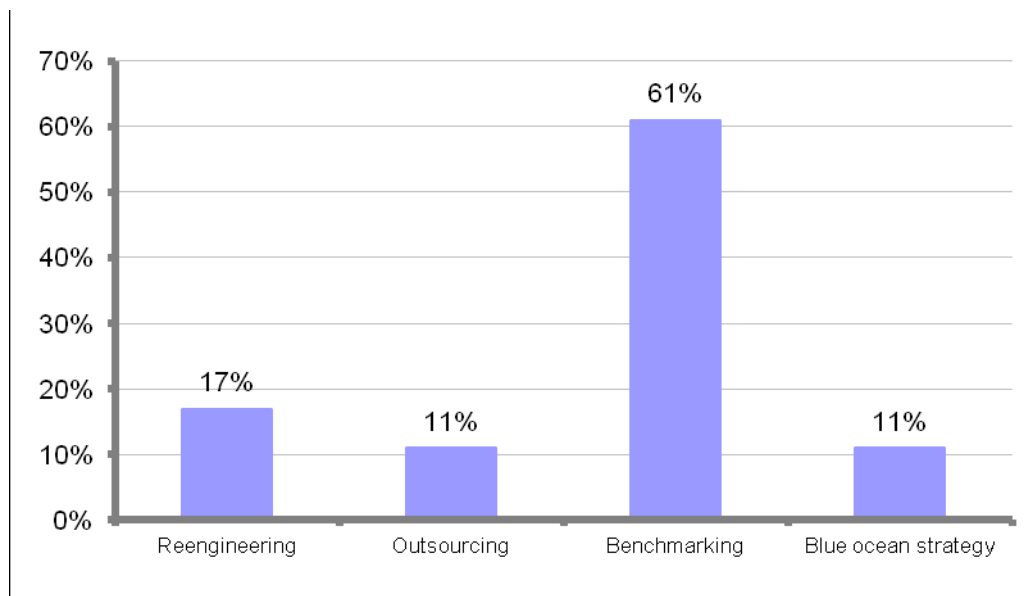


Figure 2. Management techniques.

Source: own study on the basis of research.

The technique referred to as Benchmarking was the most often chosen answer, 62% of respondents opted for it. 17% of all answers concerned the technique called Reengineering. Other techniques chosen by the respondents were Outsourcing and the Blue Ocean Strategy. Both these options received 11% of all answers each (fig. 3).

4. The economic crisis and changes in municipality management

The last eight years have been the time of the biggest recession in the world economy which resulted from the financial crisis caused by erroneousness in the American mortgage market¹². The symptoms of the crisis appeared already in 2006 and since then prices of estates in the USA have dropped significantly enough to shake not only the American

¹² A. Niemczyk, R. Seweryn, *Przyjazdy turystów amerykańskich do Krakowa w obliczu kryzysu*, [in:] A. Gotowt-Jeziorska, K. Łopaciński (ed.) *Turystyka w Polsce w okresie kryzysu*, Polskie Stowarzyszenie Turystyki, Warsaw 2011, pp. 143-158.

domestic economy but also the world economy. Due to that fact the world has entered a new economic era – from normality to economic and social turbulences.

The effects of the global economic crisis have been experienced by the Polish society, Polish local authorities and by Polish municipalities, too. Due to the fact that since 2004 Poland has been a member of the European economy our public managers are obliged to comply with the rules of economic and financial policies binding in the European Union. Public feelings correlate with the changes in people's salaries and adverse conditions for businesses. In spite of the current crisis conditions, local authorities, similarly to other business entities, have to continue fulfilling their mission in all domains including management and market-related functions. They have to accomplish their tasks and social expectations regarding how public money is spent must be fulfilled. Members of society expect the managers of the units of local authorities to possess the abilities of effective management regardless of circumstances or crisis turbulences.

Many of the assumed goals or statutory functions are difficult to realize due to economic slowdown the effects of which are experienced by municipalities in a variety of fields of their activity. The crisis forces decision-makers to use sources of financing from outside the budget, to manage the European Union funding effectively, to search for external investors and to adjust to the banks' "cautious" strategies, and to look for various cheap marketing and market related solutions to promote their municipalities at the regional and even international level. Polish municipalities have faced up to the necessity to function in the era of limited economic growth, increasing unemployment, decrease in tax revenue, decrease in the deficit of the public finance sector and the control of the debt level and in the situation in which many public obligations have been transferred to the local market with low financial support on the part of the central government budget.

In the era of unstable economic changes and development of local municipalities, public managers (of different level) should be the ambassadors of changes, that is they should undertake the role of active leaders taking the responsibility for implementation, realization and appraisal of the effectiveness of the changes. It is essential for them to be able to exert influence on each employee and at the same time to be role models to be followed and imitated. However, it must be remembered that people's attitudes change due to social and economic situation. A given situation, circumstances, course of events and the presence of third parties

are the factors that influence people's attitude. Due to that, managerial attitudes can be grouped in three categories:

1. Positive attitude – assumed goals have been achieved;
2. Passive attitude – they do not support but rather delay the realization of goals;
3. Negative attitude – they delay or even block the realization of goals¹³.

In order to manage changes effectively, public managers need to possess qualities of a good observer to be able to take notice of all signs of resistance against the changes, both proposed and those being in the process of implementation. One should remember that resistance against changes can be avoided if all employees are well informed regarding the planned implementation. When employees do not know about the changes, resistance is their most common response. Many people do not like changes; they prefer to adhere to their habits, traditions and patterns from the past. Changes regarding hierarchy and positions of leaders are especially dangerous. Participation of subordinates in the implementation of those changes is highly desirable; however, resistance in the course of those changes is a real and possible threat. Managers have to be familiar with various managerial techniques and have to use them in practice in the process of introducing changes. In a situation when managers intend to overcome resistance and implement some changes, they should undertake the following steps:

1. Consult the members of an organization regarding their fears, opinions and reactions – that will allow to select appropriate methods which lead to reaching an agreement between the employees and the managers, who are introducing changes;

2. Improve the process of communication – providing employees with detailed information regarding the planned changes, the reasons for them and effects of them should contribute to employees' better understanding the changes' essence and, what follows, to decreasing the employees' uncertainty;

3. Engage all people who the changes will concern in active participation in the process of their preparation and implementation – the employees should understand the aim and structure of the changes as they are part of them and they are working on them. Due to that they will be less suspicious;

¹³ B. Kożuch, *Zarządzanie publiczne, W teorii i praktyce polskich organizacji*, Placet, Warszawa 2004, p. 230.

4. Educate oneself and the employees – doing that the employees of an organization will prepare themselves for changes. They should be educated both before and during the introduction of changes. Due to that the new situation will be more understandable;

5. Support – the employees should feel they have the support of their authorities. They should know that their problems are not neglected and their opinions are taken into account in the process of making the most important decisions;

6. Negotiate and make contracts with the employees of an organization – the employees who decide to approach the changes positively may in return be offered more advantageous conditions of further cooperation;

7. Manipulate and impel – a manager should convince the members of an organization that changes are introduced in their best interest, should give them a chance to participate in the processes such as designing and implementing of the changes. Due to that the employees will identify with the organization, the logic of its functioning and the rightness of the introduced changes;

8. Force (overtly or covertly) – threatening the employees is a very risky and dangerous method and it is used in the cases of individual resistance. However, one must bear in mind that forcing somebody to do something never results in emergence of positive feelings. The opposite, it causes the employee to increase the distance and it may destroy the good relationship¹⁴.

According to P. Kotler and J. A. Caslione the process of managing in a public organization in chaos should be designed mainly by means of an appropriate marketing system¹⁵. The era of crisis, when there is no demand for new investments, is a good time to prepare the ground for new investments and good conditions for development in the future. It is a good idea to devote this time to conducting some marketing research and to introducing some organizational changes. When the crisis has finished, the municipality will be ready for accepting foreign investors. The results of revival will not be visible in the next few years, especially in the context of the novelization of the 2013 budget. In the newly published special report, Fitch Ratings¹⁶ presents the challenges that the units of local government in

¹⁴ B. Kożuch, *Zarządzanie...op.cit.*, pp. 230 and next.

¹⁵ P. Kotler, J. A. Caslione, *Chaos – zarządzanie i marketing w erze turbulencji*, MT Biznes Sp. z o.o., 2009.

¹⁶ *Wskaźnik długu wyzwaniem dla samorządów*, Portal Samorządowy, www.portalsamorzadowy.pl, [Access at 2013.08.06].

Poland will have to face in the years 2013 and 2014 due to new debt rates. The new debt rate is curbing investments but improves the operational results of the local governments. That perspective allows studying the positive aspects of the era of crisis.

5. Leading to the intelligent municipality in the era of economic crisis and changes. Conclusions

The study of the literature and the research conducted have allowed for drawing a few conclusions. Summarizing the main points, one will notice a specific duality - both positive aspects of the functioning of an organization in the context of public management executed by managers, and negative sides, which merely indicate that the results may vary when related to the aim of jobs. Upgrading the managers' competencies through participating in all kinds of training courses is a very important matter in the new public management. Unfortunately, this principle is not realized by Polish municipalities. Public managers do realize that improving their skills influences the development of an organization but still they do not upgrade their qualifications in a significant way. If at all, they only enrol on some very short courses. According to the subsequent NZP's assumption, it must be emphasized that public managers should make use of the methods and techniques known from the private sector. However, from the conducted research it shows that municipality heads rarely resort to those techniques and if they do that, they only use the most popular ones. The reason for that might be the lack of knowledge of modern solutions which makes it impossible to use them in accomplishing everyday goals. One of the most important roles of a public manager is managing the process of implementing changes in an organization. In most municipalities of Siedlecki District, there is no resistance against changes on the part of the employees. It is a very positive and auspicious situation. The question emerges whether the reason for that is using well in advance instruments and methods preventing resistance, or it is due to the fact that managers are not introducing changes according to the guidelines of New Public Management.

Transformation of the traditional organization into an intelligent one is a complex process requiring much effort from the whole organization. It is vital to change the approach of all employees towards their own development, enhancing qualifications and acquiring knowledge and then harnessing it for firm's advancement and boosting the effectiveness of its operations. An intelligent organization is much more than a learning

organization as it is capable of exploiting the effects yielded by learning for the benefit of its own development and for winning a leading market position¹⁷.

Therefore, it proves difficult to define a charter of the intelligent municipality, relying on above mentioned traits inherent to an intelligent organization as principles for functioning territorial self-government units are principally anchored in statutes and a strong impact exerted by a community and varied interest groups.

When defining a unit as intelligent the author largely means the persons who manage this municipality and the entire administration which helps implement these decisions. To recognize the specifics of functioning of the so-called intelligent municipality it is necessary to determine the traits which should distinguish it from other municipalities, regardless of its location and size. Such a municipality should:

1. Fulfil its fundamental tasks specified by the statutes.
2. Manage funds so as to meet these goals, seeking out the most elaborate financial sources (majority of municipalities fund their investment activities from budget resources and bank loans and credits, disregarding instrument on a capital market and EU funds).
3. Provide opportunities for boosting competences and learning foreign languages (if a municipality cannot afford to co-finance teaching a few languages, at least it should fund the English language) for personnel of the municipality offices.
4. Be open and implement changes related with market mega trends¹⁸ e.g. enabling enterprises and local communities to import skills and knowledge from other regions, and even countries.
5. Encourage new companies and investors to settle on the territory of the municipality not only through standards action strategies, but chiefly through enhancing the brand and image of the unit, creating virtual municipality office and offering the lowest operation costs for business entity on its territory, e.g. in the form

¹⁷ Report: Development trends of intelligent organizations in the global economy, PARP, Warszawa, listopad 2009, p. 15.

¹⁸ Megatrends concerned with globalization of markets and enterprises, establishment of supranational power systems (international alliances, establishment of global corporation), shifts in systems of consumers' values (heightened significance of individualism, partnership and business ethics), development of communication methods (development of services based on IT and ICT networks, invasion of new technologies with multiple applications, innovativeness of services and products, growth of inter-organizational relations, networking and co-opetition).

of lower taxes within a grace period, shortened time for acquiring permits for activities on its territory and others.

6. Make available information points to inhabitants which present the updated data with regard to the municipality, region and economic trends across the globe.
7. Make use of broadly understood promotion elements to create its brand and image.
8. Strengthen bonds between the municipality and a local community through augmenting the quality of elementary education, searching foundations assisting remarkably talented children from rural areas or giving access and opportunities for using internet services throughout the whole municipality.
9. Elect such leaders who possess not only adequate education but also are capable of persuading local community to leverage strong assets of the municipality to the maximum extent, and are able to reduce its weak points and cope with threats.
10. Ensure the society has access to standard technical and social infrastructure and model fundamentals for development focused on export and import of experiences with other municipalities, cities or regions¹⁹.

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SPATIAL DEVELOPMENT PROCESS OF EDUCATIONAL POLICIES IN ROMANIA (Short Note)

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Abstract. *Higher education institutions can play a key role in human capital development and innovation systems from Romania. Within the regional level it is proposed the development of Higher Education Regional Institutions (HEIR), system which can lead to a pole supporting growth and innovation, can provide a focus and coordinate the qualification of the labour force, as well as its search and innovation processes. HEIR can help regions become more innovative and globally competitive. It may also contribute to a more balanced and sustainable development in a more even and of sustainable local values, inducing clear economic advantages. Also, it is considered that an important role in the development of the future regional system will have local governments that will sustain the emergence/local development of “centres of excellence” around it.*

Keywords: *higher education institutions, regional system, partnership, growth, labor force, research, innovation.*

Technologies changing represent a challenge for the labour force, especially on economic decline regions, but on the whole they are a source of huge mutation for local resources use mobilizing and effectiveness in any region. The technologic changes approaching at regional level must have as objective the complementarities and synergies emergence with an impact on the whole socio-economic environment. It can be noticed that some of the regions are prepared to face the new technology changes and are dealing with their materializing manner, while others are continuing to follow less or more their obsolete specific objectives – fighting for maintaining their position on certain markets, lasting in a certain position at national level concerning the development of an activity, sector etc.

Education and training are essential when facing the technology changes, the European economy development and growing playing a

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crucial role within the Europe 2020 Strategy objectives achievement. Increasing the investments in human capital and education and professional training systems modernizing will support the EU to become an intelligent, sustainable and inclusion favouring economy... BUT we must not ignore the fact that also in the future a great part of the education and professional training investment is going to be made at national level, while the CE role will consist in granting the opportunities offered by the European Unique Market. On the other hand, EU acts for promoting the education and training in a wide range of ways. The promoting of learning mobility crossing borders programs (*as the ERASMUS Program*) proved as having a great success in helping people to develop new competences, flexibility and innovation ability, features that may be requested for their tomorrow jobs, for facing the future technology changes. An increased mobility may also contribute to the education and professional formation systems reforming, by facilitating the crossing borders ideas and good practice spreading, by including also the education within the regional development concept.

The financial and economic crisis highlighted the request of a policy development for the investments increasing stimulating within the regions competitive capacity growing in view to support the population consumption, but also in continuing to support the left behind areas development, especially by intensifying the role of higher education within the regional development.

The acknowledgement of the territorial dimension significance is not a new concept. It is situated in the centre of EU¹ structural policies starting from its emergence. Concerning the spatial policies, the eligibility for Community support is defining, mainly at regional level, requesting an increased awareness regarding the development strategies designing focused on the specific values of the territories, on their physic, human and social capital and also on the nature and innovation resources, existent or which are going to be identified.

Within the great University centres and also the international bodies (especially at level of The Economic Organization of Commerce and Development – OECD) concerns, those on the higher education institutions role within the regional development have been intensified. In the same time, within the EU documents we may see more and more often references to the request that the future financings be focused on a limited

¹ The term “structural EU policies” concerns mainly the policies interventions by the ERDF, ESF, and Cohesion Fund intended to the rural development and the fund intended to the fishing.

number of priorities, according to the Europe 2020 Strategy objectives concerning the development of “an intelligent, sustainable growth and auspicious to the inclusion”. Moreover, we emphasize also the fact the joining of Romania to the European Union requires the harmonization of the spatial development question to the Community conceptual frame, to the physic-territorial support and at the temporal horizon considered within the European space.

We wish to call your attention on the sustainable development importance of the higher education institutions at regional level (HEIR), and also on several universities difficult issues, the challenges these are facing concerning the development of “*their intern renewing ability*”. *The issues we are calling your attention on refer to:*

- The way the universities and other higher education institutions can better satisfy the requests of the regions they are located in;
- If within the central administrative decentralization terms, they intend to develop the IISRs.

After all, in each of the mentioned issues the focus is on the manner practiced by different higher education institutions, present in a certain region or which will emerge at regional level, may collaborate or compete within the regional interest and how these structures can assure a better connection between local/ regional and national level.

In the same time, for HEIRs their relationship with the social partners within the regions is important and also their ability of creating and communicating “universal” knowledge and information in accordance to the international endeavours of many university researchers at regional level, finding also clear understanding ways for the common issues and challenges on national and international level.

We consider that through the planning and administration cycles of regional development policy should be considered also the necessary elements requested to ensure and include these objectives into the future regional strategies. An agreement / protocol on the association between HEI and central/ regional administration structures should detail the way the objectives of future programs of national reform on developed at regional level can be achieved. This endeavour would include clear and measurable objectives and would highlight the regional coordination importance for the financings from different national and/ European sources for ensuring effective and visible outcomes.

Another idea supporting the HEIR system development concerns the offer of incentives for stimulating the development of higher education programmes to make it as effective and ambitious as possible. A

percentage of the financing within the higher education policy could be reserved and made available depending on the achieved quality and progress in developing the proposed national programmes, and also by the correlation between the economic growth at local level and for example the labour employment degree, unemployment level.

The strategic objectives of the regional higher education institutions system on international level may be an inspiration field for the institutional structures in Romania, also:

- They contribute to the research and innovation activity developed at regional level;
- They play a role in human capital and local competences development;
- Contribute to the social, culture, environment development and also to the environmental development;
- Play a role in the action ability development of the regional social – economic structures concerning the operability within a global, more and more competitive economy.

By this kind of approaches a diagnosis concerning the main trends in the Romania territory spatial development considered as a whole is defined, the image of main disparities intensity is developed, the priorities of a balanced and sustainable development in harmony with the local traditions are identified and a range of tools – data, indices, typologies and methodologies – for improving the spatial coordination of educational policies is ensured.

Such approaches are further involving on one hand a complex process of HEIR development territorial outcomes highlighting and on the other hand the identification of the specific features of our country territory which can be favouring premises for development speeding up and the decreasing of certain disparities on the actual labour market.

HEIR system development should be conceived according to the European spatial development concepts, having as objectives:

- Regional competitiveness increasing on long term;
- Professionals formatting specialized according to the new jobs requested by the present and future technology changes;
- Development together with some other local partners of interconnecting activities and structural mutations development within the 5 main fields in the Europe 2020 Strategy (*Knowledge society* – Research & Development & Innovation; *domestic market* – service market opening; *business climate* – decreasing of

the administrative hindrances, increasing of the law quality etc.; *labour market* – continuous learning, growth and development partnerships, etc.; *environment* – environment issues connected to the economic and social, scientific, practical issues, of the problems concerning the development sustainability connection to the subsidiaries and good governance²);

- HEIR management in association with other local partners, tries to become a knowledge transmitting tool, searching for solutions for the intern local innovation flow improvement, so that it contributes to the change of the ratio between the product or service value due to the global knowledge and the value brought in by the raw material used for manufacturing that product or service;
- Ensuring of a certain relative parity concerning the HEIR access to the infrastructures and information;
- Sustainable development, intelligent administrating and protection of the local culture heritage.

Box ... Knowledge House from the UK – a model of regional integration of higher education institutions

In England North-East, in 1996, five universities have set up The Knowledge House having as main objective to support local companies' access of university skills, expertise and specialized services.

Knowledge House offers expert solutions to develop ideas and to solve problems through collaboration, consultancy, training and by R & D. Knowledge House Services include various surveys and reviews.

In approx. 13 years The Knowledge House made 1,300 projects and had an income of 13 million euro. Also, a growing number of university centres' staff in the region have become engaged in the activities of The Knowledge House.

Source: OECD, Higher education and innovation drives growth in cities and regions, Programme on Institutional Management in Higher Education Paris, 2010.

By M. Porter (1998) the modern business organization demands ever more a "... wide geographic configuration of value chain activities to

² Completions brought to the sustainable development principles – as a global ethic value – by Agendum 2000 "Nature Capital", by the Venice Convention on landscapes and by the Councils from 2000-2001 from Lisbon and Goteborg.

use growth opportunities geographically dispersed ... This can involve for example, re-localization of production by sub-contracting – data collection, financial service centres, manufacturing facilities and / or research and development centres – the peripheries areas ...”.

In this context, HEIR system may contribute to the development / restructuring of policy-based clusters (industrial, scientific and technological parks that have been established by law), especially those that are not fully functional / operational (potential clusters) and to speed up the introduction of innovation at the local / regional level.

Box ... Potential Clusters

A clusters typology has been developed in Romania by the EU Interreg III Programme, “Industrial Cluster Development Project INCLUD”, since 2003-2005. INCLUD Project objectives have been: establishing a cross border cooperation network of industrial clusters; generating stable relationships between clusters; supporting the SMEs internationalizing process; stimulating the positive attitudes concerning the cooperation between different EU regions (*Italy, Austria, Poland, Hungary*) and these located outside EU – at that moment (*Bulgaria, Romania*).

In the same time, by the INCLUD Project the potential clusters in Romania at that time have been identified³.

Potential Clusters in Romania

Region	County	Specialization
North-East	Bacău, Botoşani, Iaşi, Neamţ, Suceava, Vaslui	Textiles
Center	Alba, Braşov, Covasna, Harghita, Mureş, Sibiu	Wood processing; Construction Products of steel and metal
West	Timiş	Textiles; Software
North-West	Cluj	Software
Bucharest-Ilfov	Bucharest	Software

Source: “Prospects and Challenges for Cluster Development in the Timişoara Region”, presentation by Pislaru Dragos.

³ M. G. Enright identified three clusters types, as follows:

- Potential Cluster – In the case there are opportunities and some key elements;
- Delayed Cluster – Cluster includes a certain number of companies, but these are poorly interconnected due to the lack of trust, weak cooperation and high cost of the performed transactions at a certain moment;
- Working Cluster – Featured by the good development of the industrial zones.

We consider that depending on the clusters, the existent industrial / regional parks HEIR may be oriented toward the discipline types' development which in the future will develop also jobs. Also, by partnership agreements concluded with the clusters, the industrial / regional existent parks may ensure research and practice units for the teachers and students.

The development of an economy based on innovating, on medium and long term, is all the more requested as each region will have to compete, not only with the others Romanian regions but also with other regions from EU (in *Slovakia, Poland, Hungary etc.*) or in the third countries. This means that the local public authorities should support the emergence/ development of “*The excellence centres*”, around the HEIR by studying more carefully the following issues:

- The implementation of “*transparent public policies*” concerning the public-private partnerships and finding solutions for their financial support;
- Facilitating the networks development gathering all the interested parties – business associations, commerce chambers, HEIR, local research centres etc.;
- Development of local public policies by advocacy practising for local and foreign entrepreneurs.

For HEIR, the partnership is rather a necessity, but also the universities request to maintain their autonomy within the partnerships concluded with the region actors by continuously consolidating the information ability concerning the problems generated by its new role.

Creating the system of the regional higher education institutions will generate stronger and larger interaction and involvement for the local communities, by:

- The increasing of students number;
- The increasing of partnerships establishing ability on research and teaching;
- Further incomes from the services performed at local level – by consulting and professional training activities.

From the synergic outcomes generated by the Regional High Education Institutions System we mention:

- It is an incomes generator, contributing to the economic development and occupational diversification at regional level;
- Contributing to the local human capital development by increasing the ability of back holding at regional level a greater number of

graduates: It is supporting the continuous professional education process on the entire life time of people;

- The emergence of new business opportunities for teachers and graduates;
- They are real “gates” for foreign investments attracting;
- They are highly specialized sources for consultancy and expertise, having the opportunity of attracting also other valuable resources;
- They contribute to the content and audience increasing at local level for different social, culture, educative etc. programmes.

In this way an homogenous economic growth may be promoted – *within all regions* – simultaneously with the regions ability development on increasing their concerns on investing in their own economic growth, in the local resources mobilization so that the capitalization of the specific competitive advantages becomes a predominant direction of local economic growth, simultaneously with the decreasing of the subventions contribution coming from national level.

Research and innovation complementarities and synergies can be concretized also by the HEIR differentiated policy which is contributing to the regions welfare and prosperity where they activate. Also, by the partnership contracts concluded with local actors HEIR they may become proper interfaces for supporting the activities of the territorial cohesion EU programs, including the education programs.

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MORPHOLOGY AND OPPORTUNITIES AGRICULTURAL VALORIZATION: THE CASE NORTHEASTERN MONTENEGRO

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Abstract. *Morphology northeastern Montenegro in terms of agricultural valuation is not well understood. Therefore, the paper discusses the morphometric analysis of the relief: hypsometric structure, the structure of the slope and exposure. Based on morphological characteristics of relief, we selected the observed geographic space, morphological entities with different benefits and limitations for agricultural development.*

Keywords: *Northeastern Montenegro, morphology, agriculture, valorization.*

1. Introduction

Northeastern Montenegro is a geographical unit, which includes the basin Lima in Montenegro, whose total area is 2557 km². Observed geographic space, with around 1304.1 km², or about 51% of the total surface of the catchment in the Republic. Northeastern territory of Montenegro includes three municipalities: Berane, Andrijevica and Plav, with an area of 1486 km², which is by the census of 2003, are the 54,658 residents lived or 36.8 po/km². The morphology of the observed geographic space in terms of agricultural valuation is not well understood. The research results have been used to examine the author of morphometric analysis relief northeastern Montenegro and separate morphological entities with different benefits and limitations for agricultural development. To what extent the agriculture in this part of northeastern Montenegro serves as the basis for the rapid development of agriculture depends on not only natural factors, but also more of social and other factors. The geopolitical and economic crisis, considered the geographical space of the Second World War was one of the least developed economic regions of the country. Only since the sixties of the twentieth century, there was a greater degree of valorization of the natural resources of

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the region, resulting in a faster economic development. Disintegration of the Federal Republic of Yugoslavia or the State Union of Serbia and Montenegro, and the border region receives a peripheral position in Montenegro, which is even more on negative impact economic trends. Given the natural resources, the holder of the economic development in the region, should be farming.

2. Methodology

This research aims to meet the professional and the public with the morphology of northeastern Montenegro in the geographical context of its exploitation and use. Results of the survey been used to determine the author of the morphological entities that r can cause more rapid agricultural streams and GeoScape considered to provide uniform spatial-functional development. Objective of this study it was possible to realize the combined use of different research methods. The core of the methodological procedure used in this paper makes geographic (spatial) method. Permeated through the entire text of the analytical method and, thanks to which we are able to recognize, define and evaluate on the basis of morph metric characters of relief northeastern Montenegro morphological entities with different benefits and limitations for agricultural development. Since work has essentially synthetic character, used the results published in the international literature. Among them this time emphasize this (Lightfoot 1994; Antrop 2002; Bills 2004; Thapa and Murayama 2008; Thapa et al 2011).

3. Results and discussion

3.1. Morphometric analysis relief

Morph metric features of the relief are important for assessing its practical role, especially when it comes to relief, as it developed in this part of northeastern Montenegro. The morph metric analysis procedure is usually taken into account hypsometric structure, the structure of the slope and exposure (Dinić, 1978). Analysis of the morph metric characteristics bees performed using topographic maps scale 1:100.000 (Military Geographical Institute, 1986). The results been transferred to the overview map. Selection of the basic proportions and scale of the presentation of the results obtained, implied a certain degree of map generalization.

3.2. Hypsometric structure

Hypsometric structure reflects the development of vertical relief. In the considered geographic space, it is considerable. Height difference between the highest (Maja Kolata 2528 m) and lowest (bottom valley Berane 645 m) is 1883 m. We allocated approximately nine elevation zones with somewhat higher equidistance of 200 m.

Altitudinal belts were grouped into three zones hypsometric (Rajović, 2005):

1. Lower hypsometric zone (up to 1100 m),
2. Hypsometric Central Zone (from 1100-1700 m) and
3. High hypsometric zone (above 1700 m).

Hypsometric lower zone is the most attractive for agricultural activities. In the northeastern part of Montenegro been affiliated basins and valleys in relief and landscapes to 1100 m above sea level, which can be roughly taken as the upper limit of rational agricultural production. Storm River alluvial plains, river terraces, lake sediments Berane, Andrijevisa and Polimlja basin, have the most favorable conditions for intensive agricultural production. These are the physical sites where possible use of so-called complete line of machinery for certain agricultural crops. For alluvial rivers are the connected fluvial lands that are the most important aspect of are the production for possible cultivation of most crops. On river terraces as the dominant soil types of different production possibilities, arise smonitsa, eutric cambisol, pseudogley and amphyogley. According to the natural advantages alluvial river terraces and river are suitable for intensive agriculture, particularly crop production. Landscapes that include Plav – Gusinje Basin is characterized altitudes up to 948 m above sea level and there is a potential use of the so-called. a complete line of machines for certain agricultural crops. The dominant soil type: fluvisol, locally present, distric camisols, eutric camisols, podzols, planohistol (Plav). Different varieties eutric camisols allow fruit production. This area sub region II belongs to the class of so-called very favorable land for agricultural production. Storm high low areas – mountainous terrain and areas of low medium - mountainous terrain up to 1100 m above sea level is characterized by greater depth of soil cover (luvisols, smonitsa, eutric camisols, distric camisols, and sometimes-represented rendzina). The land is suitable for the production of agricultural crops, primarily orchards, and over 1,000 m above sea level is mostly woodland, pastures and meadows.

Central Zone includes hypsometric altitudes between 1100 - 1700 m above sea level and covers landscapes that are drawn along the valleys of Mountain Rivers in the middle mountainous terrain and lower areas of high

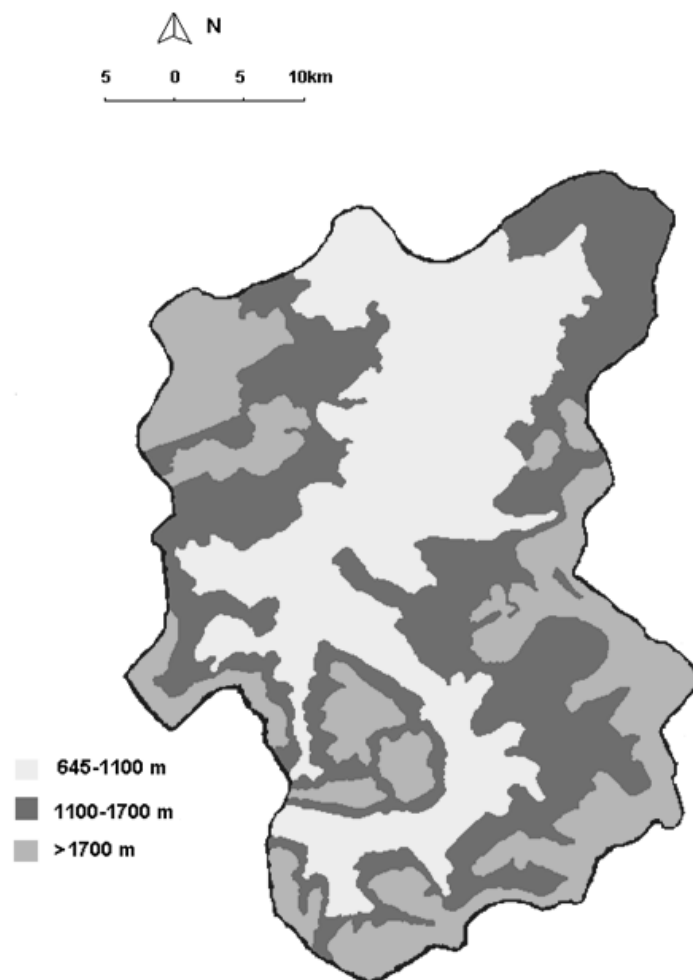
mountainous terrain. This spatial entity characterized by thinned pedological cover, with the dominant land: rendzina, podzols, kalkokambisol, kalkomensol, rankers and scantily and distric camisols, indicating that the majority under grassland and forest vegetation. These are generally steep mountain slopes, covered with dense forest. Predominantly flat terrain of meadows while the area under plow insignificant (grown mainly potatoes, barley, rye and oats). Abundance of high rainfall contributed to the creation of green areas of meadows and forests, but also a relatively significant volume of arable superficial continuously. A significant part of the arable land is been encountered along small rivers, streams, and on very steep hills. Some people think that a good part of the very steep slopes should cease to be processed and been returned to the original forests and pastures. In one part of this zone is primarily on the edges of the mountains, this is impossible to do, given that it has no other arable land (Đerković, 1992). This zone is particularly suitable for cattle breeding. This zone is particularly suitable for cattle breeding.igh hypsometric zone includes regions above 1700 m height above represents the most complex and the most prominent entity in which sharpen the contrasts and dynamics of landscapes. This zone is been represented by the most complex landscapes and ecosystems greatest biodiversity, mountain ranges with a series of sharp ridges, peaks, gaps and divisions. The area of high mountains in are the hydrographic terms, with the exception of Komova, Bjelasica and plateau lakes, characterized by a chronic lack of water (Nikolić, 2000). These courts are primarily suitable for forest ecosystems: these spaces sporadically conditionally favorable for meadow – pasture production. The most widespread land is the kalkomenasols, litisols, rendzina and podzols. Are the suitable for tourism development?

3.3. Structure slope

Structure slope is the most important agricultural activity for morph metric characteristic. In the narrow space and highly developed vertically and relief of the observed geographic space, structure slope is particularly evident (Map 2). Types and yields of agricultural crops, machinery operation and efficiency of their use, irrigation, soil erosion rate and so to a large extent are determined by the properties of the terrain (Dinić, 1978).

It was found that the amount of the annual increase of slope on the northern slopes of the radiation decreases and increases in the south (Narcisov, 1976). Thus, the south and southwest of the topographic

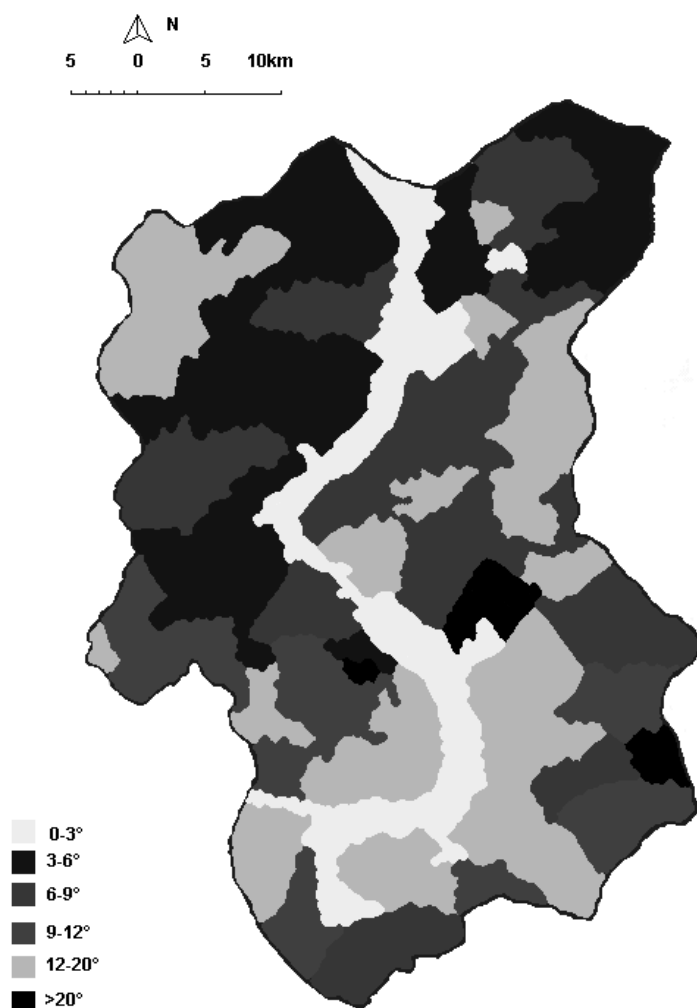
gradients are very suitable for growing crops that require more heat and light (fruit culture). The increasing slope reduces the amount of moisture in the soil.



Map 1 Hypsometric structure northeastern Montenegro (Rajović, 2011).

In morph metric slope analysis, surface topography can be classified:

1. Regardless of fitness for a particular activity, as one of the scales that were established in geomorphologic mapping or
2. Specifically defined by are the requirements of a particular human activity (Scholz, 1973).



Map 2 The structure of the northeastern slope of Montenegro.

Taking into account the basic design criteria of rural districts (Simonović and Kojić, 1980) and the current distribution of agricultural production in the northeastern part of Montenegro (Rajović, 2005), the use-value are:

1. First Courts are favorable for crop-vegetable and fruit production with an inclination of 0° - 12° and within them there are:
 - a) Courts intensive crop-vegetable and fruit production with an inclination of about 0 to about 3. These are the physical sites where it is possible to use the so-called. Is the complete line of machines for certain agricultural crops? Fields with a slope of 3° to 6° mainly include river valleys.

- b) Courts conditionally favorable for crop-intensive vegetable production and fruit with slopes of 6° to 12°, requiring contouring, terracing etc. With is the increase in slope decreases productivity.
- 2. Favorable grounds for intensive meadow-pasture and forage crops include slopes of 12° to 20°, with the use of terracing, it is possible to fruit production.
- 3. Terrain mostly suitable for forest ecosystems include slopes over 20°.

Sporadically these properties are conditionally favorable for meadow-pasture production (slope of 20° to 35°). On this side slopes, if there is no protective cover of grass, there is intense erosion processes.

3.4. Exposure page

Exposure affects the topographic surface modification elements, but no character limiting factors. Exposure is the position of the relief forms whose contour direction vertical to the direction of some of the world. According to the meaning can been taking following sequence of values: south, west, east and north. The differences in the amounts of direct radiation exposure between opposite (north south) have more pronounced with increasing slope. At the same slope of the temperature difference between sunny and not sunny slopes ground layer of air can be 6°-7°, and at a depth of 1 cm in the soil for up to 7°C (Wolf and Dimitrovskij, 1981).

Therefore, the sunny slopes are more heat, the faster they melt snow and more evaporation. For these reasons, the southern exposure spring tillage, planting and fruit ripening earlier than in the north. In addition, western and eastern exposure providing, more favorable conditions for is development of agricultural crops than north.

In the northeastern part of Montenegro is noted that the unexposed surface and good exposure to dominate the geographical areas in which they and other natural conditions are suitable for crop production. For the alluvial plain of major rivers and river terraces, and areas of intensive vegetable production, are typical unexposed area and southern exposure. Unexposed areas occupy the largest expanse of alluvial plain Lima and lower parts of the alluvial plain: Lješnice, Kraštice, Zlorečice, Grnčara, Vrulje, Ljuče and Šekularska River. On underexposed areas represented the entire production of vegetables in greenhouses. Also, depression is characterized by hills and along the borders of good exposure side. The relief is dominated by hills: the southern, eastern and western exposure. Very favorable exposure of peripheral hills: Prosjana, Čelave towers,

Tivрана, Nikolinog grave, Glavice, Paklene, on the right course Lima, Lješnice, Dapsičke, Kaludarske River and Bistrice. *Dominant western and southern exposure* suitable and for *production fruit*. *Exposure of the mountain rim* generally is *partly unfavorable* - *Northern Exposure* was *dominant on the fringes*: Prevjanskog brdo, Sovale, Sjekirice, Peštera, Bivoljka, Konjskog brda, Konjskog krša and Mokre mountains *southern and southwestern exposures* were *dominant on the edge*: Lopara, Bukovnika, Divjaka, Crnog top, Grebena, Pelinovica i Piševa.

Generally, adverse *northeast, north and northwest exposure* at *high mountain ranges* *dominate the south-eastern and southern edge of the mountain, or on the slopes*: Mramorja, Turjaka, Maja Špatita, Karaule, Štavne, Bora, Kofiljače, Štita, Skrivene i Cmiljevice. *Something better exposure with the western and eastern rim and slopes*: Carina, Suvog vrha, Crne glava, Dolova, Troglave i Maja Made (Kasalica, 1988).

On sunny exposures are: Turjak, Štavna, Skrivena, Cmiljevica, Starac, Maja e Špatit, Kofiljača, Bor, Karaula and Mramorje; *while on sunny exposures that are not*: Dolovi, Crna glava, Suvovrh, Prijedolska glava and Maja Made.

4. Morphological Entites

The relief of the region is been considered an important factor in economic development. According to economic significance, are two major morphological groups: composite Lim valley and mountainous hinterland? Lim is the most important geomorphologic whole region. Throughout its length built roads linking major regional northeastern parts of Montenegro, enabling a more even economic development. Beranska, Andrijevička, Polimska and Plav-Gusinjska basins have the best soil conditions for intensive agricultural production. Pronounced horizontal and vertical articulation of relief in the region considered is a limiting factor for intensive agricultural production, building infrastructure systems and spatial expansion of settlements. Relief dissection makes the construction of electricity networks, telephone lines and radio and television transmission (Pavlović et al 2009).

According to the basic forms of relief in the highlands of the northeastern part of Montenegro, in terms of agriculture, we can extract (Rajović, 2005):

- 1) Beransku, Andrijevičku, Polimsku, Plav-Gusinje valley and hilly and mountainous regions up to 1100 m above sea level,

- 2) Mountainous region of 1100 m above sea level to 1700 m above sea level that make mountains Kruščica (1192 m), Male (1212 m), Sovale (1320 m), Balj (1379 m), Turjak (1461 m), Šesteverac (1472 m), Trešnjevik (1573 m), Međušten (1660 m), Skrivena (1688 m) and others,
- 3) Mountainous regions above 1700 m above sea level, which include wet mountain (1933 m), Cmiljevica (1963 m), Visitor (2015 m), Bjelasica (2122 m), Komovi (2211 m) and Prokletije (2372 m). (Basic forms of altitude are given to facilitate determination of morphometric relief benefits, primarily the impact of morphometric traits in agriculture).

Beranska valley lying between is mountains Bjelasica and Cmiljevica at an altitude of about 645 m. In the narrow sense, the tectonic-erosive extension incorporated into the police, and other senior Krčevo surfaces. Surrounded by many rocks that fall to the bottom of a steep valley, at an altitude up to 800 m. It stretches in the northeast - southwest nine miles in length and width from 2.5 to 5.0 km (Lutovac, 1957). In mid-flowing rivers Lim and shared Berane Basin in two spatial areas. The alluvial plain is at the absolute height of 645-703 m accrete planes: Brnjice, Dapsićke, Kaludarske and Bistrica River. To the north, about Marsenića River narrows to 1 km. Alluvial plain muzzles, Dapsićke River, Bistrica, Kaludarska (which only belong to the lower part of its valley Berane) are much smaller space. Width of the alluvial plain at the mouth of the river Lim is in the range of tens to hundreds of meters. With this aspect of agricultural production is the most important form of relief in Berane valley. Alluvial plain of the river is characterized by favorable structure of the slope (the slope of the 0° to 3°), unexposed surface and fluvial hydro orphic high production potential. Therefore, for these forms of relief concerning agricultural production, and in general, is greatest concentration of human activities. On the right side of the basin is represented Neocene undulating landscape in which alternating valleys and lower elevations (Jasikovac, Dubica, Dapsićko hill). The relief on the left side features three fluvial-glacial terraces. A higher altitude of 718 meters and width of 300-1000 m (the move from the farm to the Hague, Škrnjevica), and the lowest terrace is situated at an altitude of 673 m. Upstream of Berane all lower, while almost disappears. This phenomenon can be explained by the fact that the water is applied and "choking" in a narrow opening in a limestone gorge and the river had to meanders alluvium by creating a flat terrace (Lutovac, 1957). However, as the inter-valley hair asymmetric, with the steeper northern slopes, terraces right hand: Brnjice, Dapsićke, the Bistrica River and Kaludarska occupy very small area. In the value from the point of view of production agriculture, river terraces behind the flood

plains of rivers. This form is characterized by slope of the terrain from 0 ° to 6 °, and unexposed southern exposure and is beyond the reach of the flood waters and groundwater. For river valley soil types are associated heavier texture and unfavorable water-air properties (vertisols, eutric camisols, pseudogley), But river terraces are suitable for growing most crops.

In the Northeast region extends Police in the shape of flattened surface. Shelf covers an area of 33 km² and extends towards the northeast - southwest 8 miles, and in the south - north 5 miles. Pumping her bottom ranges from 780-920 rounded we characterized the hills and gentle slopes. At the entrance to the gorge Tivransku, Lim splits into two branches. Today, between the backwaters raises limestone human head elevation, about 100 m above the river bed. In both Diluvia sleeve was filled with fluvial-glacial drift, but after this phase, most common is the left channel, so that the bed of the right islands remained dry. Neocene fluvial terraces of the corresponding small limestone plateaus on both sides, whose side are falling vertically into the trough 120 m (Lutovac, 1957).

Low mountainous terrain includes part of the North Tivrana, Prosjane the northeast, part Krčevsko-Peštarske surface in the east and Citadels Dolac and the West. Mild forms of relief, and the slope of the (6° to 9°), and greater depth of soil cover (vertisols and eutric camisols), make this whole relief suitable for agricultural production. The current distribution of agricultural production in this part of the relief, in addition to arable, is been related to the area under orchards. The area between the river Brzava (Prevjansko hill about 1100 m) and Lima, a mild form of relief, and the slope of the (3° - 6°), are suitable for agricultural production. Given that are dominant land – vertisols and eutric camisols. Also, the left and right sides Lješnica (consisting Petnjička and Vrbička rivers), Korajskog up the hill to the east, the south Đuča, Tiganjskog top of the southwest and west of the Dubai landscape, characterized by the slope of 6 ° to 9 ° and mild forms of relief, suitable for agricultural production.

In the area between the Sutjeska canyon in the south to enter Lima in Marseničko stricture length of 9.5 km, developed Andrijevička valley at an altitude of 800 m. Represents a tectonic – a modified extension of erosive fluvial denudation-Lima and its tributaries: Zlorečice and Kraštice. Causing enormous material tributaries, Lima pushed the bed to the east, so that only the left side, extending along the valley alluvial plains and glacial-fluvial terraces (Lutovac, 1957). Alluvial space is most pronounced in the immediate valley of Lima (the absolute altitude of 703-740 m), which accrete planes: Zlorečice and Kraštice. Of Sutjeska canyon, has extensions

at the mouth Zlorečica (alluvial plain of about 1 km) and Kraščice (alluvial plain 1.8 miles), and the downstream expansion in valleys: Zabrđa, Slatine and Trešnjeva. This is the most important form of relief Andrijevičke Valley and the structure is characterized by a favorable angle of 0° to 3° , and unexposed exposure is extremely favorable for agricultural production. A special section covers the area around the Kralja River Valley crust, spreading under moderately steep terrain (3° to 6°), dissected waterways, often with gentle slopes and fractures. A second area Konjuhe, the neighborhoods around Zlorečica, in which the basin: Kutski rivers and Perućica. On both sides Zlorečica, reveals stairs cultivated terraces with steep sections. The area around Kralja and Konjuhe, characterized by gently sloping terrain in addition to (3° to 6°) and good soil production potential (eutric and distric camisolis eugley), Most suitable for growing crops. Kutski river valley of the river can be seen as favorable for the production of certain crops (barley, oats, corn), and fruit from the mouth: Zlorečica to Cecuna. Further to the source, geomorphologic characteristics that make a home on the land are not favorable for agricultural production.

The area above the valley Andrijevičke to 1100 m above sea level covers the base just in the east, to the west Trešnjevik. Relief forms and the slope of the (3° to 6°), are highly favorable for the production of certain fruit and vegetable crops. The river valley Perućica have excellent soil (luvisols, eutric camisolis), Suitable for agricultural production. The third section includes a river valley with a small river Šekularska expansion in Madžgalj. The complex is characterized by a slope of up 6° to 9° and steeper relief forms. Šekular his position leaning towards are valley of Lima, which makes it suitable for farming.

Sutjeska canyon to the south, a distance of 2 km and a depth of 840 m, and makes the connection between the beginning Polimske and Andrijevičke basin. Polimlje valley stretches to the southeast Glavice a length of 12 km, while the width is nowhere greater than 1.5 km. According to data Kasalice (1988), the geomorphic structure is dominated Brezojevička alluvial fans, alluvial plain Lima (764-875 m), the gentle valley and ordered stepped fluvial-glacial terraces. Therefore dominates the landforms that been almost localized in a number of settlements, almost without exception, characterized by favorable topographic position (Velika, Pepići, Upper Ržanica, Mašnica, Murino, Kruševo and Ulotina). Upstream of Ulotina, Plav faces in the direction of the greater expansion (terraces) that are favorable for agricultural activities (luvisols, eutric camisolis).

Storm to 1100 m above sea level on the left side of Lima, from the extension Luga to the Pepića, characterized by a slope of 3° to 6° , and are

very suitable for agricultural production (excluding head Jerinje landscapes with slopes up to 6° to 9° , a lot of bad geomorphologic features, with moderately suitable land for agricultural production). Storm on the right foot Lima include Rasojevičke head, Javorišta, Grahovac, Koradžinog hill, Prijedola, it is from the mouth of the river to the Upper Piševske River to Ržanica in moderately favorable for agricultural production.

Plav-Gusinjska valley, situated between Visitorsko – Prokletajskog frame (the absolute altitude of 764-948 m, the length between the furthest points to 33 km and the maximum width of about 4 km), in many geomorphologic characteristics of the character of a basin – deep in relation to the above background from 1346-1622 m. In fact, part of the valley, which been developed between Vjeternik and Glavica (farthest glacial moraines Plav), a distance of 21 miles or so from Gusinje said entire series moraine 15 km, has the characteristics of a terminal glacial basin in which the lowest part (907 m) is Plavsko Lake. Moraines in rows extending from are lake to the village - Novšića. Powerful moraines are within the area of a sketch, and the area known as Zakrš. According to are Lima valley area expansion in the valley of the Đuričke and Komarače River. These take the form of glacial valleys wave. By are middle of the narrow alluvial plain (780-890 m), above which rise in steps fluvial – glacial terraces and alluvial fans. Furthermore, the older moraines, gravelly alluvial fans continue until Brezojevičkog field expansion at the mouth of the: Veličke and Murinske River. By are bottom of the basin, meandering river and its tributaries Ljuča. From Gusinja, basin extends along the glacial valley: Grnčara, Bistrice, Dolje and Vrulje River (Bakić et al., 1991). This whole area is very favorable for agricultural production (slope of 0° to 3° , Class II very suitable land for farming, good geomorphic features).

Storm over Plav-Gusinje valley up to 1100 m above sea level including the left Lima, Ljuče and Grnčara foot Visitor and Grebena; footer Trojans, Karaule, Bora and Kofiljače left side Grnčara, Bistričice, Bistrice, Dolje, Vrulje, Đuričke River and Komarače and Veličke River, pedestal Pršovog karst to Đelove towers. We can in this space as a whole, distinguish the following regions moderately suited for agricultural production: Skavkača valleys and streams Bilečkog; Jaseničke River; Valley where part of the Treskavička and Tamnjanska rivers flowing into the area between mosquitoes and Novšića and Veličke River. Marginally suitable facilities, including part of are left and right sides Vrulje. All other areas, including are fields unsuitable for agricultural production.

The mountain landscape of 1100-1700 m above sea level, locally cut by deep river valleys cut into. This spatial unit characterized mainly with

severe forms of the relief angle 12° - 20° . This region has rolled land cover, with the dominant land: rendzina, podsols, calc-camisoles, rankers, and in places and districts camisoles suggesting that the predominantly grassland and forest vegetation (forest pine, spruce, beech, oak, fir). This relief unit is suitable for cattle breeding. Given that, for each food crop biologically determined minimum, the area near the river valleys (for example, Kutski River or at the foot of the Vlahova and Javorišta) it is possible to grow certain crops (wheat, barley, oats, peas, beans, and rye), orchards and grasslands (dominated eutric camisols and rendzina). This spatial whole of 1100-1700 m above sea level is attractive for the development of sports, mountain, hunting and eco-tourism.

In the high mountain zone above 1700 m above sea level been exacerbated by the relief and soil conditions. The slope of the spatial structure of the completely dominant slopes is over 18° , and slopes over 20° . Most land is represented as calcomenasol, litisoli, rendzina and podsol, so this area under forest vegetation and mountain pastures with blueberry and juniper (except where the parent material litisols). "These spatial units above 1700 m above sea level, it is suitable for tourism development, of which one has to start to solve almost all issues of spatial organization of mountain tourism construction".

5. Conclusions

Morphology of geo considered a solid basis for agricultural valuation, given that the diverse and evenly distributed. Harmonious economic development in the future will depend on many factors, which at the end of the twentieth century proved too been limited. State agriculture at the beginning of the twenty-first century is fraught with numerous problems. Specifically, 1964 the agricultural land in the region included: 70,478 ha, 1994-68050, 2000-67740ha. Thus, agricultural areas been reduced to 2738 ha, i.e. by 3.8%, or an average of 105 ha each year. 's Say, that the basic characteristics of manufacturing units in the region, fragmentation of holdings. The average size of private farms is 6.19 ha. However, if one takes into account the farmland, then the average size is been reduced to 2.91ha. The reasons are found in its traditional agrarian structure, unregulated and inheritance law, insufficiently thought out agricultural policy, which makes the implementation more efficient and productive agricultural production and generates additional manufacturing costs, while preventing influx and cost-effective major investments, especially in completing the necessary machinery (Rajović, 2009). Mentioned necessary add and that

only by erosion, the total area of forest land and agricultural (129 811 ha), according to the Municipal Secretariat of Economy municipality Berane, Andrijevića and Plav, was attacked about eighty thousand acres of land.

Agricultural land does not possess in the region to such an extent as is often thought and emphasize. "Agricultural land should be good to keep and extremely rational use. Unfortunately, every year hundreds and thousands of acres of farmland irretrievably lose. In places recently acres in the most favorable areas for agriculture usually near urban areas, as well as major roads, appeared to cottages, industrial halls, warehouses, warehouses, parking lots, and even dump"(Rakićević, 1989).

Therefore, preserving agricultural land and increase its fertility in the region in the coming months, it is necessary to pay special attention. Rational use should be a major focus of economic policy under study GeoScape. Stable and productive farming, involves the use of scientifically based methods in that operation, and the process for its protection. Today of course we have the knowledge and resources they are able to do so fertile agricultural land (example Denmark), than it is created by nature (Rakićević, 1989).

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PRICE STABILITY VERSUS FINANCIAL STABILITY IN EUROPEAN CENTRAL BANKS

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Abstract. *In light of recent economic events occurring on a global scale, central banks around the world are beginning to ask themselves whether it would be advisable to review their fundamental objectives assumed. Increasingly more opinions support this view. This paper proposes a brief analyze on the role that a central bank should have in an economy in order to bring the most useful contribution it can to society.*

Keywords: *monetary policy, financial crisis, financial stability, price stability, economic model.*

JEL codes: E44, Q54, E43.

1. Introduction

Central banking is and has always been a tricky business. One of the primary functions of a central bank is to issue the legal currency. Money and their role and importance to an economy have been a long concerned for economists even from the beginnings of this science. Understanding this is a key element in establishing the most useful way that a central bank can act in the benefit of all the participants of any society.

In the years followed by the oil crisis the monetarism imposed as the mainstream view of how a central bank should be and act. Its main and only objective was to keep prices stability by any means necessary. This is the reason why in most advanced or emerging countries central banks are fully independent institutions from the central administration. Their sole objective is to maintain price stability while the other objectives that a government has set are left in the responsibility of other institutions. This view remained a landmark in the last 40 years. However, what has changed during these years is the way that central banks are doing this. Different strategies have been created overtime, the current most popular being the direct inflation targeting. As for the financial stability issue, the resolution

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promoted by monetarists consisted mostly of deregulation and letting the market do its magic.

This article is divided in five parts. After a short introduction the second part proposes a brief presentation of this article relevant history of money and central banking. These have been two of the most delicate issues addressed by the science of economics from its beginnings. Also the second part includes a short presentation of the main instruments that a central bank has at its disposal in achieving its objectives. Tinbergen principle tells us that we can achieve a certain number of targets only by having an equal or greater number of instruments at our disposal. The third part is about constraints faced by the Eastern European central banks in achieving their objectives of prices and financial stability in the context of the world financial crisis. The fourth part tries to imagine how a new and better economic model can be created. The last part is dedicated to conclusions.

2. Money and central banking

Since the earliest beginning of economics scholars have tried to explain the notion of money. Money is basically merchandise as any other merchandise with a few particularities mainly that they can be used by anyone, they are not deteriorating with time and they are easy to keep. In its well-known book, entitled “The Wealth of Nations”, Adam Smith establishes the difference between value of use and value of exchange for money with its famous diamond–water paradox. Another classical economist that considered and analyzed in depth money was Carl Menger, who in its book entitled “Principles of Economics” dedicates a full chapter to the occurrence of money in the world, their role and main characteristics. Money was created to facilitate trade with different kinds of merchandises. At first money were consisting from merchandising with characteristics similar to those above, especially in the form of coins of precious metals. In time banks and governments started to issue currency in the form of banknotes. These are called fiat money because they do not have an intrinsic value but instead they are based on laws and other legal acts that attributes them real value.

Actually one of the first financial crises appeared when the ruler of a realm decided to decrease the quantity of precious metal in their coins. Any government has three main ways to finance its spending. To increase the level of taxation (which is the most honest and long-time sustainable way), to borrow money from the internal sector or external sector or to issue new

currency. The last way is considered the worst way possible because it reduces the purchasing power of everybody without exception and because these effects are not felt immediately by individuals. Moreover inflation tends to sustain itself by creating and maintaining a vicious circle from which it's very difficult and costly to exit. As prices increase, individuals will ask for more and more rises which governments can't finance in any other way but through additional currency issuance.

This is why monetarists brought the idea of complete separation of the authorities that have the responsibility of currency issuance, namely the central banks from the other government authorities. This basically marks the separation between the fiscal and monetary policies. But everybody knows and agrees that there must be synchronization between these two types of economic policies in order to be efficient and not to cancel each other. According to the monetarist school of economics the monetary policy needs to be neutral in the form of constantly increase the monetary base by a specific amount (usually 2-3 percent per year). This on one hand will ensure prices stability and on the other hand will avoid the situation in which an employer will go bankrupt because of not being able to pay its employees as its products would decrease in nominal value. In the monetarist view the sole purpose of a central bank must be maintaining the prices stability.

There have been different strategies applied by central banks in achieving this objective. One of the first was by trying to control the monetary aggregates. As these also depends by the behaviour of commercial banks and ultimately by the behaviour of each individual (through the money multiplier). In time, this strategy proved difficult to follow. Another strategy was favoured called direct inflation target. The main instrument for this is the monetary policy rate.

Another very important responsibility of most central banks is ensuring the financial stability in the economy. This is done by authorization, regulation and prudential supervisions of the other financial institutions.

Jan Tinbergen's principle emphasize that one can achieve a certain number of targets only by having at its dispose an equal or greater number of instruments. If you have the same instrument and you want to achieve two different targets you might be in trouble. Of course there are many instruments for achieving financial stability, none of which are remotely related with monetary policy rate. There are mostly administrative and include maintaining an adequate solvency ratio, forcing banks to make some reserves in the form of provisions to anticipate defaults and

impairment of their assets and so on. The instruments here are many but what is important is that the monetary policy rate affects directly the sustainability of banks by influencing the liquidity available at a particular moment in time. It's like trying to shoot two rabbits with the same bullet. The most common reaction of central banks throughout the world to the financial crisis was an immediate decrease to almost zero of the monetary policy rate. Overnight financial stability became the predominate objective.

The financial crisis was not caused by the misuse of monetary policy rate. Instead it was caused by a different ideas promoted by monetarists, specifically those ideas that supported deregulation of financial institutions. Nevertheless, central banks were left to choose between a possible slow death of their economies or a sure and immediate one. The right choice was evident. However this calls for a change in the mainstream economic model that is analyzed in the fourth chapter.

3. Constrains of the central banks from Eastern Europe

Almost no public authority in the world can be proud of their performance in anticipating the financial crisis and reacting efficient to it.

In most countries the main role in the financial crisis management fell on the local central bank and largely on its decisions will depend on the crisis impact on the real sector. As shown above, what the central banks done immediately when confronted with the crisis was to make sure enough liquidity in the money market for their commercial banks.

The Eastern European countries have their economies characterized by a close proximity to the Euro Area. They still have a monetary policy of their own, but everything is depending on the stability of their big neighbour. Before the year 2008 massive foreign direct investments have found their way into Eastern Europe. This area was considered highly recommended for such investments because of their good perspectives determinate by their recent joining of the European Union and their still cheap labour force compared with what you'll find in the west. Inward investments flows were recorded in all institutional sectors of the economy and banks didn't make an exception.

So the 2008 financial crisis caught most countries of Eastern Europe with their financial systems owned by foreign companies. This was a potential big vulnerability as most foreign investors tend to pack up and leave when things go wrong. To avoid this, the Vienna gentleman's agreements was sign with most important of the financial groups investors

in which they decided not to withdraw their investments from Eastern Europe.

Another important vulnerability of the financial system was caused by the fact that most households of this part of Europe borrowed money from banks in foreign currencies, especially euro. This was due to the fact that their local currency known an appreciation before the crisis or, at least, a very stable period as foreign currency continued to enter in the eastern European countries after the liberalization of the financial account and the joining the European Union. The interests rates were more attractive for loans in foreign currencies also due to the fact that banks were avoiding having currency mismatches in their balance sheets and to the fact that local monetary policy rate was significantly higher than that of the euro area. The main cause of this was that most of Eastern European countries were still recovering from a high inflation period.

Most of the central banks failed to address these issues before the crisis or managed to do little about avoiding them. Some economists warned about the potential consequences of liberalizing the balance of payments financial account before the economy is ready but they had poor success. The European dream was too beautiful to think about any problems. However, some central banks did manage to anticipate these vulnerabilities and to cushion their negative effects. This happened mainly by establishing higher minimum reserves requirements for foreign currency liabilities than domestic currency. When the crisis started lowering these was like an oxygen pocket for local banks. These would have a negative impact in the eyes of foreign investors if it would have led to a significant decrease in international reserves so most central banks and governments from this part of Europe borrowed money from international institutions in order to avoid this effects.

It is obvious that any small country will have some economic problems when the world is facing a global financial crisis. However it is very important how the relevant institutions prepare the economy for the incoming crisis, being consistent with their mission to provide long-term economic stability.

4. Revising the central bank role for the new economic model

By far, the hardest question of all is in what way the current economic model should be improved? The science of economics must answer this question in order to rehabilitate its image.

It's clear that more attention should be dedicated on financial stability and on adequate banking regulation. The ideas about the benefits of deregulation should be left aside and it already was by most economists in the world. At this moment important changes are being implemented in the area of corporate governance of the financial system for example. Another important aspect of financial regulation is that although this was a crisis of the financial system, the banks were not the only financial institutions to have failed. More cooperation between central banks and the other financial regulation authorities in the area of insurance, pension funds and other types of financial intermediary is definitely needed. But will this be enough?

The Tinbergen problem still lays ahead unresolved. You have two different objectives, price stability and financial stability and you have a powerful policy instrument that affects them both. Of course you can split the responsibilities by creating a monetary authority and a regulation and supervision authority. Some countries already had this long before the crisis emerged and it doesn't seem to have helped them too much. It would be an additional effort to try to synchronize the monetary policy interest rate with the rest of the financial stability measures similar with what happens between fiscal and monetary policies.

The ideal thing would be to find those instruments of ensuring and maintaining financial stability that can be used efficiently independent of the monetary interest rate. However, when things go wrong in the financial area, not ensuring additional liquidity in the market will always be the wrong choice for a central bank and will lead to disaster.

5. Conclusions

The need for change is obvious and the problems are also clearly defined. It's time for economics to rehabilitate in the eyes of individuals. Any truly new economic model must bring significant changes to the current monetary policy theories accepted and promoted by the mainstream view. With all its downsides, this crisis can be seen as an opportunity to make some of the old things better.

Throughout their history, the central banks have known important changes both in their primary objectives and in their available instruments. These changes usually happened when something went terribly wrong rather than just as an improvement of the old ways. The current financial crisis might be one of these moments.

Deregulation of the financial sector, although it sounded great on paper prove to be one of the biggest mistakes of economics as a science. This is common sense. What is more complicated and still open for debate is whether central banks must add to their primary objectives the financial stability issue. In a way this can be seen as a obvious acknowledgement of the current reality. On a short term, prices stability, the fundamental objective of most central banks, had to be sacrificed for maintaining the financial stability of banking system. However, the issue is still open for debate, the Tinbergen problem is not solved and it seems that once again economics as a science is a step or two behind the reality.

It's worth to mention that it's very difficult to create a theoretical model for monetary policy implementation that works in every country. As shown in this article the Eastern European countries for example have their own particularities and any monetary policy must be adapted to the field reality. Perhaps this can be a base for reconstruction.

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EUROPEAN POLICIES BY 2020

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Abstract. *Shaping European Agricultural Policy at the horizon of 2020 was and still is a complicated subject both because of the highly volatile and unstable international context and growing diversity of European agricultural sector, mainly due to enlargement to Central and former communist Eastern European countries. Development and agricultural productivity gaps generate disparities in farmers income and hence the options on the architecture, tools and financial allocations of future agricultural policy.*

This article intends to show the importance of the Common Agricultural Policy and its role in our country's economic growth and budgetary outlook for the immediate future.

The high level of absorption of European funds is another attraction in reading this article. We note that although the attraction of European funds interest is present at all levels, from the company to the central bank and head of state, our country capitalize not enough opportunity.

Keywords: *common agricultural politics, rural development, economic growth.*

JEL Classification: Q18; J43.

1. Introduction

In 2007-2013, agriculture and rural areas in Romania will go through important steps towards integration into EU structures. Agricultural policy will fundamentally change by moving from production supporting system, which has not provided the expected restructuring, increase economic performance and competitiveness in the market to the CAP mechanisms in order to increase economic performance and competitiveness.

The Common Agricultural Policy (CAP) is one of the first common adopted policies among the EU countries. Its genesis was a reaction to

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food problems that followed the Second World War, and measures were adopted in the European Economic Community (EEC). It should be noted from the beginning that the term “common” fairly reflects one of the defining features of the CAP, namely that for about 90% of agricultural products, the decision no longer rests with the Member States, but the European Union.

CAP is not only one of the first common policies, but also the most important. Its special importance in community construction is reflected through several distinct features:

- ✓ It is an integrationist policy par excellence, to a greater extent than even the Internal Market, where harmonized standards have changed only in approximately 10% of the national ones. In the CAP national agricultural policies have been replaced, for the vast majority of agricultural production of common rules for the operation of markets and marketing.
- ✓ It is a big financial resources consuming policy. Agricultural Policy consumes, through its complex system of subsidies and other financial incentives, about half of the common budget, the other big spender being the regional policy.
- ✓ Finally, farmers’ organizations have taken a strong influence on governments during the war, which later have kept it, and during the development of the CAP, have strengthened it. The CAP concept itself of protecting farmers’ income had a significant contribution to strengthening the position of these organisations.

2. Financing agriculture

Direct payments per hectare will remain until 2013, payable in 2011, and since 2010 they will reach the level of 100% as European countries. After 2013 Romania will ask their extension.

Ways of providing national support in 2010:

1. State aid scheme to be notified to the Commission: livestock, research and development, investment in agricultural holdings, removal and prevention of diseases of animals and plants, supporting agricultural and livestock production, technical assistance in agriculture, restructuring and rescuing firms with problems; help to train young farmers, support for Agroecology and environment protection, aid for investments in processing and marketing agricultural production, losses to beekeeping production or adverse weather conditions or natural disasters, aid for early

retirement, the cessation of farming or closure of production capacity, support for producer groups, aid for the forestry sector.

2. State aid scheme exempted from notification to the Commission: losses caused by adverse weather conditions or natural disasters; coverage scrapping climate, granting state aid to create jobs, encourage competitiveness and improving the environment without Commission involvement; prevention and eradication of animal and plant diseases, aid for innovation, environment, enterprises newly created by female entrepreneurs in the form of risk capital and development researchers.

Romania where agriculture requires large investments in terms of competitiveness, it is outdated and fragmented. World Bank (WB) considers that Romanian farmers can benefit from the Common Agricultural Policy and its financial integration and stability.

Between 2007 and 2013, Romania receives 14.5 billion euro, due to the CAP, proved by BM Partnership with Romania's strategy for 2009-2013. Romanian farmers have an advantage due to market integration opportunities, and predictability and stability provided by the CAP. BM stated that Romania can handle competitiveness and restructuring in agriculture.

Given PAC fund attraction, Romania has made progress in the adoption of the National Programme for Rural Development, but monitoring of fund attraction by farmers and impact on rural restructuring and development still has to continue.

Government departments considering agriculture and rural development have been suggested by the World Bank as technical assistance and analytical work to be improved.

Although arable land in Romania is extended and there is a favourable climate, farming is outdated and fragmented requiring major investments in terms of competitiveness, all of which are proven in the report.

3. Agricultural development during 2007-2013

Common Agricultural Policy for the period 2007-2013 focus on agricultural development through joint efforts of each member country. Its new objectives and courses of action aim at targets on farmers' incomes, production and agro-food supply, agricultural prices, training, rural development and environmental protection.

CAP reform also led to changing objectives, new objectives aiming to provide a better balance between measures to support and strengthen rural

development by transferring funds from Pillar 1, Agriculture, to Pillar 2 Rural Development.

Extending the scope of the tools of targeting rural development will lead to changing the way the European Union will support the agricultural sector. CAP will be geared to the interests of consumers and taxpayers, farmers having the freedom to produce what the market demands.

Thus during this period two funds were established, the European Agricultural Guarantee Fund and the European Agricultural Fund for Rural Development aimed at achieving the new objectives of the CAP and funding of rural development measures.

EAGF finances market organization measures and price support for agricultural products, covering expenses that will be made for: export refunds on agricultural products to third-party countries, intervention measures to regulate agricultural markets, the direct payments to farmers under the Common Agricultural Policy and community financial contribution and promotion measures for agricultural products on the internal market of community and in third-party countries.

It also will make its presence felt in the financing of measures on specific veterinary measures, veterinary inspection measures, inspection measures for food and feed, animal disease eradication and Phytosanitary Measures.

Promotion of agricultural products, either directly by commission or through international organizations, establishment and maintenance of accounting systems for agriculture and agricultural survey systems, including farm structure surveys are other types of expenses that will be financed from this fund.

Most aid for various sectors financed by EAGF were allocated to the new system of direct payments, which are the result of CAP reform in 2003, changes that led to the elimination of the link between support and production, as production support system did not provide expected restructuring or increase economic performance.

The central objective of the unique payment is to guarantee farmers more stable incomes, they can decide what they want to produce knowing that they are guaranteed the same amount of aid regardless of whatever they produce and can thus adapt supply to demand. In addition to the unique payment, farmers may have other special support systems, associated to cultivated area and production (see table 1).

Table 1.

Allocation of the national budget and EU direct payments from 2007-2016

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
% Annual increase in payments from the Community budget limit	25	30	35	40	50	60	70	80	90	100
% Annual increase in payments from the national budget limit	30	30	30	30	30	30	30	20	10	0
Total	55	60	65	70	80	90	100	100	100	100

Source: Treaty of Accession of Bulgaria and Romania, the Romanian Official Gazette, 2005.

European Agricultural Fund for Rural Development is the complementary action designed common agricultural policy and aims to improve efficiency in production, processing and marketing of agricultural and forest products and local development potential of rural areas.

Importance given to this fund assumes that rural development policy should accompany and complement market policies and income support applied under the common agricultural policy and thus contributes to the objectives of this policy.

4. Budgetary outlook after 2013

According to European Commission Communication, CAP will continue in the coming years an integrated, strong policy consisting of two pillars of support. Medium-term strategic objectives behind the challenges and concerns of recent years are generous, but sometimes slightly divergent aim and means. Listed here:

- ✓ Preservation of agricultural potential on a sustainable basis, so that EU citizens have provided long-term food security. At the same time wants EU agricultural production to contribute to global food security, especially in developing countries, given that it will be threatened by instability of agricultural markets, increased climate change, pressure on agricultural prices by speculators;

- ✓ Supporting farm sector so that they provide clean and diversified quality agricultural products, made by complying with sustainable production values. Thus achieving performance agriculture is wanted, but while safeguarding the environment, water, health and welfare, plant health, in compliance with public health regulations.
- ✓ Maintaining viable rural communities where agriculture plays an important role in providing jobs and ensure economic, social and territorial balanced environment.

It brings into question the fact that agriculture is an important part of society and of the European economy and that any diminution of it can cause losses in economic terms (GDP) and social (jobs), not only in industry but also in activities upstream and downstream (vertical implications) and the rural world (horizontal implications). However we should keep in mind that agriculture is one of the sectors with the lowest productivity of capital.

The future CAP will be assigned the same as before between the two support pillars: Pillar 1, which will include increased requirements for equity funds and ecological distribution and Pillar 2, linking rural development competitiveness, innovation, environmental friendliness and implications of climate change.

The future CAP will pay farmers especially active ones and collective services which they offer society as a whole. It brings to the fore the fact that agriculture provides public goods to society, without which it could not continue to exist. And therefore the society must pay and support farmers and farming. Therefore farmers simply do not perform an economic activity, which should be subjected to the rigors of efficiency and competitiveness, but much more than that, agriculture is a more complex task overwhelming implications on environment, social and human implications in general. So the common agricultural policy is expected to ensure balanced, well-subsidized and ecological territorial development of agriculture.

Regarding the rural development policy, in the Commission Communicate proposed integration of requirements for the economic competitiveness of agriculture and its role in environmental and rural areas conservation. Support will be structured into three areas:

- ✓ agricultural competitiveness by promoting innovation and restructuring in order to hold a more efficient use of resources.

- ✓ sustainable management of natural resources, given the implications of climate change on the environment, agriculture and rural areas and the need to maintain productive capacity of the land.
- ✓ Balanced territorial development through capacity building and community authority and improving links between rural and urban areas.

Recent reforms, climate change, environmental issues have become prevalent and we see it every day. There is no sustainable competitiveness without taking into account the fact that natural resources are exhaustible. In the long run, it will be our duty as leaders to create conditions for vigorous growth without depletion of our natural resources.

Future reform of the CAP targets convergence with Europe 2020 goals on smart, sustainable and inclusive (includes partnership between agricultural production and sustainability). This envisages a common strategic framework for European funds to be included European Agricultural Fund for Rural Development (EAFRD), European Regional Development Fund (ERDF), European Social Fund (ESF), the Cohesion Fund (CF) and the European Maritime Affairs and Fisheries (EMFF).

Commission communication on multi-annual financial framework post-2013 covers a range of innovative features:

- ✓ providing pan-European logic toward supporting the implementation of the Europe 2020 strategy;
- ✓ support the implementation of measures of economic policy coordination in the context of the European Semester;
- ✓ implementation of the principle of solidarity, in which funding will be goal-oriented towards cohesion, migration, energy security, support for third countries (by providing support to less developed regions);
- ✓ ensuring an adequate level of the EU budget, in line with the recommendations of the European Parliament and the European Council - (1.05% of GNI in commitment and payment appropriations 1%), a level of 0.02% of the possible expenses outside the MFF and 0.04% possible EU expenditure outside the budget for crisis and emergency, which amounts European funding allocations to 1.11%;
- ✓ ensuring own resources for the EU budget and reduce the GNI-based contributions (tax on financial transactions, Community VAT);
- ✓ financing interventions to complete the creation of the EU single market;
- ✓ providing a response to the current challenges – environment, climate change, humanitarian aid, demographic and cultural changes.

Reflecting actual ideas from the communication “CAP horizon of 2020: future challenges related to food, natural resources and territorial balance”, i.e. keeping the two pillars architecture, the CAP budget for agriculture being at least at the level of the current one, there is a proposed mechanism for the redistribution of direct payments between Member States, market restructuring measures, CAP being ranked as one of the few truly European common. It also reiterates the fact that the CAP must support sustainable farming in Europe by improving its competitiveness through the provision of adequate and safe supply of food, by preserving the environment and the countryside, while providing fair living standards for agricultural community. As such, it replaces 27 different national agricultural policies and it basically represents “savings” for national budgets because of direct support to farmers that is provided through the EU budget, without the need for national co-financing. The new CAP should lead to a more just and equitable support across the EU, by linking agriculture with environmental policy in sustainable management of the countryside and ensuring that agriculture continues to contribute to a dynamic rural economy.

The main concrete changes proposed by the Commission are:

- ✓ Greening of direct payments: 30% of direct support will be conditioned on the implementation of agricultural practices that protect the environment;
- ✓ Convergence of direct payments to ensure a fairer distribution of direct aid. Specifically it is proposed that gradually all Member States that have a level of direct payments below 90% of average to cover one third of the difference between their current level and this level. This convergence will be financed proportionally by all Member States with direct payments above the EU average.
- ✓ Allocation of funds for rural development will be reviewed on the basis of objective criteria and better targeted policy objectives. This will ensure fairer treatment of farmers engaged in the same activities. To allow CAP to face challenges specific economic, social, environmental and geographic European agriculture and to contribute effectively to the objectives of Europe 2020 will provide flexibility between the two pillars.

- ✓ level cap direct payments by limiting the basic layer of direct income support that large agricultural holdings may receive, taking into account the economies of scale of larger structures and the direct employment these structures generate .

The second pillar will be focused more on competitiveness and innovation, climate change and the environment. Quoted document maintains the proposal that after 2013, the European Agricultural Fund for Rural Development (EAFRD) to be included in the strategic framework common to all structural funds and the European Commission contracts with all Member States thus according more attention to the territorial dimension of socioeconomic development and gathering all available EU funds for the economic development of rural areas across the EU.

Finally, the Commission proposes to restructure market measures that are currently in the first pillar of the CAP. The Commission proposes the creation of two instruments outside the multiannual financial framework, which will be subject to the same rapid procedures as emergency aid reserve (RAU): an emergency mechanism to react to crisis situations (eg food safety issue) and a new scope for the European Globalisation Adjustment Fund.

The Commission proposes to allocate € 281.8 billion to Pillar I of the CAP and € 89.9 billion to the Rural Development between 2014 and 2020. This funding will be complemented by a further € 15.2 billion as: € 4.5 billion for research and innovation in food safety, bio-economy and sustainable agriculture (the Common Strategic Framework for Research and Innovation), € 2.2 billion for Food Safety, € 2.5 billion for Food Aid for the benefit of the most deprived, € 3.5 billion in a new reserve for crises in the agricultural sector and up to € 2.5 billion from the European Globalisation Adjustment Fund.

5. The high level of absorption of EU funds

European funds are the most important policy instrument used by the European Union to promote economic growth, regional development and accelerate the convergence process in the Member States. Structural Funds absorb about a third of the EU budget.

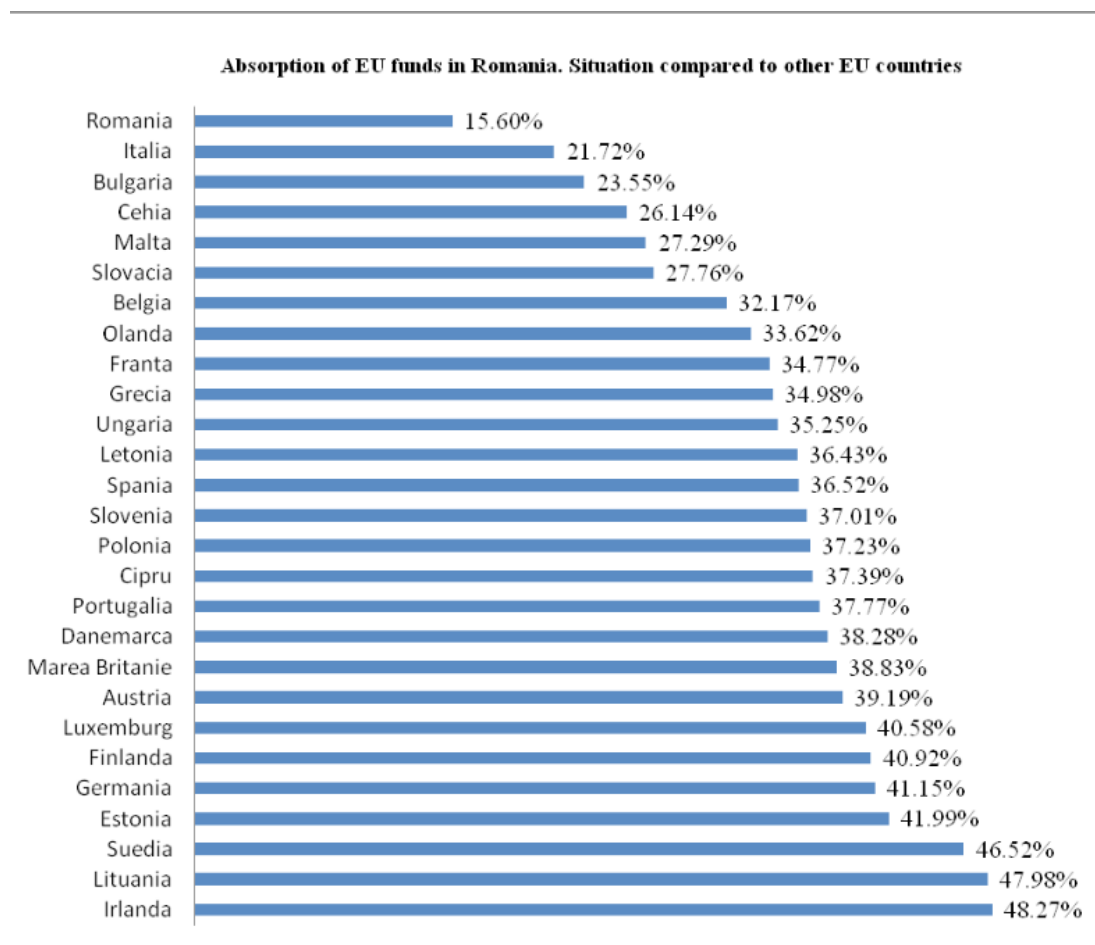


Figure 1. Status of EU funds absorption in EU Member States.

Source: <http://epp.eurostat.ec.europa.eu>

As shown in the figure above (see Figure 1), Romania ranks last among EU Member States in the absorption of funds, with a share of 15.60%. To stimulate increased absorption of EU funds there is a need for concrete and viable solutions that can be implemented in a short time.

Achieving a higher absorption of EU funds is crucial to ensure growth target in the coming years but also an accurate reflection of Romania's interests in the European Union's financial future (2014-2020). In order that attraction of European funds to grow, it is better for a country to attract capital flows generating no foreign debt than those that generate external debt. The latter are government debt and private debt, while

European funds, foreign direct investment and private transfers are those that do not generate foreign debts.

Importance of achieving a higher absorption of EU funds is supported by the fact that it contributes to economic growth. The importance of this is underlined by the fact that Romania has ongoing commitments to the IMF and other international financial institutions and the theoretical situation in which structural and cohesion funds would be absorbed at 100% then this would mean an increase of 1.8 percentage points per year. This allows Romania to negotiate the higher allocations in the next EU budget perspective, namely 2014-2020, though there is no legal or official about this.

Both Polish and Czech models require decentralization of the administrative-territorial units. Poland has centralized funds management by focusing Managing Authorities and the Czech Republic examines option to re-centralize some of the powers of local authorities in this matter. Any administrative reorganization by granting legal personality to the regions, would allow the creation of regional operational programs (like the Czech Republic and Poland) with specific objectives of each region, which would lead to an implementation tailored for the respective communities.

Importance of technical assistance from consulting and international quality firms, feasibility studies for the opportunity, work simplification and better communication among stakeholders can lead to higher absorption of EU funds.

Romania's strategies must be aligned to the priorities of the Europe 2020 strategy. Romania must turn to substantial improvements in terms of spending to have a firm position regarding negotiating the next financial years (2014-2020).

6. Conclusions

European funds are financial instruments created by the European Union for public and private sector in member countries in order to eliminate economic and social disparities between regions. European funds are a form of grant, from which benefits a variety of fields and activities, designed, therefore, for development and modernization. Although interest is present at all levels, from companies to the central bank and the head of

state, our country capitalizes not enough opportunity. Romania benefits from EU funds since joining the European Union. Although Romania was among the first Member States whose operational programs have been approved by the European Commission in the implementation of projects and there are still numerous and complex problems of which the most important are: human resources involved in this process are insufficient and weakly motivated, difficulties in preparation of project portfolio and launching calls for proposals, evaluation and selection delays, difficulty of the beneficiaries in starting project implementation, regulatory barriers and institutional issues.

The first relevant conclusion is the realization that economic development will not be uniform across economic sectors in any one of the possible scenarios of development. There will always be relative losers and winners. One of the key issues for policymakers will be to find solutions and socio-economic policy measures required to mitigate losses (costs) where they appear or are given, or, in the best case, to find ways to transfer all sectoral differences in a global growth. How well are we after accession, if we can infer the overall situation of Romanian agriculture, rural specific which currently is limited to subsistence?

Given the specificities of each region and contrasting position of countries regarding agricultural policies, the Commission has developed a reform of agricultural policy coordinates, which we consider moderate (but offering more flexibility for different types of agriculture) especially in the current economic and financial context, which is becoming increasingly unstable, putting pressure on any future financial planning.

Considering the state of Romanian rural areas, early experience in implementing EU programs and the Commission proposal on support for rural development which has many innovative elements in the development and implementation of rural development policy after 2013, special attention will have to be given to the following:

- ✓ need to identify and correct hierarchy of priorities for rural development – to avoid dispersion of support to a large number of measures and thus reduce future program effectiveness;
- ✓ joint evaluation of implementation constraints – including eligibility conditions, the intensity of Community involvement and intensity of institutional functioning;
- ✓ assessing the compatibility of the measures proposed in the Community menu and the real needs of the Romanian rural areas;
- ✓ precise definition of the object of intervention and determining the amount of intervention – exploiting the opportunity of "flexibility".

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COMPARATIVE PERSPECTIVE REGARDING THE MEASUREMENT OF COMPETITIVENESS

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Abstract. *There is a large literature regarding the measurement of competitiveness, the more recent ones focusing on the external sustainable competitiveness. This is done in the context of major changes registered in the human society due to climate changes, the limits of resources, the globalization of the economy and the economic-financial crisis. The measurement of the external competitiveness is a process intrinsically connected with the concept of competitiveness, a concept which proves to be difficult to formulate in a unitary perspective due to its complexity and the large array of factors which influence it. In this context, the paper focuses on the methodology of the European Union and of the World Economic Forum regarding the sustainable competitiveness underlying the advantages and limits of using a composed index versus a price measurement using the real exchange rate. The composed indexes offer a picture of the past competitiveness and the price measurement facilitate the long term projection of competitiveness. In this context, the paper suggests an answer regarding the possibility of using both of the techniques to connect the information regarding the past competitiveness with the future competitiveness reflected by the price evolution. The connection is reflected by the coherency between the two measurements but also by the structure of the indicators constructed. The paper suggests a hypothesis that this structure offers valuable information on how the connection between the two measurements can be done in a coherent way.*

Keywords: *competitiveness, composed index, price measurement.*

1. Introduction

Measuring competitiveness is a difficult task given the large array of aspects related to it and the many explanatory factors. Over the years, the focus of the competitiveness analysis has narrowed from the macroeconomic aspects of the phenomenon, to the micro-economic ones,

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and now more and more the focus has shifted to the individual and organizational level. Recent developments in the economy and especially the financial crisis in 2008 brought to focus the actions of individuals and companies which coupled with strategies and policies centred on short-term profitability and competitiveness led to an economic, environmental and ethical global crisis. In this context, it becomes obvious that the old approach to business models and growth is unsustainable and must be replaced with a new approach based on business and development models able to lead to a harmonious development of individuals and society as a whole. Consequently, there is acute need to address long-term competitiveness in the context of sustainable development of enterprises and society, knowing that generally the microeconomic approaches refer to short term competitiveness and the national ones are still in debate.

The European Union countries can benefit of the opportunities generated by the globalization process but should implement more effectively the Europe 2020 strategy in order to tackle the effects of the economic and financial crisis and take advantage of these opportunities. The main focus should be on: 1) intelligent growth based on knowledge and innovation; 2) a sustainable economic growth based on a more efficient use of resources and a more ecological driven economy and c) an inclusive growth based on stimulating employment for a more cohesive society. Consequently „competitiveness and sustainability” are in the forefront of the Europe 2020 strategy and are the focus researchers (Rosselet-McCauley, 2011, F. J. D. Lopez, F. Brandes, 2010, Jennifer Blanke, R. Crotti, Margareta Drzeniek Hanouz, Brindusa Fidanza, T. Geiger, 2012, Dwyer and others, 2012, Rodríguez and others, 2012, Jennifer Blanke and others, 2012, Schwab, Brende, 2012).

The studies focusing on competitiveness revealed that the interest was on the short term factors of competitiveness and that a number of long term factors were not been taken into account. The focus on the short term factors stimulates a short term focus on economic performance which proved to have unwanted effects revealed by the current economic crisis.

For a long time, competitiveness was analyzed from the perspective of prices using the real exchange rate defaulted with the consumer price index or unit labour index. In order to capture the complex microeconomic, macroeconomic and regional factors more complex indexes were created. These indexes included non-price factors (quality, product differentiating, markets efficiency etc.) and their impact on real exchange rate and factors reflecting the sustainability of competitiveness.

The inclusion of more factors proved to be efficient and offered the decision-makers valuable information. In this context, the current paper aims at seeing how the current methodologies can be used to reflect the long term tendencies of competitiveness.

The paper is structured in three sections. The first one presents the concept of sustainable competitiveness. The second section focuses on the methods of capturing the sustainable competitiveness of countries. The third section is dedicated to the sustainable competitiveness analysis for Romania.

2. The concept of sustainable competitiveness

Sustainable competitiveness combines two concepts of increasing importance in a globalized world. The concept of competitiveness is understood as “the capacity of the nation or region to provide its citizens with sustained increase in living standards with jobs available for those willing to work”¹ and in a narrow sense at a level of enterprise as “the ability of firms to sustain and gain in market share through their cost and pricing policy, innovative use of production factors and novelties in product characteristics”². The *concept of sustainability* is understood as “the capacity to endure”³. From the economic point of view, the “sustainability economics involves *ecological economics* where social aspects including cultural, health-related and monetary/financial aspects are integrated”⁴.

F. J. D. Lopez, F. Brandes, underlines the difficulties to define these terms given the lack of consensus in the scientific literature, showing that: “in essence, competitiveness is determined by productivity, which in turn is determined by a number of factors(affecting how natural resources, capital, labour, technology are combined in the most effective way [Ezaela-Harison 2005]. Innovation and technology readiness is seen as one of the most important factor for competitiveness, as they enable ensuring sustained productivity improvements and economic growth [Cantwell,

¹ SEC (2009) 1657 “Commission staff document: European Competitiveness Report 2009”

² SEC (2009) 1657 “Commission staff document: European Competitiveness Report 2009”

³ Wikipedia, the free encyclopaedia, <http://en.wikipedia.org/wiki/Sustainability>

⁴ Wikipedia, the free encyclopaedia, <http://en.wikipedia.org/wiki/Sustainability>

2005, Schwab, 2009]” (Lopez, Brandes, 2010, p. 4). With the same token “similar to the concept of competitiveness, the meaning of ‘sustainability’ is highly subordinated to the context in which it is used (e.g. globe, countries, region, industry, etc), its geographical and temporal scales, and whether it is has a major connotation – environmental (focused on environmental quality and eco-systems) economic (focus on allocation) or social (focus on distribution)” (Lopez, Brandes, 2010, p. 6).

A synthesis of the sustainable competitiveness definitions are presented in the table below.

Table 1
Defining sustainable competitiveness

Author, paper	Sustainable competitiveness definition
Suzanne Rosselet, 2011, <i>Sustainable competitiveness: a War against Short-Termism</i>	“Sustainable competitiveness involves leveraging national competitive advantages to achieve greater prosperity for the population, in terms of increasing living standards and human development (health, education, training)”
Jennifer Blanke et al., 2012, <i>Long term View: Developing a Framework for Assessing Sustainable Competitiveness</i> , World Economic Forum, p. 54.	“Sustainable competitiveness is defined as the set of institutions, policies, and factors that determine the level of productivity of a country while ensuring the ability of future generations to meet their own needs”
**** Learning from the Future: Nova Scotia and the Circular Society, <i>Sustainable Competitiveness Discussion_Paper.pdf</i>	“Sustainable competitiveness - economic growth activities that enhance and restore the health of natural and social systems upon which present and future economic growth depends while, under fair market conditions, producing goods and services that meet the test of international markets and maintain and expand the real income of all its citizens”
Lopez, Brandes, 2010, <i>Defining firm’s competitive sustainability: from a fuzzy concepthions to a primer definition and a research agenda</i> , Paper for the 16th Annual International Sustainable Development Research Conference, p. 18.	“Competitive sustainability is understood as the development and deployment of firm’s resources and capabilities used long term strategies and practices for competitive advantage, well-being, growth and profitability via innovation-ideally for contributing to reduce our carbon footprint, where the incorporation of the sustainability dimension is deeply rooted into the firm’s vision and strategy, generating value both stakeholders and shareholders.”
Weiss, 1993, <i>Environmentally sustainable competitiveness: a Comment</i> , Yale Law Journal, 102.	Sustainable competitiveness is a mechanism “which combines the interest that underlie sustainable development and international competitiveness, puts environmental protection and methods that facilitate economic growth under common umbrella”

Housman and Zaelke, 1993, <i>Making Trade and environmental policies mutually reinforcing Competitive Sustainability</i> , Environmental Law, 23(1)	Competitive sustainability is “the mechanism for achieving sustainable development by harmonizing domestic and international environmental standards through the use of competitive forces which reward the cleanest and most efficient economic actors. An international system of incentives and disincentives will create a mutually reinforcing mechanism for directing trade and environmental policies toward improving the worldwide standard of living”
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A number of invariants for the above definitions can be identified:

- The increase concern for the environment and its protection for future generations;
- The focus on human development (health, education, employment), through the reduction of discrepancies between region in respect to the living standard, economic conditions and the creation of a fair competitiveness on the markets;
- Using the long term strategies in order to maintain the level of competitiveness on the markets and of productivity through innovation and the generation of added value.

3. Measuring sustainable competitiveness

Sustainable Competitiveness is a multilevel concept which suggests the need for a multilevel measurement which takes into account at least three dimensions: the economic, social and ecological dimensions, to which we would add the vulnerability to major changes or events (economic crises, natural disasters etc).

The specific scientific literature focused on the limits and advantages of different methods of measurement and the connections between sustainable competitiveness and different economic indicators like the productivity of different economic sectors at the global market (Wysokińska, 2003, 14), management risk (Rutkauskas, 2008), indicators of environment pollutions (Pasurka, 2008), the high standard of living (Schuller, Lidbon, 2009).

The measurement of sustainable competitiveness is done by using the Global Competitiveness Index (GCI) and by adding two pillars: social sustainability and ecological sustainability.

Table 2

The composition of the Sustainable Adjusted Global competitiveness index

Sustainable Adjusted Global competitiveness index (SAGCI)		
Social sustainability – adjusted GCI	Sustainability adjusted GCI	Environmental sustainability adjusted GCI
GCI*soci al sustainability coefficient (SSC)		GCI*environmental sustainability coefficient (ESC)
Social sustainability pillar	Global competitiveness index GCI	Environmental sustainability pillar
<i>Indicators</i>	<i>Pillars (composed of a total 113 indicators)</i>	<i>Indicators</i>
Gini Index	Institutions	Stringency of environmental regulation
Youth unemployment	Infrastructure	Enforcement of environmental regulation
Access to sanitation	Macroeconomic environment	Environmental treaty ratification
Access to improved drinking water	Health and primary education	Terrestrial biome protection
Social safety net protection	Higher education and training	Agriculture water intensity
Extend of informal economy	Goods market efficiency	CO ₂ Intensity
Social mobility	Labour market efficiency	Fish stock overexploited
Vulnerable employment	Financial market development	Forest cover change
	Technological readiness	Forest loss
	Market size	Particulate matter concentration (PM2.5)
	Business sophistication	Quality of natural environment
	Innovation	

Note: Each of the sustainability pillar score is converted into a coefficient (ranging from 0.8-1.2) to adjust the GCI score.

Sources: Measuring Sustainable Competitiveness, UNEP Conference December 4th 2012.

In table 3 we can see a description of the methodology for the determination of the relevant indicators for the identification of the sustainable competitiveness of a country. At the moment these indicators

are analyzed separately focusing their influence on the adjusted global competitiveness.

Table 3

Methodology for the calculation of sustainable competitiveness.

Indicators	Formula	Explanations
Real effective exchange rate	$REER = \sum_{i=1}^n w_i \frac{E_i P^*}{P}$	<i>E</i> – nominal exchange rate; <i>P</i> [*] – external prices; <i>P</i> – internal prices; <i>w_i</i> – country weights in international commerce; <i>i</i> = 1... <i>n</i> number of countries partner in commerce.
Global Competitiveness Indicators	$GCI_{ij} = wj1Basic_i + wj2Efficiency_i + (1 - wj1 - wj2) Innovation$	Basici-Subindex basic Requirement Efficiency- Subindex efficiency enhancers Innovation- Subindex Innovation
Social sustainability pillar	$0,1 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 0,8$ $category_i = \frac{\sum_{h=1}^k indicator_h}{K}$ $6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 1$ $-6 \times \left(\frac{\text{country score} - \text{sample minimum}}{\text{sample maximum} - \text{sample minimum}} \right) + 1$ d. Variable S03. 01, S03.02 and S03.03 are combined to form one single variable e. Variable S08.01 and S08.02 are combined to form one single variable f. Variable S14.01 and S14.02 are combined to form one single variable	S01 Income Gini index* S02 Youth unemployment* S03.01 Access to sanitation* d(log) S03.02 Access to improved drinking water* d S03.03 Access to health cared S04 Social safety net protection S05 Extent of informal economy S06 Social mobility S07 Vulnerable employment
Environmental sustainability pillar		S08.01 Stringency of environmental regulation e S08.02 Enforcement of environmental regulation e S09 Terrestrial biome protection*

		S10 No. of ratified international environmental treaties* S11 Agricultural water intensity* S12 CO2 intensity*(log) S13 Fish stocks overexploited*(log) S14.01 Forest cover change* f S14.02 Forest loss* f(log) S15 Particulate matter (2.5) concentration*(log) S16 Quality of the natural environment
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To the factors reflected in table 3 we can add the issues of resource management and areas of vulnerability which are not accounted for in the GCI, but there when measuring sustainable competitiveness.

4. Sustainable competitiveness analysis for Romania

The data regarding competitiveness in Romania gives a different imagine depending on the methods of calculation. From this perspective analyzing the exports competitiveness based on real effective exchange rate for 41 competitors, 2005=100, it can be seen that in the period 2000-2007 Romania registered a loss of competitiveness followed by an increase.

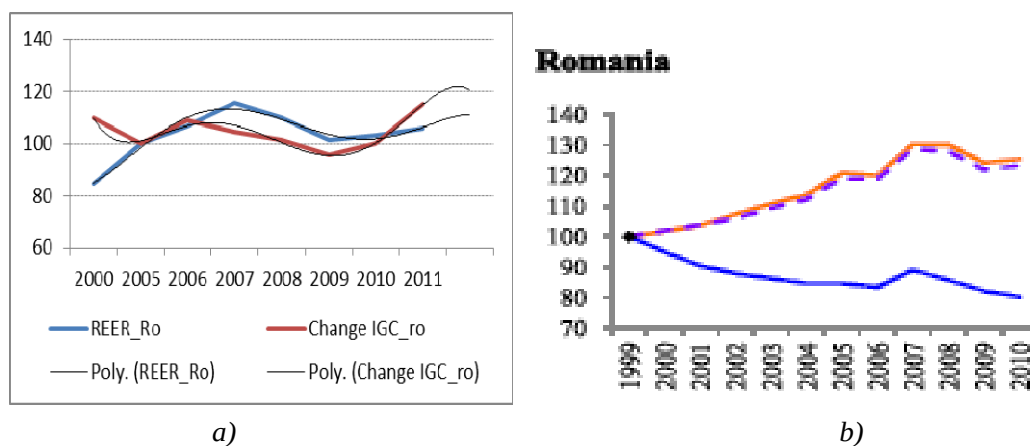


Figure 1. Competitiveness in the case of Romania.

Source: a) Own calculations based on Eurostat and WEF; b) K. Beņkovskis, Julia Wörz (2012).

Figure a) and b) underline the importance of the relevant factors used in calculating the competitiveness. In this respect, in the SEC (2009) 1657 “Commission staff document: European Competitiveness Report 2009” is mention that “The objective of competitiveness proofing is to identify and, where needed and proportionate, to quantify the likely impacts of a new proposal in three dimensions of competitiveness:

- Cost competitiveness: the cost of doing business, which includes cost of intermediate consumption and of factors of production (labour and capital);
- Capacity to innovate: the capacity of the business to produce more and/or higher quality products and services that better meet customers' preferences;
- International competitiveness or the likely impact of the policy proposal on the European industries sales performance (market shares) and comparative advantages”

Seeing the various results obtained from using different competitiveness methods a legitimate question is what determines competitiveness. The core determinant of the competitiveness at all levels (enterprises, industries, regions, member-states or the EU) is **productivity**. Productivity growth is intimately related to the **propensity to innovate**. Since resources (capital and labour) are finite, the long-term growth of the standards of living is determined by the nation's/firm's ability to produce output through a superior and innovative combination of existing resources. This is often identified with total factor productivity (the element unaccounted for by the contribution of factor inputs). Economic theory predicts that in successful enterprises, gains in market share, long-term profitability and rising real wages are unambiguously linked with vigorous productivity growth. And conventional indicators of competitiveness – unit labour costs or price and quality competitiveness – also reflect the underlying dynamics of productivity and innovation.

In the literature (Rajan, 2004) it is considered that the nominal depreciation of the exchange rate is a consequence of an increase in imports and that the use of the exchange rate instrument for the increase of competitiveness leads on the long run to a loss of economic efficiency due to the expectancy adjustments.

Comparing the evolution of NEER in Romania with the one registered UE27 it can be seen that the evolution of the effective nominal exchange rate is similar to the index of competitiveness costs which underlines the capacity of NEER to capture competitiveness (see figure 2).

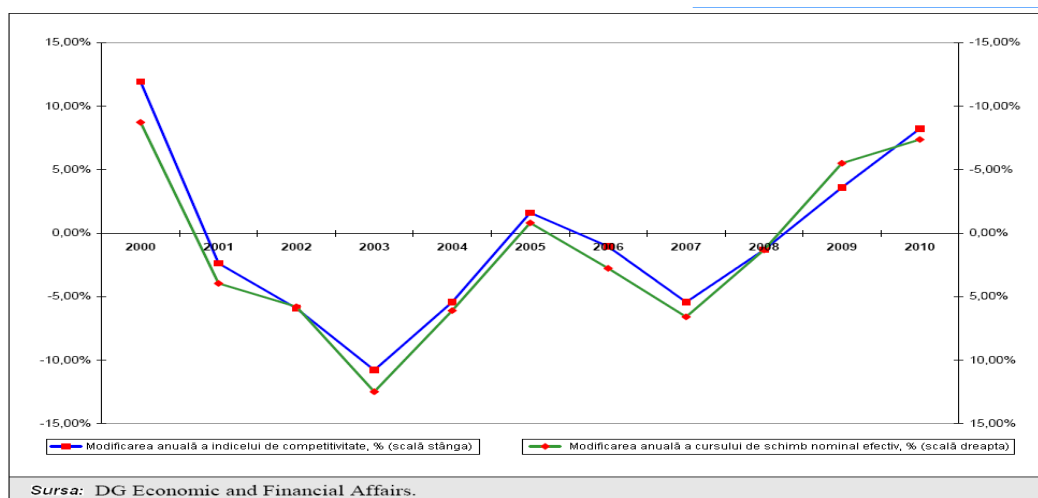


Figure 2. Competitiveness indicator based on the unit labour cost.

Source: European Commission Enterprise and industry, Commission staff working document, Member State competitiveness performance and policies 2011, SEC (2011), 1187, p. 13.

To ensure long term competitiveness it is necessary to correlate the wage policies with the evolution of labour productivity.

The evolution of REER indicates that the long term resources for the increase in competitiveness should be searched where they most likely appear, namely at the level of firms and not at the level of macroeconomic policies of exchange rate depreciation. The focus of direct investments on the activity restructuring in order to increase productivity and on the production structure would ensure an increase of the long term competitiveness of the Romanian industry on the European and global markets.

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MIXED FEEDBACK MECHANISMS OF ECONOMIC ADJUSTMENT. THE HICKS MODEL OF CYCLIC EVOLUTION

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Abstract. *All modern economies are subject to fluctuating evolutions of economic activity. These oscillations initially occur at the output level and are known as business or trade cycles. The rigorously scientific research of these economic cycles is important in terms of understanding the behaviour of economic systems, of the emerging processes that occur in the entire macroeconomic system and of the networks that are created as the global economic system expands and strengthens. This study aims to simulate the evolution of the domestic product and to identify the equilibrium trajectory, using the aggregate multiplier-accelerator type model proposed by Hicks.*

Keywords: *Hicks's model, equilibrium trajectory, Gross National Income.*

1. Introduction

The macroeconomic systems approach to modelling and simulation shows the presence of feedback mechanisms in the form of strings (cycles) of causal dependencies between the main economic variables. Their emergence is generated by the need for the macroeconomic system to maintain its integrity, reacting appropriately towards overcoming the limitations arising from the external environment and also to ensure the development of the processes to achieve the balance, growth and cyclicity – fundamental in the overall process of economic evolution and development.

The existence and action of such control and self-control feedback mechanisms are considered characteristic to complex systems. “Once the global financial networks have attained a certain level of complexity, their nonlinear interconnections quickly generated feedback loops that have given rise to many unexpected emergent phenomena. The resulting new economy is so complex and turbulent that it defies any conventional economic analysis” (F. Capra, 2004).

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The feedback control mechanisms, also known as effects, can be grouped into three categories: multiplier mechanisms, accelerator mechanisms, mixed mechanisms.

The multiplier and accelerator models were imposed in the macroeconomic studies from the '30s and they analyse the variation of the income variable in the context of the principle of acceleration in a Keynesian multiplier model. By combining the two parameters, these models aim at the reproduction of the economic cycles in the economic practice by using finite difference equations and differential equations. Depending on the type of behaviour relations, they are linear (Samuelson (1939), Hicks (1950)), nonlinear (Goodwin (1951), Kaldor (1940)) or chaotic multiplier-accelerator models (Puu (1986)).

The multiplier principle emphasizes the interaction that occurs between increasing the income and increasing the investments. Thus, the investments generate stimulating effects on the production of economic goods and thereby on the income and consumption. The investments multiplier (K) shows the change in income from the increase with one unit of the investments:

$$K = \frac{\Delta Y}{\Delta I}. \quad (1)$$

According to the multiplier principle, at an increase of investments, the income will increase K times. Assuming that in a closed economy, the savings are equal to the investments, $Y = C + E$, $Y = C + I$, it results that $E = I$, respectively $\Delta E = \Delta I$, substituting the relationship: $\Delta I = \Delta Y - \Delta C$ in (1) we obtain:

$$K = \frac{\Delta Y}{\Delta I} = \frac{\Delta Y}{\Delta Y - \Delta C} = \frac{\Delta Y}{\Delta Y - \left(1 - \frac{\Delta C}{\Delta Y}\right)} = \frac{1}{1 - c'} \quad (2)$$

where c' is the marginal propensity to consume.

Since $1 - c' = e' \Rightarrow K = \frac{1}{e'} \rightarrow$ the investments multiplier is the reverse of the marginal inclination to savings. The accelerator principle describes the effect of the income growth on investments. The accelerator (β) is expressed by the relationship:

$$\beta = \frac{I_t}{Y_t - Y_{t-1}}; \beta > 0 \quad (3)$$

where:

I_t – investments in the current period t ;

Y_t – income in the current period t ;

Y_{t-1} – income in the base period $t-1$.

The accelerator works while the size of the technical capital needed to obtain the income in period (t) is greater than the size of the technical capital existing in the base period ($t-1$). If the difference between the technical capital needed in period (t) and the technical capital existing in period ($t-1$) is a negative value, then a disinvestments phenomenon has occurred in the real economy.

E. Scarlat, referring to the accelerator effects shows that “the accelerator mechanisms, analysed in terms of cybernetics, have destabilizing effects, which correspond to positive feedback loops. These destabilizing effects are reflected usually in monotone unbounded increments of the sizes of the variables involved either in a causal chain or in their oscillations with increasing amplitudes. For this reason, the accelerator mechanisms are accompanied by multiplier mechanisms that may have stabilizing effects” (E. Scarlat, 2005).

2. The macroeconomic cyclical evolution model in Hicks's vision

2.1. Description of the model

In order to simulate the evolution of the gross national income and to identify the equilibrium trajectory, Hicks proposed the following aggregate accelerator-multiplier type model:

$$\begin{cases} Y_t = C_t + I_t + G_t \\ C_t = \alpha Y_{t-1}, 0 < \alpha < 1 \\ I_t = \beta(Y_{t-1} - Y_{t-2}), \beta > 2 \end{cases} \quad (4)$$

where:

Y_t – gross national income at market prices;

C_t – private consumption;

I_t – investments;

G_t – government expenditures;

α – the propensity to consumption;

β – the accelerator.

The model uses the multiplier mechanism for the formation of consumption (C_t) as a part $\alpha \in (0,1)$ of income (Y_{t-1}) created in the previous period, thus available for consumption in period t . Out of the structural form of the model, we obtain the reduced form:

$$Y_t = (\alpha + \beta)Y_{t-1} - \beta Y_{t-2} + G_t \quad (5)$$

Y_t being given by the second order equation with finite differences:

$$\chi^2 - (\alpha + \beta)\chi + \beta = 0. \quad (6)$$

The evolution of the gross national income Y_t and implicitly of the other indicators C_t , I_t , according to Stancu S. and Mihail N. (2009), it results from the relation:

$$Y_t = Y_t^G + Y_t^P \quad (7)$$

where: i. Y_t^G depends on the roots of the equation χ_1, χ_2 :

$$Y_t^G = \begin{cases} C_1\chi_1^t + C_2\chi_2^t, & \text{dacă } \chi_1 \neq \chi_2 \\ (C_1t + C_2)\chi_1^t, & \text{dacă } \chi_1 = \chi_2 \end{cases} \quad (7.a)$$

in which C_1 and C_2 are constants which are determined from the given boundary conditions (the Cauchy conditions).

ii. Y_t^P is given in the made assumption, through the r rate of government spending $\rightarrow Y_t^P = d(1+r)^t$. The policy on government spending is defined by $G_t = G_0(1+r)^2$.

Replacing in (5), we obtain:

$$d(1+r)^2 = (\alpha + \beta)(1+r)^{t-1}d - \beta(1+r)^{t-2}d + G_0(1+r)^t,$$

hence:

$$d = \frac{G_0(1+r)^2}{(1+r)^2 - (\alpha + \beta)(1+r) + \beta} \quad (7.b)$$

and it exists if the government decision on the r rate verifies the requirement: $(1+r)^2 - (\alpha + \beta)(1+r) + \beta \neq 0$, so that $r \neq \chi_j - 1$, $j = \overline{1,2}$.

2.2. Model estimation and results

Figure 1 shows the evolution of the gross national income, of investments and consumption in the period 1996-2012.

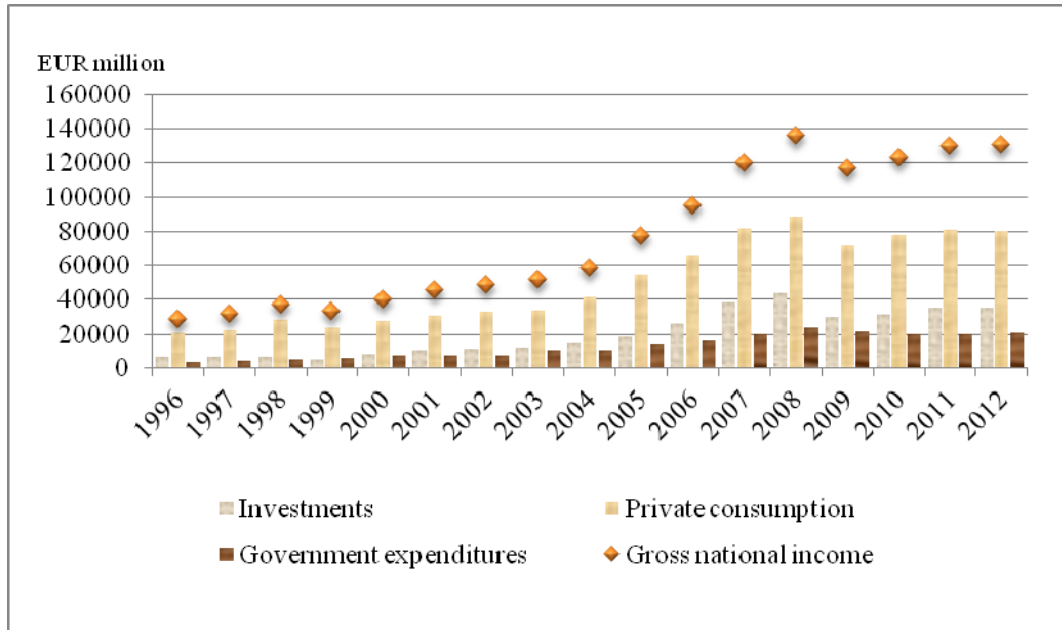


Figure 1. Gross national income, investments and consumption, 1996-2012.

Source: EUROSTAT.

We consider 2012 as the base year. The growth rate of government spending is $r = 5\%$. Through econometric studies we have estimated the parameters as follows: $\alpha = 0.69$; $\beta = 1.34$.

Starting from equation:

$$Y_t = \alpha Y_{t-1} + \beta Y_{t-1} - \beta Y_{t-2} + G_t \Rightarrow Y_t = (\alpha + \beta)Y_{t-1} - \beta Y_{t-2} + G_t$$

the characteristic equation is written:

$$\chi^2 - 2.03\chi + 1.34 = 0,$$

hence the solutions:

$$\chi_1 = 1.015 - 0.5566 \cdot i = |\chi| (\cos \theta - i \sin \theta)$$

$$\chi_2 = 1.015 + 0.5566 \cdot i = |\chi| (\cos \theta + i \sin \theta)$$

$$|\chi| = \sqrt{1.015^2 + 0.5566^2} = 1.1576$$

$$\theta = \arccos \frac{1.015}{1.1576} = 0.5016 \Rightarrow \lambda_1 = 1.1576 e^{-0.5016i}$$

$$e^{i\theta} = \cos \theta + i \sin \theta \Rightarrow \lambda_2 = 1.1576 e^{0.5016i}$$

The evolution of the gross national income is expressed by the equation:

$$Y_t = C_1 \cdot \chi_1^t + C_2 \cdot \chi_2^t + Y_t^*,$$

and the equilibrium trajectory is:

$$Y_t^* = d(1+r)^t = d(1,05)^t = 73342.48 \cdot (1,05)^t,$$

where:

$$d = \frac{20688.9 \cdot 1,05^2}{1,05^2 - 2,03 \cdot 1,05 + 1,34} = 73342.48.$$

Because $\beta \in [(1 - \sqrt{1 - \alpha})^2, (1 + \sqrt{1 - \alpha})^2]$, the evolution of the gross national income has its own periodic oscillations, with the period $T = \frac{2\pi}{\text{Im}\chi_1}$ and the exponential amplitude proportional to $|\alpha_1|^t$, the coefficient of proportionality being $2|C_1| \rightarrow$ depending on the initial situation Y_{t-1} , Y_0 determining coefficients C_1 and C_2 complexly conjugated.

For constants C_1 and C_2 :

$$t = 0 \rightarrow C_1 + C_2 = Y_0 - Y_0^*$$

$$t = -1 \rightarrow \frac{C_1}{\chi_1} + \frac{C_2}{\chi_2} = Y_{t-1} - Y_{t-1}^*$$

$$Y_0 - Y_0^* = Y_0 - d = 57280.52$$

$$Y_{t-1} - Y_{t-1}^* = 59757.42$$

we obtain:

$$\begin{aligned} C_1 &= 28640.26 - 19706.18 \cdot i \\ C_2 &= 28640.26 + 19706.18 \cdot i \rightarrow C_1 = \overline{C_2} \end{aligned}$$

where:

$$\left. \begin{aligned} \gamma &= |C_2| = 34764.9 \\ \omega &= \arg C_2 \end{aligned} \right\}$$

it results that:

$\omega = 0.6027$, so that:

$$C_1 = 34764.9e^{0.6027i}; C_2 = 34764.9e^{-0.6027i}$$

Substituting and using the trigonometric properties, we obtain the evolution trajectory:

$$Y_t = 2 |c| |\chi|^t \cos(\theta \cdot t - \varpi) + d(1.05)^t.$$

The evolution of the economy is cyclical, with its own variations having a period of $T = \frac{2\pi}{0.5016} = 12.53$ years and the exponential increasing amplitude equal to $2|C_2|(1.8164)^t = 69529.8(1.1576)^t \rightarrow$ the process is not stable and such an evolution is not real. From a direct calculation based on equation $Y_t = 2 |c| |\chi|^t \cos(\theta \cdot t - \varpi) + d(1.05)^t$, we observe that in year $t = 2014$ the equilibrium level is exceeded by 2.06 times.

3. Conclusions

The models developed so far consider that the economy as a pyramid structure, in which the effects are transmitted linearly. Therefore, the relations used in these models are primarily linear and additively separable (the effects can be distinguished according to the influence factors that enter into the relationships of the models). The overall conclusion is that the cyclical macroeconomic models are perfectible, this being a challenge for contemporary economists.

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CONNECT TO COMPETE. THE LINK BETWEEN INTERMODAL TRANSPORT AND LOGISTICS

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Abstract. During the last decades, the term of logistics regroups a wide range of activities. For a while, the assumed meanings were limited to external flows, namely for transport and distribution. The race to development new technologies together with collateral management brought the logistics approaches into complex understandings and use. Today, the logistics sector has grown, putting together persons and systems. This vigorous impetus is mainly due to the phenomena of outsourcing the logistics of industrial enterprises and the increased complexity that the transport and logistics sector benefits of. It has become a new economic area, in addition to transport, that includes storage, handling, real estate management, information services, etc. If we make the analogy between a logistic organization and a house, each logistic activity can be likened to a room. Each room contains three elements: processes, people and systems. The processes are likened to the walls, ceilings and floors and define the relationships between activities, people are tenants who are working with processes and the systems are the electrical installation that is connecting the rooms. The main objective of the present paper is to reveal the role of intermodal transport in logistics for the reference of further improvement. This paper was conducted to assist logistics and intermodal transport managers and researchers to comprehend the basic elements of logistics and intermodal transport, and its various applications and implications in intelligent transportation systems.

Keywords: complex logistics, intelligent transport systems, competitiveness, sustainability, innovative concepts.

JEL Classification: L91, M16, O18, P51, Q57.

1. Introduction

The current period, characterized by extensive transformations in the economic and social sector, in all fields of activity, is significantly

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influencing the industry of infrastructure. The impact of this sector is even more relevant because it manifests two contrary trends. On the one hand, an initial tendency is to limit direct investment funds earmarked for infrastructure development and maintenance, but, on the other hand, infrastructure projects constitutes a reliable economic activity such as constructions, the production of raw materials etc., to maintain the unemployment level controllable. The positive result of those two trends shown is influenced by the ability of the authorities to allocate the appropriate resources on the most relevant projects, with the economic and social potential, and which are capable of generating revenue. Throughout the current transformations, I noted the need for increasingly larger infrastructure projects that can solve most of the problems faced by people, organizations and governments. The intensification of international trade with the major products and services requires the creation and operation of fast transport solutions between different countries and even continents. The emergence and consolidation of transport corridors, in particular the road and rail, is a priority for all states, which has generated a situation of competition for choosing the best version in the shortest time. As I mentioned the status and level of development of infrastructure is a key factor for the development of sustainable transport.

2. Characteristics of intermodal transport

Countries from around the world are trying to stimulate the intermodal transport in order to achieve sustainable development, while the demand for intermodal transport is continuously decreasing because of the present economic crisis. The main characteristics of the intermodal transport are different from a region to another; the European intermodal system is influenced by traditional and modern concepts of different means of transportation. Most European countries are interconnected; the distances between the regions of the European Union are motivating the development of the intermodal transportation and the logistic systems. Improvement in these systems will provide many benefits including better services and the reduction of costs. Since Europe has the busiest ports and airports in the world the need for containerized cargo is vital for the development of the logistics infrastructure in some countries.

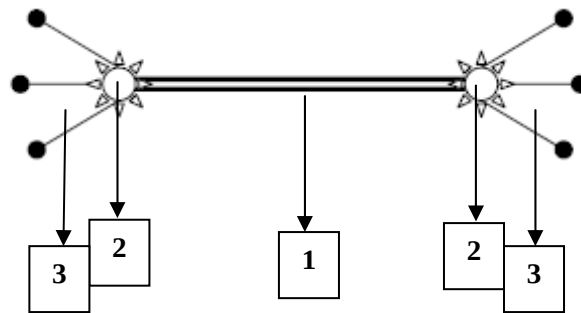


Figure 1. The structure of the intermodal transport system is based on three elements.

Source: http://www.mt.ro/nou/_img/documente/strategie_de_transport_intermodal_text.pdf.

Legend:

1. a system of transport of goods over long distances;
2. transport terminals which provide efficient transfer of units load on a modal transport system to another;
3. a system for the collection and distribution of flows of goods from the points of destination of the transport chain.

To improve the intermodal transport in the E.U.¹ it is necessary to improve the cross-border documentation to increase the productivity of rail and road transport (ECMT, 2001). The NAFTA² region is based on land transportation with a very efficient road and rail systems, and has a limited need for cross-border documentation.

3. Logistics and intermodal transport

Logistics and intermodal transport will influence the development of the global economy, and face the multiple challenges and obstacles that will lead to ever-stricter service requirements and an increasing number of small consignments. The main cause of the relatively low development of intermodal transport is its inability to respond in a satisfactory manner to the requests of logistics customers in the new environment.

It was found that significant time is lost in the transfer terminals of goods on/from the means of transport to their deposits or trans-shipping between vehicles of the various transport modes. The measures of the

¹ E.U. – European Union

² The North American Free Trade Agreement (NAFTA) is an agreement signed by the governments of Canada, Mexico, and the United States, creating a trilateral trade bloc in North America. The agreement came into force on January 1, 1994

increase efficiency of intermodal chain targets are like investments and organizational solutions applicable in intermodal terminals.

Therefore, in order to comply with these strict service demands and to be able to compete with road transport, intermodal transport needs sophisticated logistics concepts, using advanced information systems.

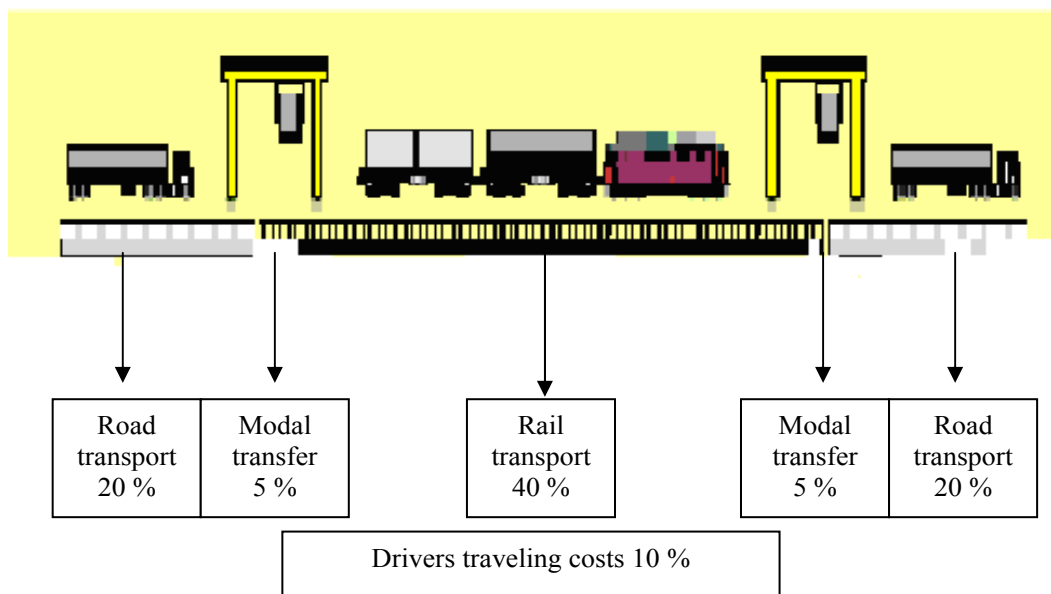


Figure 2. The share of the costs involved in intermodal transport

Source: <http://www.agir.ro/buletine/527.pdf>

4. Overcoming the obstacles of intermodal transport

The intermodal transport sector is essential in the society in which we live and for the current state of the economy; it is vital for a sustainable economic growth and for the creation of new jobs. In the European Union in the transport sector there are working about 10 million people³ (see table no. 1), who produce approximately 5% of GDP⁴.

³ According to EUROSTAT indicators from 2009

⁴ Gross domestic product (GDP) is the market value of all officially recognized final goods and the services produced within a country in a given period of time

Table 1.
Key indicators, transportation and storage in the E.U., 2009

	Number of enterprises	Number of persons employed	Turnover	Value added	Personnel costs	Investment in tangible goods
EU-27 (1)	1 110.5	10 580.4	1 137 281	436 643	297 427	126 012
Belgium	16.7	198.1	42 281.3	13 043.1	9 146.1	4 549.8
Bulgaria	19.3	161.1	4 337.1	1 343.6	752.7	485.7
Czech Republic	39.5	285.1	17 547.1	5 751.3	3 588.2	1 536.8
Denmark (2)	13.9	320.7	47 505.7	11 677.9	7 048.8	6 427.6
Germany	87.5	1 846.3	217 029.6	86 458.3	53 233.0	19 503.0
Estonia	3.9	37.2	3 505.6	844.7	442.9	286.1
Ireland	10.1	82.2	13 004.4	4 856.0	3 641.6	2 143.4
Greece	.	.	.	.	.	.
Spain	220.8	937.3	94 780.7	39 789.3	24 754.1	13 374.5
France (3)	85.8	1 300.6	177 429.5	73 025.9	57 057.5	.
Italy	137.4	1 125.2	125 984.4	48 641.4	36 097.8	15 771.8
Cyprus	3.7	21.1	1 737.0	867.6	536.6	263.5
Latvia	5.4	70.5	3 701.4	1 286.8	651.8	364.1
Lithuania	7.0	93.5	4 021.3	1 156.1	737.6	378.1
Luxembourg	1.0	23.3	4 222.3	1 370.5	1 156.3	119.0
Hungary	31.4	224.7	12 455.5	3 355.2	2 528.3	2 492.9
Malta	.	.	.	.	.	.
Netherlands	26.1	415.8	66 485.2	22 532.2	16 282.4	4 636.7
Austria	13.8	211.6	34 357.0	12 745.3	8 504.4	4 717.8
Poland	132.0	715.0	29 403.8	10 066.2	5 522.2	2 369.6
Portugal	24.1	168.7	16 567.9	6 676.9	3 993.5	2 765.4
Romania	35.1	335.2	9 488.1	3 349.5	2 083.8	2 393.2
Slovenia	8.8	52.6	4 067.6	1 350.5	951.4	872.4
Slovakia	0.6	92.5	4 702.9	1 363.3	1 155.3	1 367.5
Finland	23.3	152.5	19 677.3	7 284.7	5 396.0	1 688.2
Sweden	28.9	265.1	36 208.7	11 056.6	8 901.9	2 831.1
United Kingdom	67.9	1 225.9	143 803.1	62 961.5	39 853.7	13 904.6
Norway	21.8	152.3	33 321.8	12 323.5	7 196.6	5 267.2
Switzerland	4.4	201.6	37 502.8	16 641.7	11 413.4	6 623.5
Croatia	11.7	82.6	3 739.4	1 746.0	1 106.6	486.0

(1) Investment, 2008.

(2) 2008.

(3) Number of employees instead of number of persons employed.

Source : Eurostat (online data code: sbs_na_1a_se_r2)

Source: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Key_indicators,_transportation_and_storage_%28NACE_Section_H%29,_2009_A.png&filetimestamp=20120604154315

Efficient transport systems are a decisive factor for the ability of European companies to compete in the global economy. European companies pay for logistic (transport and storage) 10-15% of the cost of a finished product. The quality of transport services has a major impact on the quality of life of the population.

4.1. Lack of intelligent means in the infrastructure

In the new concepts of infrastructure the lines of demarcation between producers and users, emitters and receptors are eliminated – they have new implications of accessing these borders. Infrastructure is becoming more consistent, and connects a wide range of applications within the company, in particular in the field of production. The present lack of intelligent means in the infrastructure needs, on the basis, solutions that are extended requests and requirements far too complex or even impossible to fulfil without smart solutions that are constantly facing new challenges.

Another major impediment for the development of the intelligent infrastructure in the E.U. is the lack of marketing and service information. However there is a complementary modal system that encourages the development of a wide range of services that links the modal services already existing to companies that have the best chance to develop the skills to serve the increasing demand for high quality logistics.

4.2. The constant changes in the infrastructure

Infrastructure should provide longer service life and ensure compatibility and insights thanks to the flexibility and capacity expansion. Therefore, infrastructures have a contradictory nature: ● some are structural conservative – in a positive sense – they have a long service life and guarantees the compatibility sustained investment; ● the infrastructure must provide flexibility to overcome huge challenges in the future. Therefore, combining infrastructure tasks require altered concepts that allow users to integrate technologies that are already exists. To achieve these capabilities in most cases it is necessary to adapt the intelligent infrastructure to the existing one. In a communication network with different applications, this means active management with intelligent network components. Related technologies are the key to new infrastructure solutions, so that compatibility does not affect innovation. In many cases, new infrastructure technologies need to comply with the existing infrastructure.

5. Conclusions

Logistics and intermodal transport represent an industry which had seen a strong evolution after the Second World War and especially in the past three decades regarding the role and forms of development in the economy. The logistic and intermodal transport sector has faced many challenges such as local levies licenses, increased complications in handling multiple impacts of vendors and suppliers, central and state tax and foreign regulations.

The objective of the logistics and intermodal transport system is to maximize profits, not sales. No logistic or intermodal transport system cannot simultaneously maximize the customer's service and minimize distribution costs, which are required in the first phase to investigate the importance of customer service to various distribution services and then establish the level of service for each segment. It can be said that the objective of the logistics and intermodal transport marketing system must be to provide a level of customer service in terms of the smallest cost.

In conclusion, the main relevant indicators should be selected and for which data can be obtained. They should be applied in a circumstance that provides the industry and government with the necessary insights to determine contributing factors to inefficiencies in the main supply chains, and strategies / policies to lift performance.

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