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MACROSTATE PARAMETER – A NEW ECONOPHYSICS AND TECHNICAL INDEX FOR THE STOCK MARKET TRANSACTIONS ANALYSIS*

Anca GHEORGHIU** and Ion SPÂNULESCU**

Abstract. *In this paper we present some considerations concerning the risk analysis of the financial market transactions using the phenomenological thermodynamics methods togheter with results of the statistical physics about entropy nature and echilibrum macrostate of the physical systems. A new index for the financial risk estimation of the stock-exchange markets transactions, named macrostate parameter, was proposed and discussed.*

Keywords: *econophysics, stock-exchange markets, informational fascicle, financial risk, entropy, macrostate parameter.*

1. Introduction

Although recently appeared, at the border between the XX and XXI centuries, the econophysics – by the numerous articles, books and communications at international conferences – imposed itself as interdisciplinary science, representative and extremely useful for the analysis and to model the socio-economic systems.

The majority of the studies and works published or communicated at conferences or symposiums, referred, in majority, over to model the capital markets specially by statistical physics methods and mathematical statistics methods (see for instance [1÷15]).

In the last years, many researchers included in their papers some models based on analogies between the economical phenomena and phenomena from other fields of physics such as thermodynamics, electricity, spectroscopy, phase transitions physics, reliability theory and so on [16÷25].

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In some papers the sharp economic development and even stock-exchange market crashes are assimilated to phase transitions and related to the "critical points" from thermodynamics (see for instance, [16, 18]).

In order to analyse some aspects of the risks in the financial market transactions, we used in this paper the phenomenological thermodynamics methods and the statistical physics results concerning statistical interpretation of entropy and of the equilibrium conditions of physical systems. In the like manner, in the next section some considerations upon the economic value and the information fascicle in the financial markets analysis are made.

Section 3 recalls some considerations upon the volatility and, by correlation with the Section 2 results, a concept of the normalized volatility is proposed and analysed. In the Section 4, using this concept and correlation with Section 2 considerations, on the basis of the analogy between the thermodinamic entropy and the degree of disorder from financial markets, an important index, named macrostate parameter, is proposed. This parameter can be very useful to analyse risks in the stock-exchange market transaction and to predict the expectations of investors.

Finally, in Section 5 the principal conclusions are summarized.

2. Economic value and economic information

As it was shown in the previous papers [21, 24], besides its intrinsic value, characterized by use 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 exchange value are tighter tied upon the mass or order concept or things construction, whereas the own information of a material good is not physicaly palpable having an immaterial aspect like a wave, therefore a waved (pulsatory) 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 informations 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.

Taking into account the previous considerations, in the case of systems with a big number of constituents as are the financial markets,

money, share number, the price or the volume of the shares transacted on the market etc., the laws of the statistical physics or probability theory and statistical calculus can be applied. So several authors esteem that the shares as well as money or economico-financial informations about them and the types of shares or their prices, for example, are compared with the particles from an informational beam rather by similitude and not by identification with objects from the physical reality. As it will be shown later, such a representation, used by other researches too, see e.g. [20, 25], is useful to us to introduce new parameters and indexes to characterize the risk of the transacted shares on the financial markets.

3. Simple volatility and normalizated volatility

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

For volatility, usually the relation that express the shares price difference at two successive moments is used:

$$Vol = p_t - p_{t-1} \tag{1}$$

where t represents the present time, and $t-1$ is the time at the previos moment, separed from t by the time unity (minute, hour, day, month, year etc.), as well by logarithmic expression:

$$Vol = \ln(p_t) - \ln(p_{t-1}) \tag{2}$$

which allows the graphic representation for longer time periods.

From the stock-markets analysis it is sometimes established that, altough 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. Contrarily, the assets with a more reduced price that can attract the investors, consequently being able to determine large transacted volumes, can inspire some confidence on the

market although the shares do not have a corresponding good evolution (having many price oscillations and price corrections etc.).

In the first case mentioned it can be said that such a share of high value, has a much more inertia on an increasing/decreasing tendency of the transacted price and at the same time, by reduced liquidity, is much more risky, as will compare a lump pile with a sand hillock. Even if the volume should be the same, the effects are very different. From this point of view the product price × transacted volume, can be assimilated with to impulse of a particle defined by the product of mass *m* and speed *v:*

$$p = m \cdot v \tag{3}$$

from the elementary physics.

For a more complete understanding of the share evolution from the point of view of the price and transacted volumes, the product **price × transacted volume** can be assimilated to the impulse of a particle (which symbolize the respective financial information) defined by the product pV similar to the impulse of a particle-information defined by a relation of (3) type.

Such an index can delivers 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.

In the like manner it can be considered other parameters resulted from combinations of the two entities of the type: price/volume or volume/price etc., all these combinations can be simbolically marked by parameter a_t.

Considering the product price × volume, $a = pV$, we can define the normalized volatility as:

$$Vol_n = \frac{p_t V_t - p_{t-1} V_{t-1}}{p_{t-1} V_{t-1}}, \tag{4}$$

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*.

The normalized volatility represents a powerful index of the share's status compared with the previous day and meanwhile an information refering to the investor perceiving with respect to the asset and theirs

expectations toward the investment in the respective share or company from a moment to another. This index will be used in the next section to introduce and analyse the macrostate parameter – a new index very useful for the risk estimation in the financial market transactions.

4. The macrostate parameter of the financial market transactions

As we mentioned above, all the informations from the financial field can be assimilated with the particles of a gas of impulses $p = mv$ (see relation 3) confined in a precinct ("financial boiler") that is the very capital 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 particles that symbolise the shares (or other financial instruments) from the virtual precinct can be exist at various moments. Every "particle-information" contained in the financial boiler (virtual precinct) is characterized – in a first phase – by the product price × volume of transacted shares, i.e. by the parameter $a = pV$ 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 reach an equilibrium state which is a **macrostate** that can be described by measurable macrostate parameters [26].

By financial (or economic) macrostate we understand the assemble of informations and decisions materialized in the share price and the transacted volume (individual and for all the day, hour or minute of transacttion) when we refer to an emitor quated or to the quote of the stock-market index, if the market is analysed in its assemble or for one section of it.

So, if we consider $a = pV$, a microstate for the capital market is given by the assemble of the price and share's volume situation at a very moment t. If this microstates is altered by the transaction of a single investor, for example, which buys or sells a single share, 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 of transactions) so the microstates number should be extraordinary big and can be interpreted and statistically evaluated by a similar formula like that given by L. Boltzmann for the

microstates of a thermodynamic system (mix of gases) which defined the entropy of a thermodynamic system [22, 26]:

$$S = k \ln W. \tag{5}$$

In equation (5), $k = 1.380.662 \times 10^{-23}$ J/K represents the Boltzmann's constant, and:

$$W = \frac{n!}{n_1! n_2! n_3! \ldots} \tag{6}$$

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

Starting from the definition (5) of entropy $S = k \ln W$ from thermodynamics, we can introduce a similar parameter named **macrostate parameter**, for the financial markets:

$$P_M = k_B \ln W_B \tag{7}$$

where W_B represents a probability in succeeding a new microstate of the stock market and k_B 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 relation like [22, 26]:

$$\mathrm{d}S = \frac{1}{T} \mathrm{d}Q \tag{8}$$

or for the finite variations, by the relation:

$$S = \frac{\Delta Q}{T} \tag{9}$$

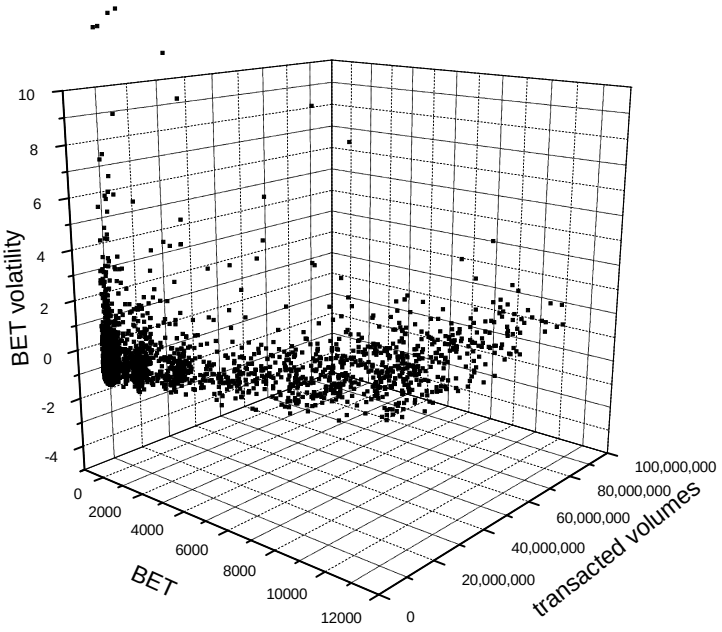
that is to say that the thermodynamical entropy is proportional to the reverse of the temperature T.

Similarly, for the financial markets, to abstract a proportionality factor ΔQ, the reverse of P_M parameter represents the stock-exchange market temperature T_B, which is also an important macrostate parameter for the financial markets analysis (see relation 9):

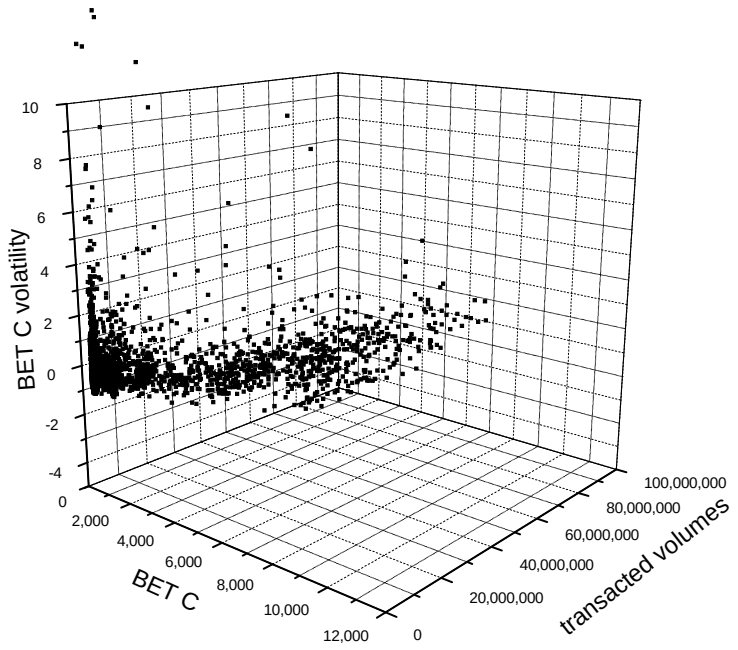
$$T_B \cong \frac{1}{P_M}. \tag{10}$$

If we imagine a virtual precinct, characterized by the parameters of momentary economic state (time, index value at the end of the transactional day and the volatility define as the index value variation from a day to another one), we can "visualize" the state of a given period, as it can be seen

in figure 1 of the romanian stok-market indexes (for data series from the creation of the respective market index up to December 2007).



a) BET



b) BET-C

Figure 1. "Thermal" precincts of the romanian stok-market indexes [21, 24].

Considering the displacement in the linear direction of some imaginary particles, the microstates assemble of all the particle mouvement reflects the "thermal stir" state of particles contained in the precinct. The bigger the displacement speed v is, the more, the impulse $p = mv$ of these particles will increase, as well the precinct temperature and the system energy will increase. As it was mentioned before, for the informational precinct (i.e. "financial boiler") the product $a = pV$, is similar to the impulse $p = mv$ of the material microparticles which, in the case of the financial virtual precinct, is close tied to the volatility generally, and to the normalized volatility Vol_n, defined by (4) relation, especially.

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 (see rel. (4)):

$$Vol_n = \frac{a_t - a_{t-1}}{a_{t-1}}. \tag{11}$$

A microstate of the stock-exchange market is given by the assemble of total prices and trade volumes for a transactioned shares at a given moment t. The assembly of the share 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 is a three – dimensional one, with the following coordinates: 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 parameter of macrostates accounting the sum of all microstates reported to the totality of their number, N, that could be similar to the financial entropy P_M.

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

$$P_M = \frac{\sum \text{normalized volatility}}{N} = \frac{1}{N}\sum_{t=1}^{N} \frac{a_t - a_{t-1}}{a_{t-1}} \tag{12}$$

where a_t symbolise the price × volume product.

Comparing the formula (12) with the relation (7) for entropy, we can write also the equality:

$$P_M = \frac{1}{N}\sum_{t=1}^{N} \frac{a_t - a_{t-1}}{a_{t-1}} = k_B \ln W_B = S_e \tag{13}$$

where S_e represents the economic entropy being determined and equal to the macrostate parameter P_M.

If in the relation (13) we can be considered the factor k_B as being given by $1/N$, it results that the expression $\ln W_B$ can be identified (and evaluated) by the sum of the characteristic normalized volatilities for the system microstates and defined by the relation (11).

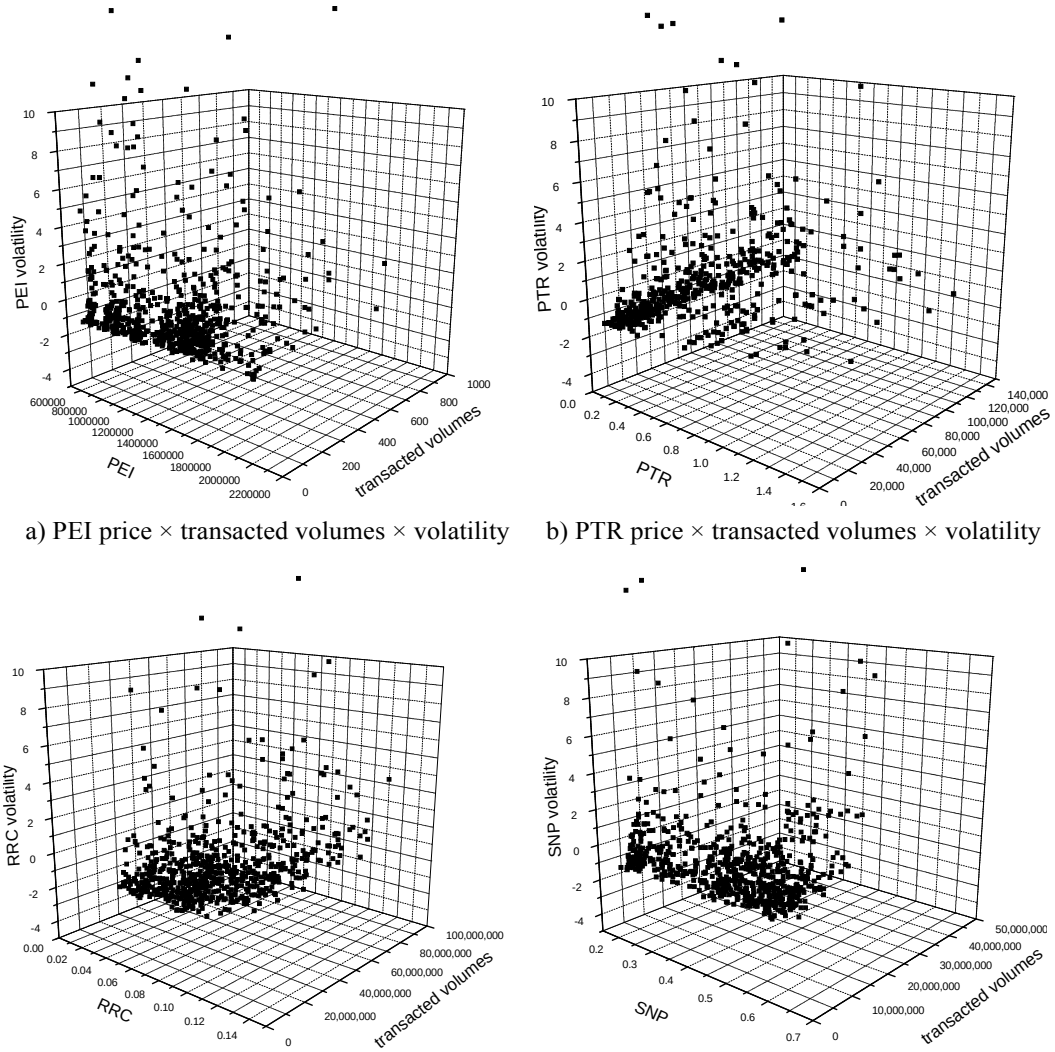
As it was mentioned, a thermodynamic system is wholly described by dint of two macroscopic parameters. A macroscopic parameter represents the statistical value of all microscopic states at a given moment t or under certain conditions (of volume, impulse etc.). Such a parameter is the macrostate parameter P_M defined by the relation (12), as well as its reverse, the financial market temperature, T_B (see also eq. 10):

$$T_B = \frac{1}{P_M} = N\sum_{t=1}^{N} \frac{a_{t-1}}{a_t - a_{t-1}} \tag{14}$$

where $a_t = p_t V_t$.

To illustrate this, in figure 2 the "economic virtual precincts" of the some romanian petroleum companies performances, currently quoted at Romanian Bourse for 4.07.2004-23.11.2006 period are represented. The normalized volatility is represented as price as well as volume function i.e. as $a_t = f(p, V)$ function.

On the basis of volatility data, price and volume, in figure 3,a the values for P_M and $T_B = \frac{1}{P_M}$ given by (13) and (14) formulas are represented, where $a_t = p_t V_t$. In the figure 3,b the same results using the histogram form for P_M parameter, much more suggestive for interpretation and analysis, are represented.

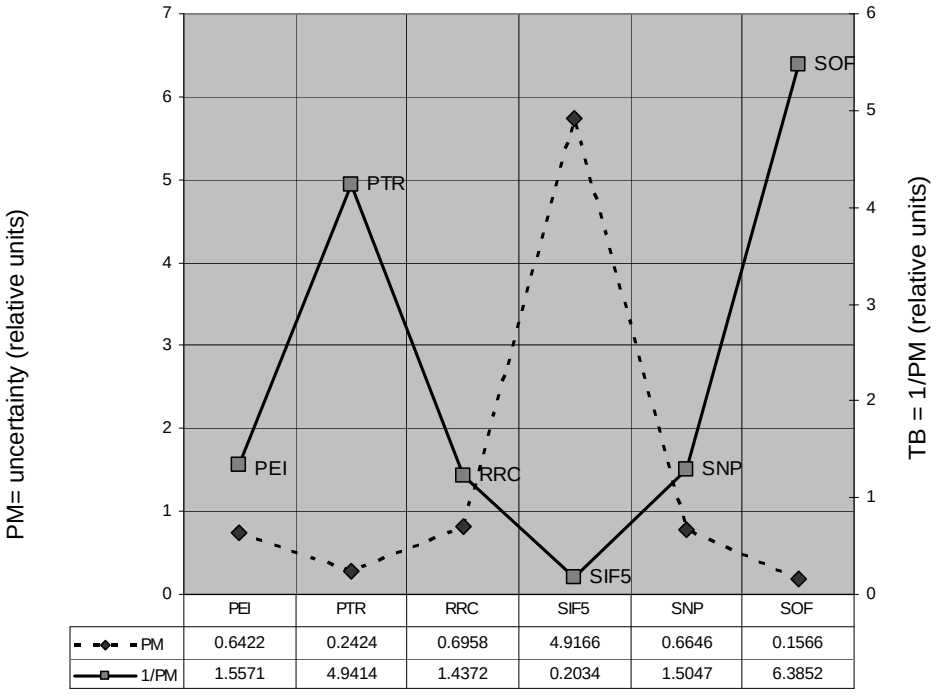


a) PEI price × transacted volumes × volatility b) PTR price × transacted volumes × volatility

c) RRC price × transacted volumes × volatility d) SNP price × transacted volumes × volatility

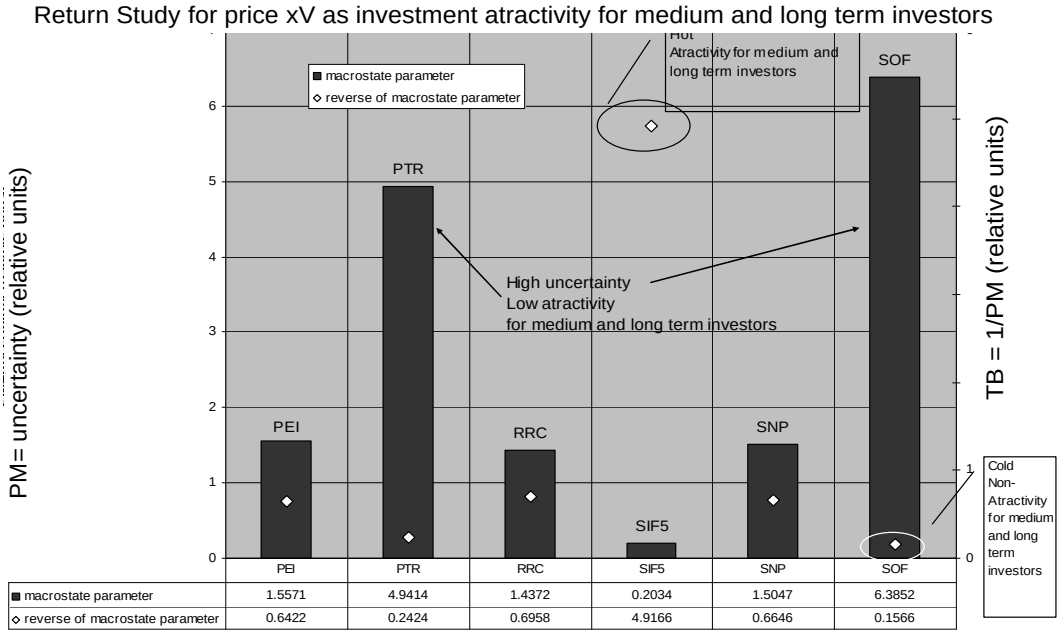
Figure 2. Economic virtual precincts of the performances of some romanian oil companies quoted at BVB (04.07.2004 – 23.12.2006) [21, 24].

To be able to appreciate the perception degree of the investors, besides the four petroleum companies analysed in the figure 2, we applied the same calculus for two shares situated at the extremities of the stock-exchange market i.e. SOF, which represents the symbol of Sofert Bacău, a society with weak results for which it was declared the payment incapacity and SIF5, symbol of SIF Oltenia, from the financial field, which in 2004-2006 period, appreciated itself with more 200%, very transactioned and interested for the specualtor's portfolio, but as well for the investors for the dividends annualy granted. The comparative results are ilustrated in the figure 3,a and 3,b respectively.



	PEI	PTR	RRC	SIF5	SNP	SOF
PM	0.6422	0.2424	0.6958	4.9166	0.6646	0.1566
1/PM	1.5571	4.9414	1.4372	0.2034	1.5047	6.3852

a)



	PEI	PTR	RRC	SIF5	SNP	SOF
macrostate parameter	1.5571	4.9414	1.4372	0.2034	1.5047	6.3852
reverse of macrostate parameter	0.6422	0.2424	0.6958	4.9166	0.6646	0.1566

b)

Figure 3. a) The macrostate parameters P_M and $1/P_M$ for the some companies transacted an Romanian Stock-exchange market (BVB); b) The same results for the quoted companies, the macrostate parameters being represented by histogram forms.

As it was specified above, in all the analyses cases, a share is represented by the doublet price × transacted volume, state parameter P_M and $T_B = 1/P_M$, being calculated taking into account product $pV = a$ (see (13) and (14) equations).

As it was shown by the equations (10) and (13) the macrostate parameter P_M defines the economic entropy S_e, and the reverse of the macrostate parameter, $1/T_M$, represents the economic (financial) „temperature" T_B of the capital market, for the chosen criterions (parameter $a = pV$) and the analyses companies [21, 24].

Let us argue the aspects illustrated in figures 3,a and 3,b. Under the investors' certitude, a chaos minimize, the investors are strongly attracted to SIF5 (the investment fidelity on medium and long periods), what we knew, but what we did not know is just the high "temperature" this share proposed to the market (see the circle round the point up on figure 3,b). The shares PEI, SNP and RRC are situated on moderate market equilibrium positions, unlike of PTR, which although has a financial good situation is affected of low liquidity and a reduced visibility in the markets, which generate an anormal "thermal" agitation. And surley, at antipodes, SOF, the "coolest" share and the same time transacted on large volumes because of a very low price, of a lack of investmentional culture of some players on the market and of the presence in zone of imprudent speculators.

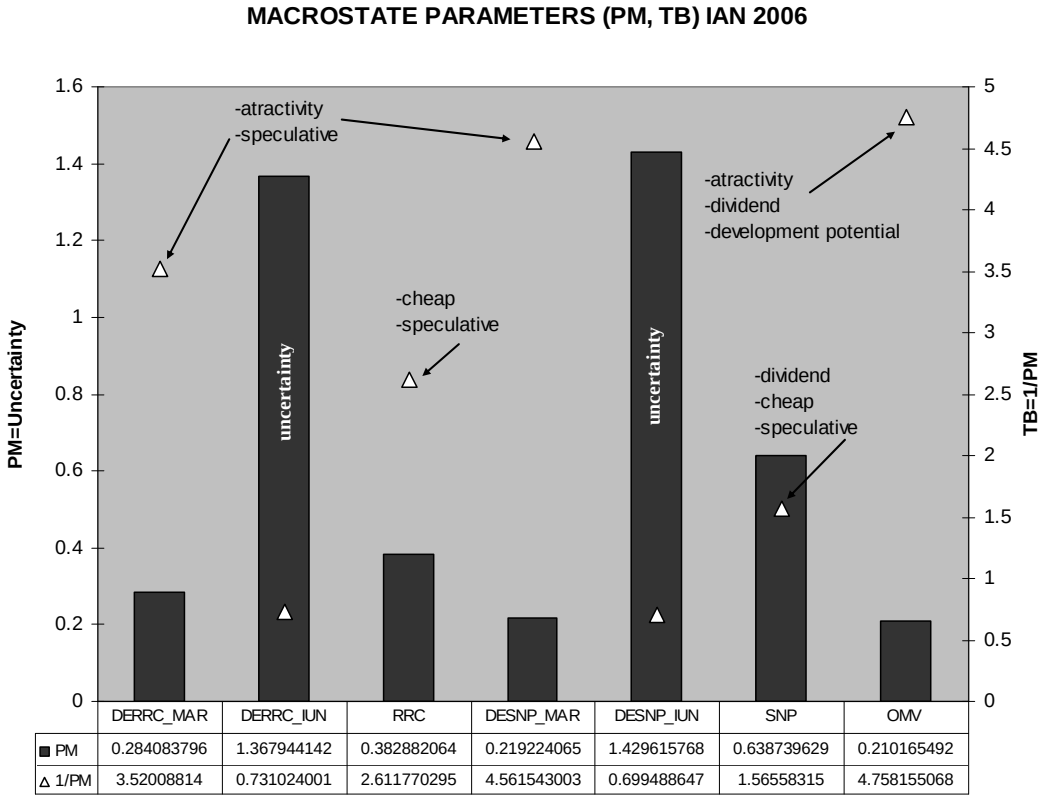
If we look at charts where the diagrams of the macrostate parameter P_M is represented (figures 3,a or 3,b), we can directly see how it can be used. It value is showing us the degree of uncertainty for uncertain shares although they have a large volume of trading (see SOF or even PTR cases). We can conclude that with this low interest shares, the entropy is larger mostly due to chaos induced by the market because of low prices and large transacted volumes despite of strong uncertainty and lowly liquidity.

To be sure that the precedent reasonings are correct and we can introduce a new technical index for the portfolio investor on medium and long periods, we extended the study on the same emittent quoted on four markets namely on spot romanian market (BVB), on forward market (BMFSMS) at two different terms of payment and a foreign market (Wiener Boerse). The alone emittents, in the category selected by us (petroleum sector) which fulfild this condition at the analyse moment were RRC and SNP, respective DE_RRC and DE_SNP and OMV respectively.

The selected time for this analysis was one month, namely January, 2006. The analysis results are given in figure 4.

By using the macrostate P_M and respective $T_B = 1/P_M$ parameters, it can be immediately seen which are the attractive shares (Fig. 4) and how intervene the uncertainty factor, which in this situation (future market) is more varied acting.

The fact that $T_B = 1/T_M$ takes low value at DE_RRC_JUN can be explained by the fact that the transaction of the contracts with term of payment on 30 June just begun (the sampler period being January 2006) the traders are prudent and small quantities of shares are transacted in order to identify the probable trend of the market, did not find the traject on basis, are very volatile and risky, transacted on low volumes (some time are not transacted). On the contrary, DE_RRC_MAR and DE_SNP_MAR are already, transacting since three month (from 1-October 2005), the market established a trend.



	DERRC_MAR	DERRC_IUN	RRC	DESNP_MAR	DESNP_IUN	SNP	OMV
■ PM	0.284083796	1.367944142	0.382882064	0.219224065	1.429615768	0.638739629	0.210165492
△ 1/PM	3.52008814	0.731024001	2.611770295	4.561543003	0.699488647	1.56558315	4.758155068

Figure 4. The macrostate parameters for RRC and SNP on the spot (BVB) and the futures (BMVFMS) markets and OMV on the spot Austrian (Wiener Boerse) market.

For OMV (Austrian company), from figure 4 it is seen that macrostate parameter P_M for this company is much lower compared to RRC and SNP, which denots a much diminished entropy, i.e. a smaller uncertainty degree for this emitent, in other words the investors "know" better the company potential and its development plans.

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) 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 the considerations made in this section 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, two investitional risk scales for the companies enlisted during 2006 and 2007 years were established (Fig. 5 and Fig. 6). The financial results of the companies corroborate with their hierachy on the macrostate parameter value for the 2006 and 2007 years verified the theoretical considerations of foundation of the econophysics model for the risk estimation in the stock-exchange markets.

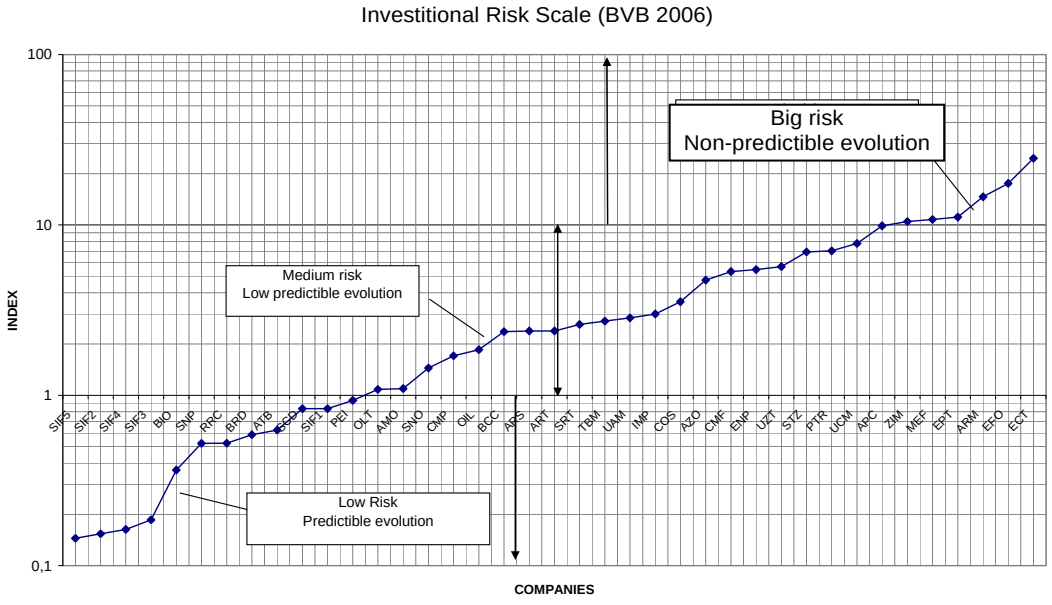


Figure 5. Investitional risk scale for the 40 romanian companies quoted at Bucharest stock-exchange market (BVB) during 2006 year.

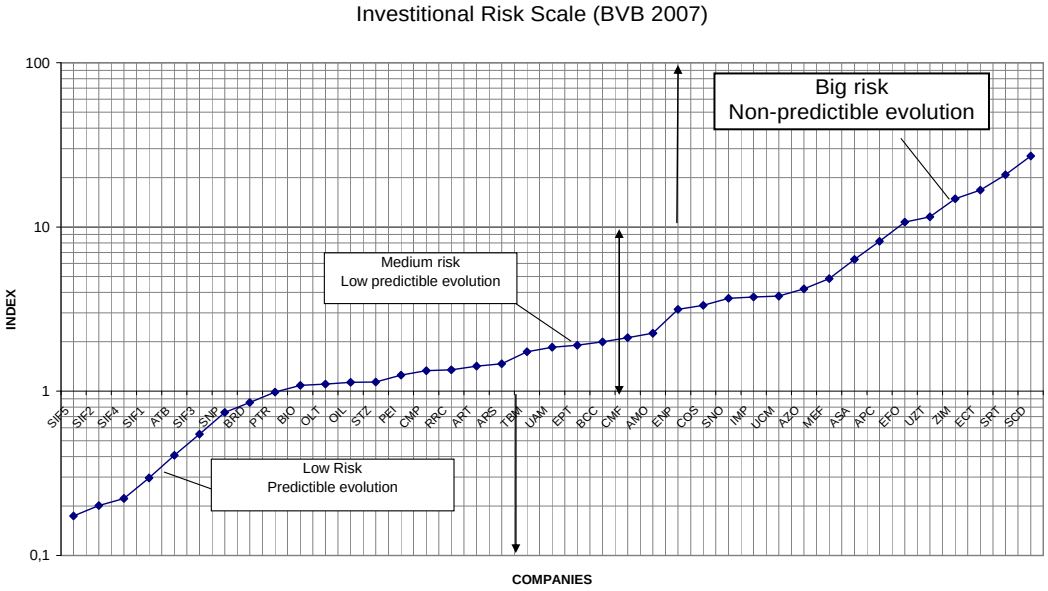


Figure 6. Investitional risk scale for the 40 romanian companies quoted at Bucharest stock-exchange market (BVB) during 2007 year.

5. Conclusions

Considering totality of the information about stock-exchange market like a financial boiler, on the basis of the analogy of the thermodynamic entropy and the disorder degree from the capital (financial) markets, a new index for the risk estimation and evolution of shares quoted on regularly markets, named macrostate parameter, was introduced.

From the econophysics point of view, the macrostate parameter P_M is a measure of the disorder (entropy) from the capital market, being similar to the thermodynamic entropy from physics. Its size shows directly the uncertainty degree from the economic (financial) point of view for various transacted companies, being able to constitute a measure of the attractive degree on medium or long term. This method can be applied on multiple financial exercises or on a single fiscal year. As a conclusion, it results that P_M is a strong parameter for the appreciation of the investors if to take or not into consideration for their portofolio one or other companies.

The macrostate parameter "smoothes out" the useful information, dismisses the "parasite noise" and put into evidence the value of risk and the real appetite of the investors towards the analysed company.

The macrostate parameters are intensive and deliver synthetical informations to the investor on the regulated markets, on the basis of which

he can build scales of risk and investitional uncertainty for the transacted companies on the financial markets.

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ON THE SOLUTION OF SOME DIFFERENTIAL EQUATION IN THE CLASSICAL MAXWELL THEORY

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Abstract. *Some scalar differential equation was obtained after diagonalization of the generalized electrodynamics axiomatic system that was given in the differential form over the classical Maxwell space (x, y, z, t). This equation was solved explicitly for the various types of the electromagnetic media and the time parameter t was taken into account.*

Keywords: *differential Maxwell system, Maxwell space, scalar PDE (partial differential equation), scalar function.*

1. Introduction

It is not a new fact that quite a lot of modern industrial and applied physical problems even now deal with the solution of PDEs and their systems in the classical Maxwell space. Thus, in [1] the concrete industrial problems were solved and they dealt with the study of the signal transmissions in the various kinds of media. Mathematically these problems were considered as the generalized Maxwell system of PDEs:

$$\begin{cases} rot\ \vec{H} = (\delta \pm \lambda\varepsilon_a)\vec{E} + \varepsilon_a \partial_0 \vec{E} + \overrightarrow{j^{os}}. \\ -rot\ \vec{E} = (r \pm \lambda\mu_a)\vec{H} + \mu_a \partial_0 \vec{H} + \overrightarrow{e^{os}}, \end{cases} \tag{1}$$

where: the unknown vector functions $\vec{E} = \vec{E}\,(x, y, z, t)$ and $\vec{H} = \vec{H}\,(x, y, z, t)$ with their scalar components $E_k = E_k\,(x, y, z, t)$, $H_k = H_k\,(x, y, z, t)$ $(k = \overline{1,3})$ represented the electric and magnetic field tensions; the positive constants $\sigma, \mu_a, \varepsilon_a$ were the specific conductivity, absolute and dielectric permeability of the medium; the given vector functions $\overrightarrow{j^{os}} = \overrightarrow{j^{os}}\,(x, y, z, t)$,

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$\overrightarrow{e^{os}} = \overrightarrow{e^{os}}(x,y,z,t)$ with the scalar components $j_k^{os} = j_k^{os}(x,y,z,t)$, $e_k^{os} = e_k^{os}(x,y,z,t)$ $(k = \overline{1,3})$ described the outside current sources and tensions; the partial differential operator $\partial_0 = \dfrac{\partial}{\partial t}$.

In comparison with the usual Maxwell axiomatic case system (1) had the additional positive constants λ and r whose presence led to some generalizations of the classical electromagnetic field theory. Namely, λ was the parameter of the signal that intruded into the medium and r was the theoretical constant which existence at the current stage of research could be only assumed. The diagonalization of (1) was done explicitly in paper [2], and the proposed algorithm did not depend neither on the initial nor on the boundary conditions of the original problem. Moreover, the mentioned diagonalization procedure was done in the vector and scalar meanings (in other words, by the blocks and coordinates consistently).

The considerable generalization of the above mentioned diagonalization problem in the case of the arbitrary finite-dimensional system of the partial differential operator equations over the m-dimensional real space was done in [3].

2. The problem statement

After the last diagonalization stage of (1) by the coordinates the final scalar equation was expressed uniformly:

$$\tilde{\partial}_0^2(\tilde{\partial}_0^2 - \Delta)F_{ik} = (\partial_k^2 - \tilde{\partial}_0^2)\varphi_{ik} + \partial_k(\partial_v\varphi_{iv} + \partial_l\varphi_{il}),$$

$$v \neq l,\ \ k \neq v,\ \ k \neq l\ \ (k,v,l = \overline{1,3};\ \ i = 1,2). \qquad (2)$$

Here:

$$\tilde{\partial}_0^2 = \mu_a\varepsilon_a\partial_{0*}^2 + (\sigma\mu_a + r\varepsilon_a)\partial_{0*} + r\sigma,\ \ rot = A,\ \ \partial_0 \pm \lambda = \partial_{0*},\ \ \sigma + \varepsilon_a\partial_{0*} = C,$$

$$r + \mu_a\partial_{0*} = D,\ \ \overrightarrow{F_1} = \vec{E},\ \ \overrightarrow{F_2} = \vec{H},\ \ \overrightarrow{\varphi_1} = A\overrightarrow{e^{os}} + D\overrightarrow{j^{os}},$$

$$\overrightarrow{\varphi_2} = C\overrightarrow{e^{os}} - A\overrightarrow{j^{os}},\ \ \Delta = \partial_1^2 + \partial_2^2 + \partial_3^2,\ \ \partial_1 = \frac{\partial}{\partial x},\ \ \partial_2 = \frac{\partial}{\partial y},\ \ \partial_3 = \frac{\partial}{\partial z}, \qquad (3)$$

and some other remained notations are recently mentioned in (1). In fact, the explicit solution of (2) that does not depend on the boundary and initial

conditions can be expressed in terms of the following general PDE over the classical Maxwell space (x, y, z, t):

$$\tilde{\partial}_0^2(\tilde{\partial}_0^2 - \Delta)F = f, \tag{4}$$

where: $F = F(x, y, z, t)$, $f = f(x, y, z, t)$ are the sought for and the known scalar functions respectively; the differential operator $\tilde{\partial}_0^2$ and Laplacian Δ are from (3).

3. Undisturbed vacuum medium

If the original given function $\overrightarrow{e^{os}} \equiv 0$, the investigated undisturbed $(\lambda = 0)$ isotropic medium is vacuum $(\sigma = 0)$ and additionally $r = 0$. Then we get the simplest but the most important particular case of (4):

$$\partial_0^2\left(\partial_0^2 - \frac{\Delta}{\mu_a \varepsilon_a}\right)F = \tilde{f}, \quad \tilde{f} = \frac{f}{\mu_a^2 \varepsilon_a^2}, \tag{5}$$

and f is given in (3), (4), i.e.:

$$f = (\partial_k^2 - \mu_a \varepsilon_a \partial_0^2)\varphi_{ik} + \partial_k(\partial_v \varphi_{iv} + \partial_l \varphi_{ik}),$$
$$\overrightarrow{\varphi_1} = \mu_a \partial_0 \overrightarrow{j^{os}}, \quad \overrightarrow{\varphi_2} = -rot\, \overrightarrow{j^{os}}, \tag{6}$$

$(i = \overline{1,2};\ v, k, l = \overline{1,3};\ v \neq k,\ k \neq l,\ v \neq l)$.

It is evident that though (5) has the common differential operator at its left side for all possible cases of v, k, l, i from (6), but the unknown F and the given f scalar functions are different for each case of i, v, k, l from the same formula (6). The last assertion is the obvious corollary of (2), (3).

After application to (5), (6) of all integral transformations that correspond to the spatial boundary conditions on (x, y, z) we obtain the final ODE (ordinary differential equation) with respect to the time coordinate t and in terms of the sought for and given functions' F_{tr}, f_{tr} transformants, which depend only on the time argument t and on the parameters of the applied integral transformations:

$$\frac{\mathrm{d}^2}{\mathrm{d}t^2}\left(\frac{\mathrm{d}^2}{\mathrm{d}t^2} - \frac{\Delta_{tr}}{\mu_a \varepsilon_a}\right)F_{tr} = f_{tr}^{*}. \tag{7}$$

In (7): $f_{tr}^{\ *} = \dfrac{f_{tr}}{\mu_a^2 \varepsilon_a^2}$, $F_{tr} = F_{tr}(t, p)$, $f_{tr} = f_{tr}(t, p)$, p is the set of the parameters of the applied integral transformations, $\Delta_{tr} = \Delta_{tr}(p)$ is the Laplacian transformant and it is constant in the meaning of t. Putting:

$$\frac{\mathrm{d}^2 F_{tr}}{\mathrm{d}t^2} = \Phi = \Phi(t, p) \tag{8}$$

we come to the simplified ODE that is equivalent to (7):

$$\frac{\mathrm{d}^2 \Phi}{\mathrm{d}t^2} - \frac{\Delta_{tr}}{\mu_a \varepsilon_a} \Phi = f_{tr}^{*} \tag{9}$$

and whose characteristic equation has two simple roots:

$$\gamma_{1,2} = \pm \sqrt{\frac{\Delta_{tr}}{\mu_a \varepsilon_a}}. \tag{10}$$

Since $\mu_a, \varepsilon_a = const > 0$ according to the initial problem statement (1), then the values from (10) are defined completely by the values of Δ_{tr}. Hence, we come to three possible variants of roots (10) and, as the corollary, to three various FSS (fundamental solution systems) for the homogeneous ODE that corresponds to (9): 1) $\Delta_{tr} > 0$; 2) $\Delta_{tr} < 0$; 3) $\Delta_{tr} \in \mathbb{C}$.

The general solution of (9) will be constructed below for all mentioned cases 1) – 3) by means of the well-known method of the arbitrary constant variations [4]. So, let 1) $\Delta_{tr} > 0$. Then the appropriate FSS is the following:

$$\{e^{\gamma t}; e^{-\gamma t}\}, \tag{11}$$

where:

$$\gamma = \sqrt{\frac{\Delta_{tr}}{\mu_a \varepsilon_a}}, \tag{12}$$

and we look for the general solution of (9) as the functional combination of (11):

$$\Phi(t, p) = C_1(t, p) e^{\gamma t} + C_2(t, p) e^{-\gamma t}. \tag{13}$$

The unknown functions $C_i(t) = C_i(t, p)$ $(i = 1,2)$ are found as the solution of the following system:

$$\begin{cases} C_1'(t) e^{\gamma t} + C_2'(t) e^{-\gamma t} = 0 \\ \gamma C_1'(t) e^{\gamma t} - \gamma C_2'(t) e^{-\gamma t} = f_{tr}^{*} \end{cases}. \tag{14}$$

It is easy to get from (14) that:

$$\begin{cases} C_1(t) = \dfrac{1}{2\gamma}\int e^{-\gamma t} f_{tr}^{*}\mathrm{d}t \\ C_2(t) = -\dfrac{1}{2\gamma}\int e^{\gamma t} f_{tr}^{*}\mathrm{d}t \end{cases}. \tag{15}$$

Therefore, after the substitution of (15) for (13) we have the required function:

$$\Phi(t, p) = \frac{1}{2\gamma}(e^{\gamma t}\int e^{-\gamma t} f_{tr}^{*}(t, p)\mathrm{d}t - e^{-\gamma t}\int e^{\gamma t} f_{tr}^{*}(t, p)\mathrm{d}t). \tag{16}$$

Returning to (8) we obtain the general solution of the ODE (7):

$$F_{tr}(t, p) = \int\int \Phi(t, p)\mathrm{d}t^2 =$$

$$= \frac{1}{2\gamma}\int\int (e^{\gamma t}\int e^{-\gamma t} f_{tr}^{*}(t, p)\mathrm{d}t - e^{-\gamma t}\int e^{\gamma t} f_{tr}^{*}(t, p)\mathrm{d}t)\mathrm{d}t^2, \tag{17}$$

where γ is from (12).

2) Let now $\Delta_{tr} < 0$. Then the roots (10) look like:

$$\pm i\sqrt{\frac{-\Delta_{tr}}{\mu_a \varepsilon_a}} \in \mathbb{C}, \tag{18}$$

where the expression under the symbol of radical is positive and everywhere in the present case 2) $i = \sqrt{-1}$.

We denote:

$$\gamma = \sqrt{\frac{-\Delta_{tr}}{\mu_a \varepsilon_a}} > 0, \tag{19}$$

and the FSS of the corresponding homogeneous ODE for (9) is written below:

$$\{\cos\gamma t \pm i\sin\gamma t\}. \tag{20}$$

Therefore, the structure of the general solution of (9) is represented as:

$$\Phi(t, p) = C_1(t, p)(\cos\gamma t + i\sin\gamma t) + C_2(t, p)(\cos\gamma t - i\sin\gamma t) \tag{21}$$

and the unknown functions $C_q = C_q(t, p)$ $(q = 1,2)$ can be obtained from the following system:

$$\begin{cases} C_1' \ (\cos \gamma t + i \sin \gamma t) + C_2' \ (\cos \gamma t - i \sin \gamma t) = 0 \\ C_1' \ (-\gamma \sin \gamma t + i\gamma \cos \gamma t) + C_2' \ (-\gamma \sin \gamma t - i\gamma \cos \gamma t) = f_{tr}^* \end{cases}, \tag{22}$$

where $C_q' = \dfrac{\mathrm{d}C_q}{\mathrm{d}t}$ $(q = 1,2)$.

After acceptance of the auxiliary notations:

$$D_{1,2} = C_{1,2}'(\mp \sin \gamma t + i \cos \gamma t) \tag{23}$$

we get the equivalent system instead of (22):

$$\begin{cases} D_1 + D_2 = 0 \\ D_1 - D_2 = \dfrac{f_{tr}^*}{\gamma} \cdot \end{cases} \tag{24}$$

Obviously, the solution of (24) in terms of (23) looks as:

$$C_{1,2}' = \mp \frac{f_{tr}^*}{2\gamma} (\pm \sin \gamma t + i \cos \gamma t)$$

and the initially unknown functions for (21) are written below:

$$C_{1,2}(t, p) = \pm \frac{1}{2\gamma} \int (\pm \sin \gamma t + i \cos \gamma t) \, f_{tr}^*(t, p) \mathrm{d}t. \tag{25}$$

Putting (25) into (21), after simple transformation we have:

$$\Phi(t, p) = \frac{1}{y} (\sin(\gamma t) \int (\cos \gamma t) \, f_{tr}^*(t, p) \mathrm{d}t -$$

$$- \cos(\gamma t) \int (\sin \gamma t) \, f_{tr}^*(t, p) \mathrm{d}t). \tag{26}$$

Returning to (8) in terms of (26) we come to the general solution of (7) for the above mentioned case 2):

$$F_{tr}(t, p) = \int \int \Phi(t, p) \mathrm{d}t^2 =$$

$$= \frac{1}{\gamma} \int \int ((\sin \gamma t) \int \cos(\gamma t) \, f_{tr}^*(t, p) \mathrm{d}t - (\cos \gamma t) \int \sin(\gamma t) \, f_{tr}^*(t, p) \mathrm{d}t) \mathrm{d}t^2. \tag{27}$$

Now the last possible variant of Δ_{tr} remains, when 3) $\Delta_{tr} \in \mathbb{C}$. In other words:

$$\frac{\Delta_{tr}}{\mu_a \varepsilon_a} = \alpha + i\beta;\ \alpha = \mathrm{Re}\frac{\Delta_{tr}}{\mu_a \varepsilon_a},\quad \beta = \mathrm{Im}\frac{\Delta_{tr}}{\mu_a \varepsilon_a} \in \mathbb{R}$$

and $i = \sqrt{-1}$ everywhere in this section. (28)

It is easy to find from (28) that:

$$\gamma = \sqrt{\frac{\Delta_{tr}}{\mu_a \varepsilon_a}} = \pm\frac{1}{\sqrt{2}}\left(\sqrt{a + \sqrt{a^2 + \beta^2}} + i\frac{\beta}{\sqrt{a + \sqrt{a^2 + \beta^2}}}\right). \qquad (29)$$

Then the FSS of the appropriate homogeneous ODE for (9) looks like:

$$\{\exp(\pm\gamma_1 t)(\cos(\gamma_2 t) \pm i\sin(\gamma_2 t)\}. \qquad (30)$$

In (30):

$$\gamma_1 = \frac{\sqrt{\alpha + \sqrt{\alpha^2 + \beta^2}}}{\sqrt{2}},\ \ \gamma_2 = \frac{\beta}{\sqrt{2}\sqrt{a + \sqrt{a^2 + \beta^2}}} \ \text{ and } \gamma \text{ is from (29).} \qquad (31)$$

Therefore, the sought for general solution of (9) may be expressed by the formula:

$$\Phi(t, p) = C_1(t, p)\exp(\gamma_1 t)(\cos(\gamma_2 t) + i\sin(\gamma_2 t) +$$

$$+ C_2(t, p)\exp(-\gamma_1 t)(\cos(\gamma_2 t) - i\sin(\gamma_2 t)). \qquad (32)$$

Here $C_{1,2} = C_{1,2}(t, p)$ are the unknown functions that have to be found from the following system:

$$\begin{cases} C_1' \ \exp(\gamma_1 t)(\cos(\gamma_2 t) + i\sin(\gamma_2 t)) + \\ + C_2' \ \exp(-\gamma_1 t)(\cos(\gamma_2 t) - i\sin(\gamma_2 t)) = 0 \\ (\gamma_1 + i\gamma_2)(C_1' \ \exp(\gamma_1 t)(\cos(\gamma_2 t) + i\sin(\gamma_2 t)) + \\ + C_2' \ \exp(-\gamma_1 t)(-\cos(\gamma_2 t) + i\sin(\gamma_2 t))) = f_{tr}^* \end{cases}, \qquad (33)$$

and again as earlier in the case 2) $C_q' = \dfrac{\mathrm{d}C_q}{\mathrm{d}t}$ $(q = 1,2)$.

If we assume that:

$$D_{1,2} = C'_{1,2} \exp(\pm\gamma_1 t)\,(\cos(\gamma_2 t \pm i \sin(\gamma_2 t)); \tag{34}$$

then (33) can be simplified in the equivalent way:

$$\begin{cases} D_1 + D_2 = 0 \\ D_1 - D_2 = \dfrac{f^*_{tr}}{\gamma_1 + i\gamma_2} \end{cases} \tag{35}$$

and the solution of (35) in terms of (34) looks like:

$$C'_{1,2} = \pm \frac{f^*_{tr} \exp(\mp\gamma_1 t)}{2(\gamma_1 + i\gamma_2)(\cos(\gamma_2 t) \pm i \sin(\gamma_2 t)}. \tag{36}$$

Further the initial unknown functions $C_{1,2}$ can be expressed by means of (36):

$$C_{1,2} = \pm \frac{1}{2(\gamma_1 + i\gamma_2)} \int \frac{\exp(\mp\gamma_1 t)\, f^*_{tr}(t, p)\mathrm{d}t}{\cos(\gamma_2 t) \pm i \sin(\gamma_2 t)}. \tag{37}$$

Hence, due to (37) we get the explicit required function (32) that after easy simplification looks like:

$$\Phi(t, p) = \frac{1}{2\gamma}(e^{\gamma t} \int e^{-\gamma t} f^*_{tr}(t, p)\mathrm{d}t - e^{-\gamma t} \int e^{\gamma t} f^*_{tr}(t, p)\mathrm{d}t) \tag{38}$$

and $\gamma = \sqrt{\dfrac{\Delta_{tr}}{\mu_a \varepsilon_a}} \in \mathbb{C}$ is defined by (28), (29), (31).

At last, turning to (8) and using (38) we come to the general solution of (7):

$$F_{tr}(t, p) = \int\int \Phi(t, p)\mathrm{d}t^2 = \frac{1}{2\gamma}\int\int (e^{\gamma t} f^*_{tr}(t, p)\mathrm{d}t - e^{-\gamma t} \int e^{\gamma t} f^*_{tr}(t, p)\mathrm{d}t)\mathrm{d}t^2, \tag{39}$$

where γ has the same values as previously in (38).

Comparing (39) and (17) it is easy to notice that in two studied cases 1) and 3) when $\gamma \in \mathbb{R}$ and $\gamma \in \mathbb{C}$ respectively the sought for general solution of (7) can be written uniformly, just as:

$$F_{tr}(t, p) = \frac{1}{2\gamma}\int\int (e^{\gamma t} \int e^{-\gamma t} f^*_{tr}(t, p)\mathrm{d}t - e^{-\gamma t} \int e^{\gamma t} f^*_{tr}(t, p)\mathrm{d}t)\mathrm{d}t^2. \tag{40}$$

Here $\gamma \in \mathbb{R}_+, \mathbb{C}$ and is described by (12) and (29).

After application to (40) and (27) of the inverse integral transformations that correspond to the initial ones which were used for the spatial coordinates $(x, y, z,)$ we get the explicit solution of the original PDE (5) for all possible cases 1-3.

4. Undisturbed isotropic homogeneous linear medium

Now the next approach of our study begins and it concerns the case of the linear homogeneous isotropic undisturbed medium when the outside currents exist. In comparison with the previous section 3 it implies that all assumptions which were accepted for the PDE (5) remain the same and only $\sigma \neq 0$.

The first impression of this generalization is its ridiculous simplicity and it seems that there is nothing to do. The structure of the general investigated PDE (4) justifies the considered case of $\sigma \neq 0$ completely, since we shall deal here with the PDE of the fourth order that looks like:

$$\partial_0\left(\partial_0 + \frac{\sigma}{\varepsilon_a}\right)\left(\partial_0\left(\partial_0 + \frac{\sigma}{\varepsilon_a}\right) - \frac{\Delta}{\mu_a\varepsilon_a}\right)F = \frac{f}{\mu_a^2\varepsilon_a^2}, \tag{41}$$

where functions F, f and all other objects have the same meaning as in (4), (3). Only the explicit expression of the given function f differs from (6) considerably because of the partial differential operator:

$$\widetilde{\partial}_0^2 = \varepsilon_a\mu_a\partial_0\left(\partial_0 + \frac{\sigma}{\varepsilon_a}\right) \tag{42}$$

that is present in the below written formula of f and though the vector functions $\overrightarrow{\varphi_i}$ $(i = 1,2)$ coincide with their values from (6) completely. Namely:

$$f = (\partial_k^2 - \widetilde{\partial}_0^2)\varphi_{ik} + \partial_k(\partial_v\varphi_{iv} + \partial_l\varphi_{il})$$

$$v \neq l,\ k \neq l,\ k \neq v\ (k, v, l = \overline{1,3};\ i = 1,2). \tag{43}$$

After application to (41) of the necessary integral transformations on the spatial coordinates (x, y, z) we come to the corresponding ODE of the

fourth order just as in the preceding section 3, but in the present generalized variant:

$$\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}}{\mathrm{d}t}+\frac{\sigma}{\varepsilon_a}\right)\left(\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}}{\mathrm{d}t}+\frac{\sigma}{\varepsilon_a}\right)-\frac{\Delta_{tr}}{\mu_a^2\varepsilon_a}\right)F_{tr}=\frac{f_{tr}}{\mu_a^2\varepsilon_a^2}. \tag{44}$$

Here the transformants of the unknown $F_{tr}=F_{tr}(t,p)$ and given $f_{tr}=f_{tr}(t,p)$ scalar functions depend only on the time coordinate t in the meaning of the derivation in (44).

Obviously, the order of (44) can be lessened as follows:

$$\left(\frac{\mathrm{d}}{\mathrm{d}t}+\frac{\sigma}{\varepsilon_a}\right)\left(\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}}{\mathrm{d}t}+\frac{\sigma}{\varepsilon_a}\right)-\frac{\Delta_{tr}}{\mu_a\varepsilon_a}\right)F_{tr}=\frac{\tilde{f}_{tr}}{\mu_a^2\varepsilon_a^2},$$

$$\tilde{f}_{tr}=\tilde{f}_{tr}(t,p)=\int f_{tr}(t,p)\mathrm{d}t, \tag{45}$$

but no more at the current stage of research.

After evident transformation of (45) we obtain the equivalent ODE:

$$B\left(\left(B-\frac{\sigma}{\varepsilon_a}\right)B-\frac{\Delta_{tr}}{\mu_a\varepsilon_a}\right)F_{tr}=\frac{\tilde{f}_{tr}}{\mu_a^2\varepsilon_a^2}, \tag{46}$$

where the linear differential operator:

$$B=\frac{\mathrm{d}}{\mathrm{d}t}+\frac{\sigma}{\varepsilon_a}. \tag{47}$$

Putting:

$$BF_{tr}=\chi=\chi(t,p) \tag{48}$$

we decrease the order of (46) and get the following ODE of the second order:

$$\chi''-\frac{\sigma}{\varepsilon_a}\chi'-\frac{\Delta_{tr}}{\mu_a\varepsilon_a}\chi=\frac{\tilde{f}_{tr}}{\mu_a^2\varepsilon_a^2}, \tag{49}$$

and $\chi'=\dfrac{\mathrm{d}\chi}{\mathrm{d}t}$, $\chi''=\dfrac{\mathrm{d}^2\chi}{\mathrm{d}t^2}$.

It is easy to find that the characteristic equation of (49) has two simple roots:

$$\omega_{1,2}=\frac{\sigma}{2\varepsilon_a}\left(1\pm\sqrt{1+\frac{4\varepsilon_a}{\mu_a\sigma^2}\Delta_{tr}}\right), \tag{50}$$

and their set properties depend only on the values of Δ_{tr}, since $\sigma, \varepsilon_a, \mu_a > 0$ by the initial conditions from (1). Therefore, we come again to three existing possibilities for (50), just as:

$$1)\quad 1+\frac{4\varepsilon_a}{\mu_a\sigma^2}\Delta_{tr} > 0 \;\Leftrightarrow\; \Delta_{tr} > -\frac{\mu_a\delta^2}{4\varepsilon_a}. \tag{51}$$

So, Δ_{tr} is the arbitrary real $(\Delta_{tr} \in \mathbb{R})$ but satisfies (51).

$$2)\quad 1+\frac{4\varepsilon_a}{\mu_a\sigma^2}\Delta_{tr} < 0 \Leftrightarrow\; \Delta_{tr} < -\frac{\mu_a\delta^2}{4\varepsilon_a} < 0\,. \tag{52}$$

Here $\Delta_{tr} \in \mathbb{R}$ because of the fraction $\frac{\mu a^{\sigma^2}}{4\varepsilon_a}$ has original positive value.

$$3)\quad 1+\frac{4\varepsilon_a}{\mu_a\sigma^2}\Delta_{tr} \in \mathbb{C} \;\Leftrightarrow\; \Delta_{tr} \in \mathbb{C}\,, \tag{53}$$

since $\frac{\mu_a\delta^2}{4\varepsilon_a} > 0$ by (52) at least.

The general solution of (49) will be found again by the method of the arbitrary constant variations [4] as it was done at the former section 3.

From the very beginning we shall study the simplest of the above mentioned cases – 1) $\forall\ \Delta_{tr} > -\frac{\mu_a\delta^2}{4\varepsilon_a} \in \mathbb{R}$.

Then the FSS of the respective homogeneous ODE for (49) is represented below:

$$\{\exp(\omega_1 t), \exp(\omega_2 t)\}, \tag{54}$$

$\omega_{1,2} \in \mathbb{R}$ are from (50) and it is clear that $\omega_1 > 0,\ \omega_2 < 0$. Therefore, the general solution of (49) is sought as the functional combination of (54):

$$\chi(t, p) = C_1 \exp(\omega_1 t) + C_2 \exp(\omega_2 t)\,, \tag{55}$$

where $C_q = C_q(t, p)$ $(q = 1,2)$ are the unknown functions and we should to remind that p is the set of parameters of the relevant integral

transformations that were applied earlier to the PDE (41) by its spatial coordinates (x, y, z). Functions C_q $(q = 1,2)$ form the solution of the following ODEs system [4]:

$$\begin{cases} C_1' \ \exp(\omega_1 t) + C_2' \ \exp(\omega_2 t) = 0 \\ \omega_1 C_1' \ \exp(\omega_1 t) + \omega_2 C_2' \ \exp(\omega_2 t) = \dfrac{\tilde{f}_{tr}}{\mu_a^2 \varepsilon_a^2}, \end{cases} \tag{56}$$

and $C_q' = \dfrac{dC_q}{dt}$ $(q = 1,2)$. It is easy to verify that:

$$C_{1,2} = \pm \frac{1}{(\omega_2 - \omega_1)\mu_a^2 \varepsilon_a^2} \int \exp(\omega_{1,2} t)\, \tilde{f}_{tr} \mathrm{d}t \tag{57}$$

and satisfy (56) completely. Then the required general solution of (49) in the present case 1) is written by means of (55), (57):

$$\chi(t, p) = \frac{1}{(\omega_2 - \omega_1)\mu_a^2 \varepsilon_a^2} \left(\exp(\omega_2 t) \int \exp(-\omega_2 t) \tilde{f}_{tr} \mathrm{d}t - \right.$$

$$\left. - \exp(\omega_1 t) \int \exp(-\omega_1 t)\, \tilde{f}_{tr} \mathrm{d}t \right) \tag{58}$$

and really satisfies (49), since $\omega_{1,2}$ are the roots of the characteristic equation of (49) that is shown below:

$$\omega^2 - \frac{\sigma}{\varepsilon_a} \omega - \frac{\Delta_{tr}}{\mu_a \varepsilon_a} = 0. \tag{59}$$

Thus, the function χ from (48) is described by (58) explicitly and the initially required function F_{tr} can be found as the solution of the following ODE by means of the operator (47):

$$F_{tr}' + \frac{\sigma}{\varepsilon_a} F_{tr} = \chi, \ \ F_{tr}' = \frac{\mathrm{d}F_{tr}}{\mathrm{d}t}. \tag{60}$$

Here χ is the known function from the formula (58). It is easy to notice that (60) is the linear inhomogeneous ODE of the first order with the constant coefficients. Hence, its solution looks like

$$F_{tr} = F_{tr,g} + F_{tr,0} \tag{61}$$

where $F_{tr,\,g}$, $F_{tr,\,0}$ are the general solution of the homogeneous ODE that corresponds to (60) and the particular solution of (60) respectively. So, by the well-known methods [4] we find:

$$F_{tr,g} = C\exp\left(-\frac{\sigma}{\varepsilon_a}t\right),\ \forall C = cons \in \mathbb{R} \tag{62}$$

and:

$$F_{tr,0} = \exp\left(-\frac{\sigma}{\varepsilon_a}\right)\int \exp\left(\frac{\sigma}{\varepsilon_a}t\right)\chi \mathrm{d}t. \tag{63}$$

Using (61)-(63) and (58) we obtain the explicit expression of the sought for function (61) that represents the general solution of the ODE (45) in the recently mentioned case *1)* of the present section 4:

$$F_{tr} = C\exp\left(-\frac{\sigma}{\varepsilon_a}t\right) +$$

$$+\frac{\exp\left(-\frac{\sigma}{\varepsilon_a}t\right)}{(\omega_2-\omega_1)\mu_a^2\varepsilon_a^2}\int \exp\left(\frac{\sigma}{\varepsilon_a}t\right)(\exp(\omega_2 t)\int \exp(-\omega_2 t)\,\tilde{f}_{tr}\mathrm{d}t -$$

$$-\exp(\omega_1 t)\int \exp(-\omega_1 t)\,\tilde{f}_{tr}\mathrm{d}t)\mathrm{d}t.$$

The above mentioned remained cases *2), 3)* of the current section 4 are also investigated in detail but are not shown here because for the lack of space. After application to the last formula of the inverse integral transformations with respect to the initial ones that were used by the spatial coordinates (x, y, z) we come to the explicit solution of the original PDE (41) in the case *1)* of the present section 4.

5. Conclusion

The proposed solution and present results do not depend on the character of the initial and boundary conditions in the both considered cases of the medium from the sections 3, 4. Hence, the obtained formulas can be used directly for industrial applications and only the correct integral transformations by the spatial coordinates (x, y, z) must be taken into account.

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THE PROCESS ORIENTED FAULT-TOLERANCE OF THE COMPLEX ECONOMIC SYSTEMS

Ioana ARMAŞ*

Abstract. *The complex economic systems represents the main context that form an important part of the human society, and that determine the other dimensions regarding the society, these determinations being more acutely observed in the perspective of globalization. In this context becomes critical to consider the economical systems through their complexity, but also, as artificial systems that can be designed and controlled based on the objective laws that governs them, such that their functions to the society and individuals is optimal and positive. In this context the safety problem should be considered, and its corresponding solution of fault-tolerance must be integrated and developed in the complex economic systems. From this point of view, this paper proposes a specific safety analysis of the complex economic systems and the application of the process oriented approach for the fault-tolerance of the complex economic systems, such that a desired positive evolution of the complex economic systems in the present framework of globalisation will be obtained.*

Keywords: *complex economic systems, fault-tolerance, synergy, safety, economic systems design.*

1. Introduction

The complexity of the economic systems becomes a new dimension of our world development and future, that has important influences in the global evolution of the human society. In this context, considering the system theory and models in the representation and analysis of the economic reality, the design and development of the artificial systems with various objectives and functionalities becomes an important problem, considering that hey are building a new reality of actions, relations, evolution, and even of social existence.

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From this point of view, the aspects regarding safety as the expression of trust in these systems and their performed functions is a critical problem that must consider both the complexity of the context and the fault-tolerance capabilities as the expression of working in the presence of faults / errors.

2. The complexity problem

The attribute of complexity has many interpretations, according to the context considered. From the systemic point of view and taking into account the safety problem, the following dimensions of complexity are proposed:

1. The functional complexity that implies at least one feedback and the control and decision capabilities at the system level.

2. The structural complexity is determined by a large number of components and interconnections. It should be noticed that structural complexity does not necessarily imply functional complexity.

3. Heterogeneity represents the presence in the construction of a system of different types of functions and accordingly, of components that appertain to different disciplinary domains.

4. Synergy determines the creation of a new level of the economic systems construction through collaboration, communication, cooperation, (self) organization, and (self) structuration.

5. Evolution or dynamics represent the capabilities to develop different properties, structures, or even functions, such that the initial construction of the economic system is modified by the system itself.

6. The transdisciplinarity level represents the number of reality levels integrated in the context, a reality level being defined as a set of systems that are invariant to the actions of some general laws (e.g. technical, social, cultural, economical, ethical, educational etc.).

According to the above determined dimensions, results that the complex economic systems integrate all the identified characteristics (Fig. 1).

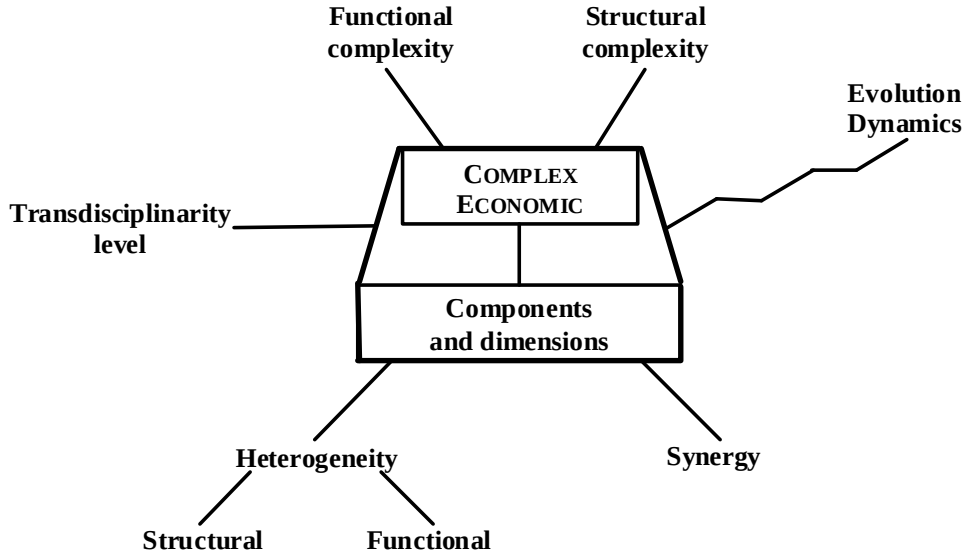

Figure 1. The complexity dimensions of the economic systems.

3. The safety of the complex economic systems

As any developed system, the economic ones may be considered through their specific states that can be classified in three main categories:

a) the correct states regarding functions and/or dynamics that are performed according to the accepted specifications of the system;

b) the faulty or erroneous states for which the behavior of the system does not correspond to the accepted functions and/or dynamics;

c) the maintenance states that are oriented to 'repair' the errors or faults of the system and to preserve the trajectory of the desired evolution.

All the states of a complex economic system at different moments and in different time intervals correspond to these categories, such that their succession in time through transitions in the state space determines the real trajectory of the system.

In this context, it should be considered that any complex economic system integrates humans, being based on specific relations between individuals and organizations, and also represent a 'product' that offers specific services to the human society and to the every individual (Fig. 2).

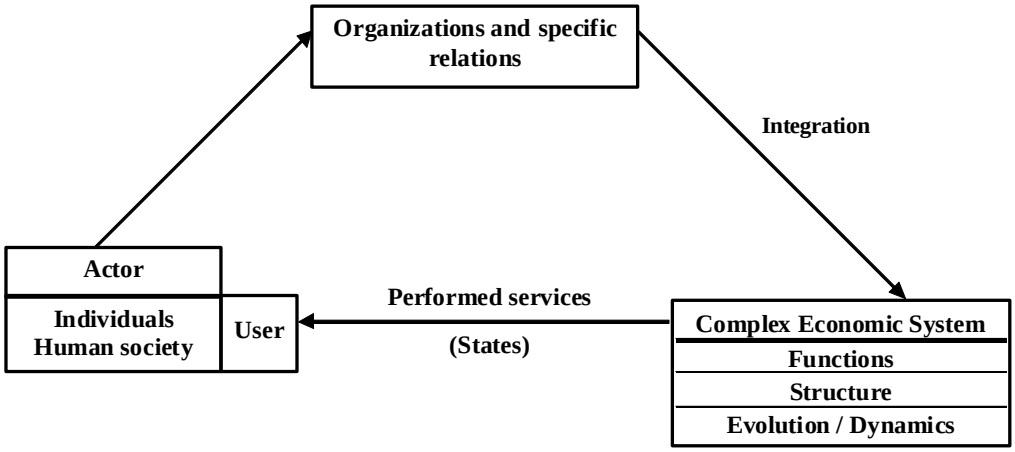

Figure 2. The human factor – complex economic system relation.

From figure 2 results that any state transition of the complex economic systems determines responses at the human society level, fact that imposes to consider the trust in the functions and dynamics / evolution of the complex economic systems. At the system level, the users' trust in complex economic systems is integrated in the **safety** concept defined as following:

Definition 1. The safety of a complex economic system represents its properties that permit the user to consider it in all its dimensions with a justified trust.

Definition 2. The safety of a complex economic system represents its capability to perform correctly its functions at a given moment and in a given time period, if it is used in the specified conditions, to perform selftesting, and selfdiagnosis of the present faults or errors, with selfreparation, reconfiguration or by blocking its erroneous functions (error oriented fail safe).

According to the above definitions, the safety dimensions can be determined from two points of view: the user, and respectively, the complex economic system.

For the **user** the safety of the complex economic systems is perceived through the performed services, and the corresponding dimensions are identified as following:

U1. *The reliability* – the service is uninterrupted.

U2. *The availability* – the service can be performed at a given moment.

U3. *The security* – the losses associated to the faults or errors of the service.

U4. *The informational security* – the integrity and confidentiality of the information corresponding to the performed service.

U5. *The credibility* – the complex economic system does not perform undetected erroneous services.

U6. *The diagnosability* – the possibility to identify the process of the service that is not performed according to the specifications and to the corresponding users' requests.

U7. *The independence of the service regarding some faults or errors* – the service is performed even if some processes are defective, being possible that some performance parameters to be degraded.

U8. *The conformity degree* – the performance characteristics of the service, at a given moment, correspond to the specifications and their accepted tolerances.

For the internal context of the **complex economic systems** the safety is considered through the following dimensions:

E1. *The reliability* – the functioning of the system is continuous.

E2. *The availability* – the functioning is correct at a given moment.

E3. *The security* – the losses associated to the faults or errors of the complex economic system.

E4. *The informational security* – the integrity and confidentiality of the information corresponding to the functions performed by the complex economic system.

E5. *The detection capability* – there a not faults or errors in the complex economic system that are not identified.

E6. *The diagnosability* – the possibility to identify the causes and the defective components that determined the fault or error of the complex economic system.

E7. *The capability to cover the errors / faults* – the complex economic system functions correspondingly to the specifications in the presence of some known, detectable, and reparable defects.

E8. *The reconfiguration capability* – the inner structure and interconnections of the complex economic system can be modified, such that, in the presence of some faults, the system is functioning correspondingly to the specifications, or in an accepted degraded manner.

E9. *The selftestability* – the capability of the complex economic system to identify its states or the states of its components.

E10. *The predictability* – the capabilities of the complex economic system to determine its future states based on the information regarding the dynamics of its inner and external parameters until a given moment.

E11. *The conformity degree* – the performance characteristics of the complex economic system, at a given moment, correspond to the specifications and their accepted tolerances.

Between the above two perspectives U1 ÷ U8, and E1 ÷ E11 can be established the correspondence relationships, as in figure 3, based on which the safety requests from the user's point of view can be translated at the level of the complex economic system, and reciprocal, the specifications of the complex economic system can be expressed in terms of safety of the services offered to the user.

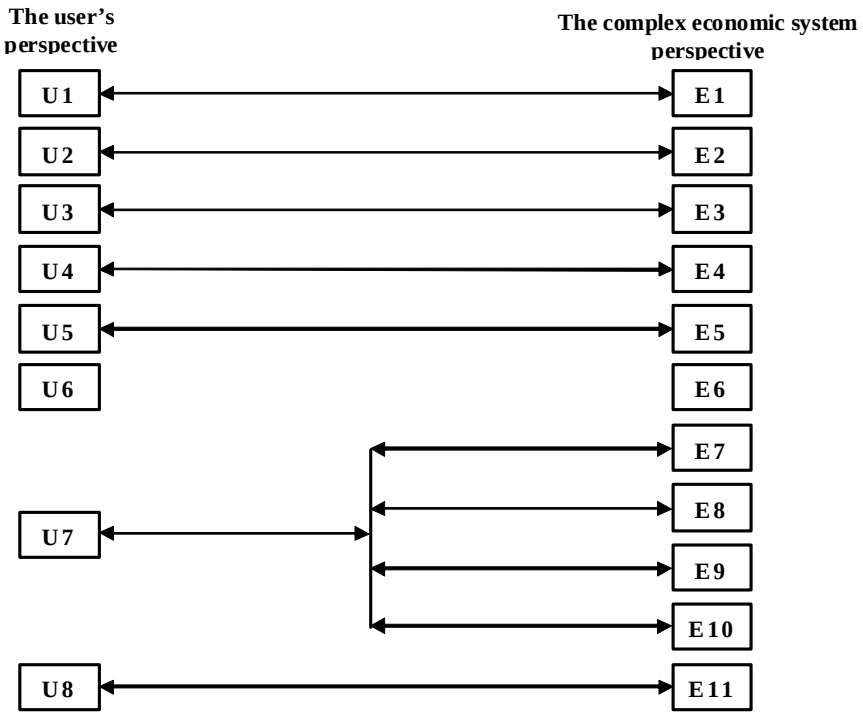

Figure 3. The relations between the user's perspectives (U1 ÷ U8), and the complex economic system perspective (E1 ÷ E11) of the safety concept.

Thus, the following safety solutions for complex economic systems are identified:

a) the solutions user / service oriented, that considers the dimensions U1 ÷ U8;
b) the solutions oriented to the structure and functions of the complex economic system, that considers the dimensions E1 ÷ E11, both these perspectives must be integrated in order to obtain a **global safety solution** of the complex economic systems, as in figure 4.

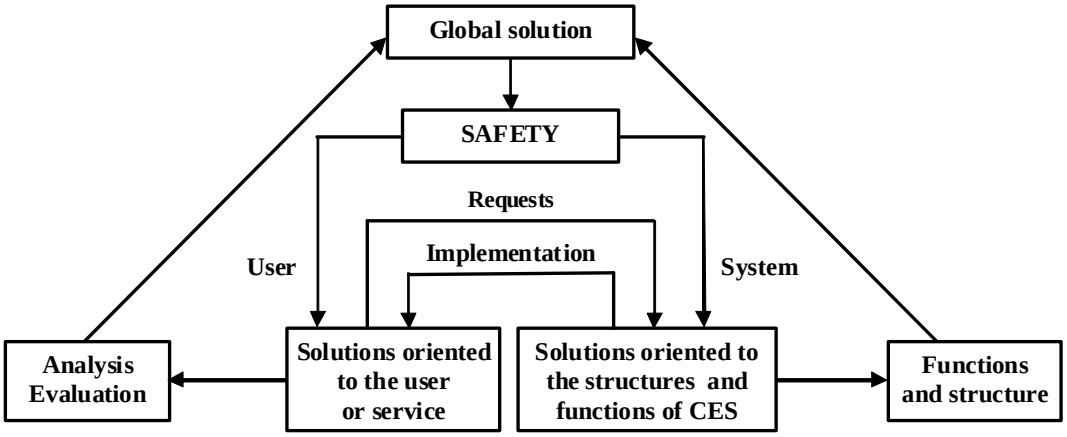

Figure 4. The global safety solution for a complex economic system (CES).

4. The fault-tolerance of the complex economic systems. The process oriented approach

The global safety solutions are implemented by developing the fault-tolerance concept that will represent the basis to develop complex economic systems able to work tolerable in the presence of defects and/or errors. The corresponding adopted definitions are:

Definition 3. The fault-tolerance of a complex economic system represents its capability to function in acceptable limits of performance in the presence of some specified defects or errors.

Definition 4. The fault-tolerance of a complex economic system represents a method of corrective (or preventive) maintenance that actions simultaneously with the service delivered by the system and in an invisible manner for the user.

According to the above definition, in [1] the main principles of the fault-tolerance development and implementation were determined, and these are applicable to the complex economic systems also:

Principle 1. The safety of a complex economic system is positively dependent with its reliability. Thus, the safety is improved if the intrinsic reliability is sufficiently high.

Principle 2. The fault-tolerance is obtained at the detailed structural and functional level of the complex economic system.

Principle 3. The efficiency of a fault-tolerance solution increase, and its action are effective for a longer period of time if the defective components are identified and replaced or repaired.

Principle 4. The development of any fault-tolerance solution should be process oriented, such that the structure of the complex economic system does not induce a segmentation of the constitutive processes.

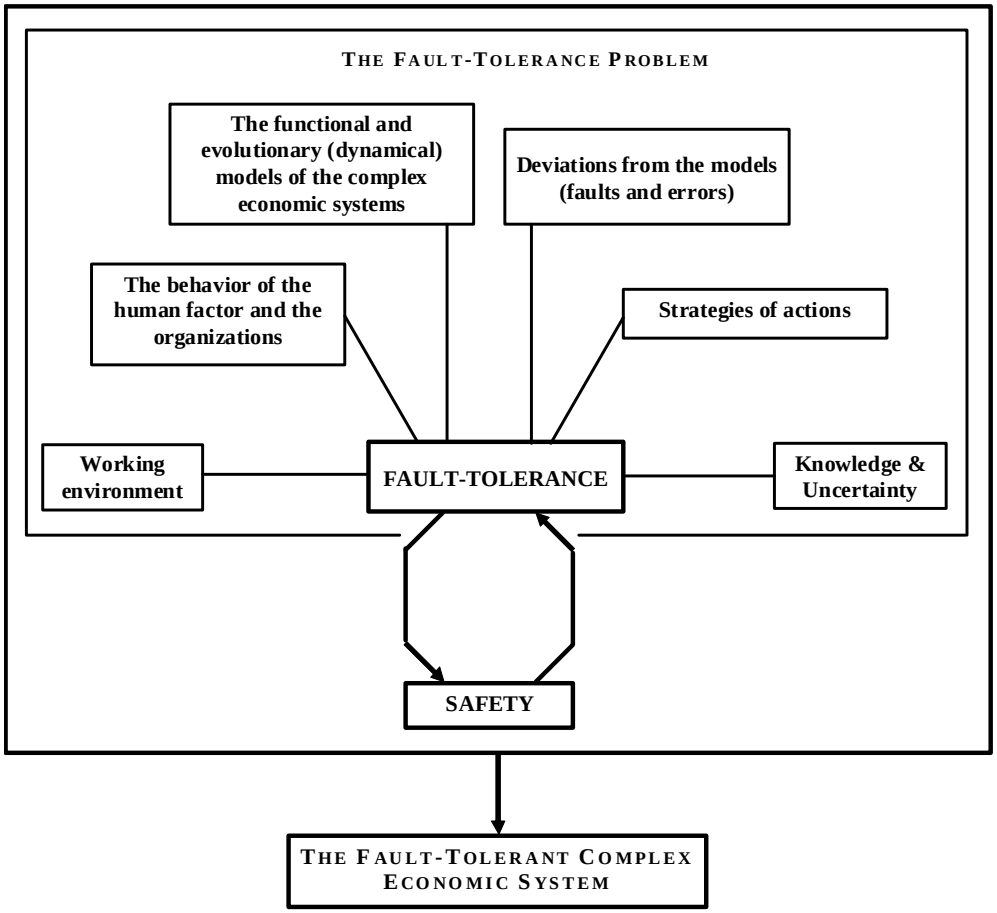

Figure 5. The framework of the relations between fault-tolerance and safety in developing the fault-tolerant complex economic system.

From this point of view, the relations between fault-tolerance and safety is according to the framework presented in figure 5, were are highlyghted the components of the fault tolerance problem:

- the working environment (cultural, technical, social etc.) of the complex economic system, and the relations between them;
- the behavioral characteristics of the human factor and organizations both as components of the complex economic system, and as its users;

- the functional and evolutionary (dynamical) models of the complex economic system, corresponding to the desired behavior of the system in time and space (environment);
- the types of faults and errors as the manifestations of the system's deviations from the models;
- the strategies of actions, their planning, that are executed at the internal level of the complex economic system;
- the knowledge requirements, and its limitations and uncertainties, considering that all the involved actions are generally characterized by incomplete knowledge.

According to the 4th principle determined in [1], results that for the complex economic systems the fault-tolerance should be developed in a process oriented manner, based on the process map represented in figure 6, were the processes are defined as in table 1.

Table 1

The definitions of the fault-tolerance processes

The fault tolerance process	Definition
The communication process	Data and information transmission between the complex economic system and the internal and external working environments, the human factor, and the organizations.
The detection process	A classification of the behaviors and/or states of the complex economic system, as accepted or erroneous relative to the function performed (delivered services).
The diagnosis process	The actions regarding the determination of faults causes and their locations.
The decision process	The solution identification of a problem, and the planning of the actions to be taken in order to implement the determined solution at the complex economic system level.
The reconfiguration process	The realization of the necessary actions for stopping the error propagation to the output of the system
The learning process	The human, organizational and/or artificial (artificial intelligence) actions of knowledge acquisition, organization, integration, and abstraction.

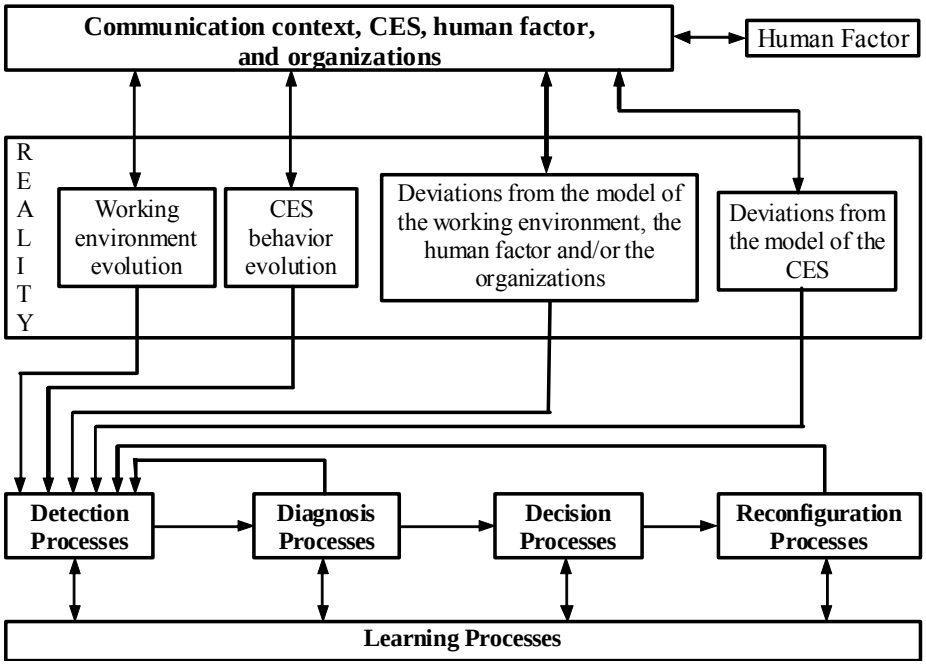

Figure 6. The process map of the global fault-tolerance solution of a complex economic system (CES).

The created context determines the necessity to develop / design the complex economic systems considering both their functions that deliver the corresponding services, and the functions that implement the process oriented fault tolerance (as in figure 6) that are able to 'deliver' the safety dimensions.

According to the general results in the process oriented fault-tolerance approach [1, 2], the development of the corresponding solutions for the complex economic systems must consider the following design principles:

DP-1. The fault-tolerance of any complex economic system is one of its functions, and accordingly must be correlated with the global functions determined by the definition of the service delivered by the considered system.

DP-2. All the functions (i.e., the global ones, and the fault-tolerance) will be represented by their dominant processes, and the corresponding process maps will be determined at both levels. This means that for the existing complex economic systems is necessary an reengineering stage to determine the corresponding dominant processes that will realize the global functions (service), in order to eliminate the useless processes or segmentations, and only after that the fault tolerance process map will be considered and developed.

DP-3. The processes determined at DP-2 will be unified, integrated and, eventually, if absolutely necessary, segmentation will be applied, such that a global process representation of the fault-tolerant complex economic system will be obtained.

DP-4. The corresponding relations between the processes of the global complex economic system representation will be integrated in the global process map of the fault-tolerant complex economic system.

DP-5. Based on the definition of the complex economic system at the process level, the corresponding architecture will be established and, consequently, the structural design including directions, organizations, and departments will be developed, such that the result will be the functional – structural fault-tolerant complex economic system.

According to these design principles, the general framework design of the fault-tolerant complex economic system will correspond to figure 7.

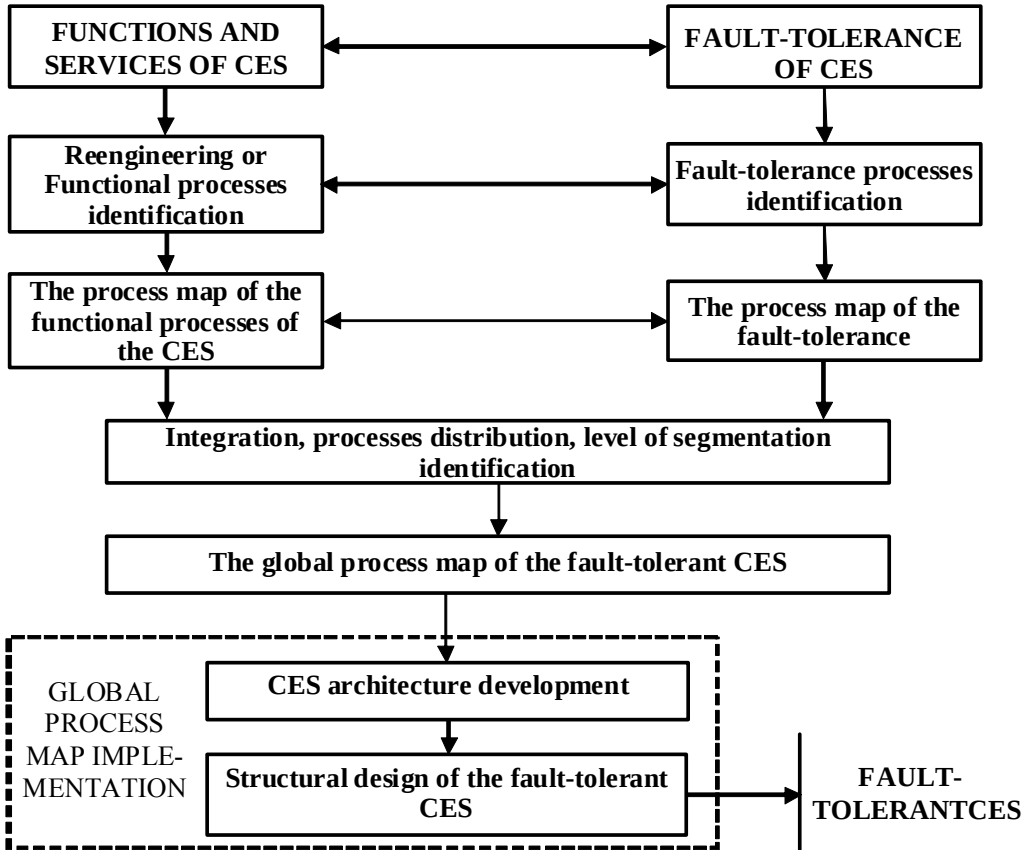

Figure 7. The general framework design
of the fault-tolerant complex economic system (CES).

5. Conclusions

The safety problem of the complex economic systems must be considered in the present context of globalization.

In the present paper a corresponding solution by using the process oriented approach for fault-tolerance design is developed. Thus, results that the complex economic systems can be modeled and developed in the general frameworks of design, such that the desired functions will be obtained and the effects of faults / defects and errors will be eliminated or diminished.

The proposed solution can be applied for redesign the existing complex economic systems or for designing new ones, is compatible to the general system theory, and represents a new vision of the complex economic systems as 'products' offered to the society as a base of its future evolution.

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ON COMPLEXITY IN SOCIAL STUDIES, THE CASE OF UNEVEN DEVELOPMENT*

Valentin COJANU**

Abstract. *Unevenness seems to control, besides material prosperity, important characteristics of social life as well; there is a pervading popular sense of accidental, inevitable evolutions that govern people's life along imbalanced and probably undeserved destines. This paper attempts to dismiss one common view that there is a tension between 'formal' and 'verbal' models of cumulative causation. Economic modelling as much as historical social analysis may be misleading and at any rate futile provided that one continues to think of economic evolutions in the logic of 'physical' imagery of the natural systems as is suggested by their common recourse to complexity studies' language, mindset, and analytical discourse. The complexity-based argumentative mode reveals inconsistencies in terms of both subject matter and methodology and outlines an incomplete epistemological context in the study of social evolutions as suggested by the theory of uneven development.*

Keywords: *high development theory; world-system analysis; complexity; cumulative causation; epistemology; social evolutions.*

1. Introduction

Uneven development is a result of historical evolutions relative to cumulative acquisition or deprivation of wealth usually assumed to occur within a large geographical area and over a sufficiently long period of time. The topic provokes an elementary question: why should "uneven development" require a different treatment as subject matter than, say, more neatly elaborated alike topics such as "economic growth" or even "development economics" *per se*? The scientific discourse has not been deprived of attempts that seem to have eventuated in settled analytical

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frameworks. Out of these traditions, two theoretical schemas stand out for their encompassing explanatory power: the economic modelling of 'high development theory' (HDT) and the analytics of historical social systems encapsulated by the 'world-system analysis' (WSA).

We argue that the epistemological basis of inquiry in the study of social evolutions can be enhanced by a contrasting perspective of these modes of argumentation. Radically opposing methodological approaches take the two visions apart. As Krugman repeatedly informs, the central feature of enquiry in his tradition – its *differentia specifica* – consists of the fundamental role formalism plays in guiding the investigation towards useful insights, "to help bridge the congenital communication gap between the social and physical sciences" (1994) and to put forth ideas "in the kind of tightly specified models...increasingly becoming the unique language of discourse of economic analysis" where "good mainstream" economics is equated to "full formal models" (2004). The world-system analyst is proposed in her turn a theoretical schema endowed with its own unit of analysis (the 'world-system'), language, method, and core assumptions (cf. Wallerstein, 1974, 349 and Wallerstein, 2004b, 17, 97ff) in opposition to "the dominance of one particular mode of scientific method (which we may label simplistically 'Newtonian'), which has claimed to be the only legitimate mode of scientific behaviour" (Hopkins and Wallerstein, 1996, 7).

We are in the presence of two reputed bodies of knowledge which ignore one another by virtue of a self-professed claim to *the correct approach*. The more so intriguing, three similarities along their respective paths of inquiry startle any observer, namely the question they ask, the answer they find, and the wholeheartedly embrace of complexity studies' epistemic insights.

The next section proceeds with an overview of these similarities and attempts to dismiss one common view that there is "a tension between 'formal' and 'verbal' models of cumulative causation" (cf. Setterfield, 2001). The discussion shows instead that the theory of uneven development is built on an equally shared core set of consolidated premises. On this basis, it is subsequently put forth a criticism of the two bodies of knowledge. We propose a more radical observation which does not partake of those opinions that attempt to find a right balance between quantitative and interpretive methods in the study of historical evolutions. Economic modelling as much as historical social analysis may be misleading and at any rate futile provided that one continues to think of economic evolutions

in the logic of 'physical' imagery of the natural systems as is suggested by their common recourse to complexity studies' language, mindset, and analytical discourse. Of particular interest here, the comparison between their argumentative modes reveals inconsistencies in terms of both subject matter and methodology and outlines a different epistemological context in the study of economic evolutions as hitherto suggested by the theory of uneven development.

2. The common language of uneven development

The theory of uneven development is obviously inspired by uncontested evidence of increasing differentiation between aggregate economies in historical time. What does it take for a historical accident to propel some countries or regions on the path of development much faster than others? And, following Kaldor's (1960) search for "an alternative theoretical scheme", why things "happen in a certain way and why they do not happen in some other way?" (p. 247). These are the very questions to which, as is going to become evident along the way, both modes of theorizing have proposed an encompassing set of answers that have made them so prominent.

In both perspectives, the theory of uneven development grew out of a familiar set of ideas built on the core concept of *circular cumulative causation* (CCC). We channel the discussion towards the common embrace of 'the science of complexity'– often used interchangeably with 'chaos theory'– a choice that fittingly sheds light on the underlying rationale of uneven development.

The common language of cumulative causation has been a working hypothesis in mathematical writings at least since Jules Henri Poincaré (*Science et méthode*, 1908) asserted:

"A very small cause which escapes our notice determines a considerable effect that we cannot fail to see, and then we say that the effect is due to chance...It may happen that small differences in the initial conditions produce very great ones in the final phenomena. A small error in the former will produce an enormous error in the latter. Prediction becomes impossible..." (quoted by Gleick, 1987, 321).

The mathematical branches of topology and non-linear dynamic systems, which led Poincaré to fame and inspired him the above thoughts, as well as insights from then newly nascent physics of thermodynamics, have so begun providing answers to a scientific study of chaotic behaviour of complex systems. Its mathematical apparatus' capability to substitute

the rules of reversibility and determinism for those of irreversibility and randomness (Prigogine and Stengers, 1984, 8), as well as to depict 'out of chaos' emergence of "rich kinds of behaviour that never occur in linear systems" (Gleick, 1987, 24) has made a strong appeal to scholars in both traditions.

In trying to make sense of the logic of *unpredictability* that so manifestly affect development in its various materializations, both modes of theorizing have seized this methodological alternative that seems to reflect at best a twofold epistemological concern for (1) a valid replacement to justify their overt dissatisfaction against the mainstream view; and (2) an original, insightful conceptual thinking able to embody at once both causal explanation and accidental occurrences.

What one eventually gets consists of two distinct analytical frameworks erected on the common logic of historical accident and indeterminate evolutions. In quantitative tradition, the problem of inquiry arises as an intellectual artefact, under no spatial or temporal conditionality; for world-systems analysts, the experience of uneven development is a dual reality, of systemic and of historical change.

The mathematical models of complexity lend themselves so persuasively to the social study thanks to their feature to resemble real-world phenomena. For example, the asymptotical process intrinsically associated with chaos modelling shows that the developmental gaps widen until dampened by countervailing processes. In historical evolutions this belief in progress or in the ineluctability of catching-up embedded capabilities seems to be the analyst's will-o'-the-wisp. While still remains subject to unpredictable evolutions, the modelled action of countervailing processes that close off the endless accumulation of advantage allows for patterns of periodic reconfigurations of spatial economy in a way which seems to be hard to include, for example, in orthodox convergence models.

In another instance, the 'nonlinear' mechanism is apt to lead to a life-resembling representation by using difference instead of differential equations and hence enabling the process of evolution, be it natural, biological or social, to make jumps from state to state instead of changing smoothly (cf. Gleick, 1987, 61). Evolution proceeds through feedback loops, that continuously reinsert end results as *new* values of the parameters in the system, and is so able to produce *novelty*, of which no foreknowledge is possible. Further still, non-linearity leads to points of bifurcation, that is, points where there are two equally valid solutions for the equations, critical states of evolutions at which established configurations are no longer sustainable. Which equilibrium – read *high* or

low level of development – the economy ends up, runs the argument, depends on the previous history of the system, which in fact is a very technical issue reducible to the change of parameters and endless computer simulations. As the story goes on, *the history* so understood may illustrate at once a recurring narrative of punctuated equilibrium, of growth and decay, and an irreducible random element of historical accidents leading to long-run cumulative consequences.

Scattered analytical narratives have been used in the WSA tradition to depict a historically thick part of the reality as it became to emerge from the sixteenth century on: three different modes of labour control (i.e. forced labour, free labour, and an in-between form, share-cropping); increased dominance of long-distance trade as a source of "rapid accumulation of capital"; a geographical distribution of productive forces as a function of technology, possibilities of transport and communication, and political system; and the consequential emergence of a capitalist world-system distributed across three types of economies, a narrow, rich *core*, a middle zone – the semi-periphery – that enjoys partial prosperity at the risk of shortly possible decline, and, a vast, poor periphery. "Which areas play which roles is in many ways accidental" says Wallerstein (1974, 355), but the overall picture is one of an economy-world which perpetuates inequality to the extent that the core-periphery relationship indicates the degree to which surplus-value is unevenly distributed and cumulatively augmented in the direction of the core.

The thread of reasoning leads again to ascertain that the historical accident of the cumulative effect of small differentials would leave some regions in disproportionate (dis) advantage. Here is a WSA exemplar that concludes on the development gap between Eastern and Western Europe:

"One region has a *slight* edge over another in terms of one key factor, *and* there is a *conjuncture* of events which make this *slight* edge of central importance in terms of determining social action, then this slight edge is converted into a large disparity and the advantage holds even after the conjuncture has passed...The *slight* edge determined which of the two alternatives would prevail. At which point, the *slight* edge of the fifteenth century became the great disparity of the seventeenth and the monumental difference of the nineteenth" (Wallerstein, 1974, 98-99).

Later development of the theory (e.g. Hugon, 1991; Wallerstein, 2004b; Lee, 2004) has however connected the logic of uneven developpment to complexities studies as fundamentally as its rival epistemology. In the new conceptualization, the peculiarity of historical systems implies that (1) they are not eternal and, consequently, "they had beginnings, lives

during which they 'developed', and *terminal transitions*" (Wallerstein, 2004b, 18; emphasis added), and (2) the cyclical processes (medium-run trends, expansions and contractions) along with their crises "cannot be resolved within the framework of the system, but instead can be overcome only by going outside of and beyond the historical system of which the difficulties are a part" (Wallerstein, 2004b, 76).

The intriguing observation that one can be provided with a quasi-identical explanation by two opposed modes of argumentation will be subsequently followed through.

3. Understanding historical evolutions: a critique of the theories of uneven development

Our perspective is grounded on the observation that the *subject matter*, as well as the *method* of both theories are crippled by inconsistency if one follows the logic of complexity in historical processes to its ultimate consequences. The point is subsequently advanced along the lines of a discussion relative to the mathematical assumptions and interpretation of development.

In perfect confidence of the explanatory power of the natural imagery of chaos theory, Gleick (1987) narrates how a scientist of life sciences chooses the analytical toolkit:

"A physicist...finds the right equations from the first principles. Then he solves the equations, if he can. A biologist, by contrast, could never simply deduce the proper equations by just thinking about a particular animal population. He would have to *gather data and try to find equations* that produced similar output" (60; emphasis added).

One defining characteristic of economic modelling is the belief that the logic of mathematical formalism resembles the real world, of biotic populations, as well as of human affairs; what is theoretically possible is of necessity a fair description of economic reality: "Economists insist that their equations actually do say something about the real world" (Krugman, 1998).

Economic systems are indeed prone to unpredictable behaviour, runs the argument of HDT, due to the existence of economies of scale. An early version of the theory (Krugman, 1981) proves that 'uneven development' is a necessary outcome in a two-country model of capital accumulation and growth: on the presumption that the industrial sector exhibits increasing returns to scale, "an initial discrepancy in capital-labour ratios between the

two countries will cumulate over time, leading to the division of the world into a capital-rich, industrial region and capital-poor, agricultural region".

The availability of new modelling techniques for non-linear dynamic systems has made possible a more realistic, detailed view of the economic systems that translates in fact as an ever more challenging mathematical construct. In more developed variants (e.g. Fujita et al., 1999; Krugman, 2004), the economic descriptions can barely be visualised or theoretically assembled unless a computer simulation emulates a real-world situation.

In a typical simulation of, say, the three-region case, the computer run would yield four equilibria, three in which all manufacturing is concentrated in one location and one in which there is an equal distribution of manufacturing across locations. Where have these outcomes resulted from? It turns out that the answer is but a figment obtained *for the most interesting range of parameters*, which for that matter were only three, i.e. the elasticity of substitution among products in the manufacturing sector, set for this example at 4; the share of manufactures in expenditure, set at 0.2; and the transport cost between any two locations, set at 0.4 (cf. Krugman, 1994).

It is only now that details of economic evolutions enter the scene. The location of economic activities is at the behest of the simultaneous work of centrifugal and centripetal forces, which in their turn are determined by a complex combination of variable factors. For example, the cost of transportation may be conducive both to a greater mobility of factors or to a locally based economic development, as the availability of pools of knowledge and technological spillover may reinforce or abate the trend when abundant or scarce, respectively. The economic landscape thus changes in unpredictable configurations from path dependant and locked-in processes to endlessly agglomerative processes and vice versa. Prosperity (poverty) follows the inherently superior (inferior) activities in terms of generating increasing returns.

The preceding discussion has shown that the essential feature and minimal assumption of cumulative causation consists of the emphasis on economies of scale. That income-generating activities possess distinct intrinsic capabilities to spawn increasing returns to scale may indeed be a source, *the* source, of exponential differentiation, but neither is this of necessity the case, nor the direction of causal link, if any. That is why our contention to economic modelling regards its in-built capability to provide a 'historical' account of equilibrium and not of *development* per se, with a resulting significant loss of critical social detail along the way.

One may nevertheless notice a nuance of interpretive concession. As at any moment in time the future course of diverging evolutions is explained by *a set of initial conditions* these latter may be conceived in terms of historical specificity. "Whether one prefers to explain the greater initial accumulation of capital in one region by the slave trade or the Protestant ethic, this is a model in which small beginnings can have large consequences". (Krugman, 1981) By implication, *any* other historical set of circumstances could so replace economies of scale as model's premise as long as, of course, they could be made tractable in quantitative terms.

It may be also retorted that the choice of equations' parameters in the first place has been indeed a case of economic appraisal of how the world works. This assertion is already weakened by an assumed Friedmanian type economics which advocates analysis on its capability to predict evolutions irrespective of the realism of its assumptions. "A set of clearly untrue simplifications… dictated partly by guesses about what is important, partly by the modelling techniques available" (Krugman, 2004). For those insensitive to these presuppositions, it could be further assumed that the formal model may turn someday into a more realistic image of the world based on similarly more realistic assumptions by virtue of increased computational complexity and continued recalibration.

For this reason, our counterargument that critical details in the representation of subject matter get lost in the modelling approach apparently becomes superfluous. This is not however the case precisely because it is the very logic of formalism and not its analytical capability which is of little relevance in historical contexts. Its main explanatory power is based on in-built 'predictive' characteristics of the models, which misleadingly takes *mathematically necessary* outcomes for *historically possible* economic evolutions.

Consider again Gleick's narrative of the choice of method. The mathematical parameter, say *x*, lends itself to interpretation across scientific disciplines *exclusively* according to the researcher's modelling needs. The amount of heating or of friction in physical systems may correspond in biology to fecundity of the fish, the propensity of population to boom and to bust, concentration of substance, whereas in economics metamorphoses into concentration of manufacturing or of employment in a given region or industry. What is used to describe characteristics of population like birth rate, death rate, or the amount of resources available becomes characteristics of local levels of economic activity such as migration, share of income spent locally, size of market or the region's

'export base' (cf. Gleick, 1987, 60, 63; Prigogine and Stengers, 1984, 194, 160; Fujita et al., 1999, 27-28).

By the same token, the computer simulation in economics will as meaningfully describe the successive evolutionary steps of the process dependent on some parameter *x* as in physics or in biology. The isomorphism translates from cases of climatic fluctuations or ecological evolution to spatial configuration of larvae of coleopteran, construction of a termites' nest or arrangements of a population of macromolecules to examples of spatial configuration of economic activities or of emergence of dominant cities (cf. Prigogine and Stengers, 1984, 181, 190, 194; Fujita et al., 1999, 27-28) according to the technique of choice. The logic of reasoning is of purely technical character: the degree of nonlinearity and hence of unpredictability rests on the abstract manoeuvring of the various levels of parameter *x*.

The emerging picture of evolution includes, in truth, explanations of "the nature of the positive feedback that can lead to self-reinforcing growth or stagnation" (Krugman, 2004) but only for a snapshot of its temporal sequence. Capturing historical growth and development processes in 'formal' models does not make however possible to escape the trap of linear chronology. Evolutions cannot be accurately explained along the *widening gap* curves: the increasing complexity of production and social life in general is neither unambiguously beneficial nor harmful to growth, nor do circumstantial factors inevitably and irrevocably doom an economy to a future of relative decline or progress.

To bring the argument more forcefully to light, let us take an example fully disclosed in its most significant details by various researches. The Dutch economy was for fairly long time – cca. one hundred years – the leading force of economic progress in the sixteenth and seventeenth centuries. This achievement was made possible by a unique combination of economic capability "in the historically oldest form of food production, that of gathering, in this case the gathering of fish" (Wallerstein, 1980, 39) and a shrewd control of power in the Baltic trade. The whole set of economic activities – fishing industry, agriculture, livestock husbandry, textiles, shipbuilding – constituted itself indeed in a favourable environment, with its forward and backward linkages, but only a peculiar contingency embodying the circumstances of political power and economic tradition triggered the boom. The envying naval position in the Baltic's in fact reinforced the advantage of the shipbuilding and eventually placed the Dutch "in the happy circumstance of the spiral effect: circular reinforcement of advantage" (Wallerstein, 1980, 40).

The Dutch economy example is just an instance of the causal sequence that connects the monopoly power of "trade circuits and communications" (Braudel, 1982, 153) to ordinary episodes of economic life. A distinct implication of this historical account is that specialization does not appear any more as mere result of the interplay of maximizing decisions in a constrained environment. It even comes out that its relevance in determining a certain course of evolutions in the long term is virtually nullified as long as prosperity has recurred mainly in association with the influence and political power of deeds of trade. What conventional economic theory expounds as reciprocal benefits of free trade, the historical fact describes rather as an indeterminate interplay of historical circumstances. In the light of historical evidence, the famous Ricardian example of Anglo-Portuguese trade becomes an historical outcome of "an inheritance, the consolidation, historically achieved over time, of a situation dating from some earlier period... established progressively as a chain of subordinations" along which "Portugal, once a rich country…had been pushed towards the other direction [of unequal exchange]" (Braudel, 1984, 48).

The supposition of economies of scale or of any other tractable economic fact as one all-covering causality is further weakened by other works that place cumulative advantage within a rather diverse range of sources besides power relations. For instance, Neckerman and Torche (2007) and Berger and Elsner (2007) emphasize the circular cumulative causation of specific organizational contexts, whereas Martin (1999), in the same vein, enlists a host of important locally-varying factors (e.g. infra-structure, state spending and intervention, regulatory arrangements, human capital formation) to make up for what geographers call "institutional thickness".

A claim to valid interpretation is also advanced by the literature that ascribes a role for "growth spurts" (Fearn, 2004) or "power jumps" (Mann, 1986, 525) as isolated or unique economic episodes instrumental in generating positive feedback over time (se also Martin and Sunley, 1996; Nayyar, 2006). Economic externalities may become indistinguishable in a socio-cultural context that is the millennia receptor of human breakthroughs ranging from animal domestication and iron smelting to satellite television and digitalization of arts.

Even the literature sympathetic with quantitative techniques has to concede a sort of middle-range theorising in favour of historical interpretation. The latter may include concepts like "countervailing and supporting changes of cumulative causation" (Myrdal, 1957, 13, 20),

"attitudes to risk-taking and money-making" (Kaldor, 1960, 228) or "entrepreneurial response" (Setterfield, 2001). The role of increasing returns, of no negligible importance in *ceteris paribus*-based abstract reasoning, goes nevertheless almost unnoticed within a historically embedded sociality which eventually explains why "spatial agglomerations occur in particular places and not in others" Martin (1999).

Our thesis therefore implies that quantitative theorising cannot but lead to results expected by virtue of the in-built features of the model itself. This is just a restatement of the trivial evidence that, by their very logic, mathematical propositions – within the presuppositions underlying their construct – may well prove infallible as the truths are logically deduced from premises which are themselves definitions. For event regularities and law-like phenomena, this approach could indeed make sense, but as will become evident in the ensuing discussion of the interpretive thinking, they occupy but a secondary position in the economic study.

4. Concluding remarks

It might be assumed that, in a more historically based study of economic phenomena, unpredictability is essentially linked to the randomness of the overlapping sequences rather than *a priori* centres of agglomeration (attractors) or dissipation (bifurcations), or any other possible natural imagery. The sequential causality implies a more radical view on unpredictability: it not only regards future events, but also past events. In a phrase attributable to Mark Twain, it is hard to make predictions, especially about the past.

Historical specificity embedded in the subject matter (e.g. uneven development) builds up the argument from broad historical sequences (e.g. capital accumulation, control of power) to narrower and subordinate, explanatory sets of events (e.g. capital-labour ratios, trade cycles) to the least historical events, those historical particulars, that recur more or less identically over time, such as pricing in the period of severe drought or selling under conditions of monopoly, and which are characteristic to a market economy in this very narrow sense.

"Where chaos begins, classical science stops", said Gleick (1987, 3), whereby pronouncing a radical departure from a resolutely deterministic approach to physical science. Soon after, scholars from various fields, including social science took in earnest his predicament, for better or for worse. It is much in the spirit of this paper to conclude by saying, where

socio-economic evolution begins, natural imagery withers. The logic implied by this paper suggests that we do not possess an explanatory framework akin to natural events when inquiring about economic phenomena, but we do now what to look for: a historical toolkit that combines understanding of sequences and techniques for the particulars.

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NEW ECONOMY Section

TARGET MARKET RISK EVALUATION

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Abstract. *After the shocking series of bankruptcies started in 2008, the public does not trust anymore the classical methods of assessing business risks. The global economic severe downturn caused demand for both developed and emerging economies' exports to drop and the crisis became truly global. However, this current crisis offers opportunities for those companies able to play well their cards. Entering new markets has always been a hazardous entrepreneurial attempt, but also a rewarding one, in the case of success. The paper presents a new indicator meant for assessing the prospective of success or failure for a company trying to enter a new market by using an associative strategy. In order to take the right decision concerning the optimal market entry strategy, marketers may use a software application, "AnBilanț", created by a research team from Hyperion University.*

Keywords: *risk, market entry, investment, evaluation, discounted cash flow, adjusted net asset.*

1. Introduction

People seem to fail to remember about the probability of crisis outbreak in times of prosperity and fail to take quick crisis management actions. Coming out of the current economic crisis, the world has a historical chance to reshape its policies, architecture and institutions and support balanced global growth and financial stability. Especially the emerging economies should avoid macroeconomic imbalances and follow a sustainable growth trend backed by structural reforms. The current financial crisis has highlighted the need for up-to-date and transparent information by type of instrument, currency, creditors, and debtors.

Nevertheless, the crisis offers opportunities for those companies which aim to enter new markets, or to buy cheaply assets and companies in distress. Purchasing at a bargain price has always been a risky attempt,

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but in most cases a rewarding one, if the return of investment is satisfactory.

2. An overview over the risks or potential chances to develop a business at a global scale

The firm internationalization process is habitually accomplished in a gradual manner, by achieving several stages in accord with the motivation to enter and develop globally. There are four stages of internationalization: the exporter, the international firm, the multinational firm and finally, the transnational firm.

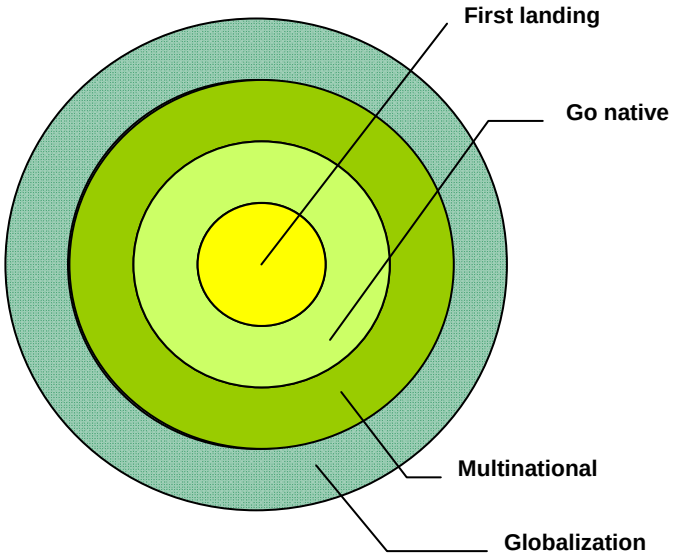

Figure 1. Stages of the Internationalization Process.

Source: the Authors.

Each stage corresponds to the similar four phases of the internationalization process:

- the early internationalization phase,
- production cooperation/local implementation,
- multi-nationalization and,
- globalization.

Getting into a new market is, of course, a difficult process, because of the numerous barriers of the internationalization, all being related to

the commercial field, to the competitive filed, to the costs resulted from the changing of the suppliers and the products, and to the government policy. There might also be technical barriers, or barriers created by the geographical distance, by the business infrastructure, by the local customs, by the prohibitions, by the customs restrictions, by the specific requests related to the capital. Other aspects that make difficult the process of getting into a foreign market are the languages, the culture, the legislative instability or the lack of the laws for these sensitive domains, or the corruption phenomenon.

Often, the firms start their international process through export operations, which frequently sustain an important weight of their activities. The risks associated with the export are: the risks related to the physical integrity of the wares, the juridical risks, the exchange rate risks, the currency transfer risks, the risks of default etc.

The associations with other firms for producing and comercialization of goods or services usually have better perspectives to obtain benefits than in the case of exports, but there are a series of disadvantages which could not be neglected, such as: a diminished control of the partners' activities, the possibility that, in time, the partners may become competitors, the misunderstandings concerning the policy of investments, the marketing, etc. These strategies take different forms: licensing, franchising, management contracts, strategic alliances, complex dynamic networks.

The foreign direct investment (FDI) is defined as the establishment of an enterprise by a foreign person or company. The FDI relationship consists of a parent enterprise and a foreign affiliate which together form an international business or a multinational corporation. In order to qualify as FDI the investment must afford the parent enterprise *control* over its foreign affiliate, i.e. owning 10% or more of the ordinary shares or voting power of an incorporated firm or its equivalent for an unincorporated firm; lower ownership shares are considered as portfolio investment.

In the case of a FDI, the firm has the possibility to get the entire control over the operations, it may develop production and marketing policies on long term, it may also obtain reduced production costs by using the local work-force and the raw materials from proximity, it may become the beneficiary of the incentives given by the host-state, and also of the positive image because of the new jobs created by the firm. Even so, the

risks related to direct investments are big enough: the currency restrictions, the depreciation of the national currency or, the worst situation, the expropriation. The country risk surveillance is fundamental for taking the best investment decision or for production delocalization in a certain country or region.

Country risk refers to the likelihood that changes in the business environment unfavorably affect operating profits or the value of assets in a specific country. Country risk is a complex term, which includes political risks, financial factors such as currency controls, devaluation or regulatory changes and social factors such as riots or civil war.

Today, managers have a lot of tools to measure the magnitude of risks, among them the most famous are those provided by credit rating agencies, which use quantitative econometric models and focus on financial analysis, whereas political risk providers tend to use qualitative methods, focusing on political analysis. For instance, the rating agencies Moody's and Standard & Poor's make a hierarchy of the countries for their ability to fulfill financial debts and for the bonds quality. The rating's assessment is standardized, by using letters for each risk class, like in the table 1.

Table 1

Grades on Standard and Poor's and Moody's scale

Moody's	Bonds Quality	S&P	Ability to fulfill financial debts
Aaa	Best quality	AAA	Extremely strong
Aa	High quality	AA	Very strong
A	High average quality	A	Strong – but sensitive on economic factors
Baa	Average quality	BBB	Adequate – but sensitive on economical
Ba	Speculative quality	BB	Less vulnerable – but uncertain in the future
B	Without investment characteristics	B	Vulnerable – but for the moment respects the terms of commitment
Caa	Low level quality	CCC	Vulnerable
Ca	Speculative quality	CC	Very vulnerable at present
C	Lowest quality	C	Payment difficulties – but for the moment, payments continue
		D	Major payments defaults

Source: Scott David, Understanding and managing investment risk & return, 1990, p. 188.

From the rating agencies prospective, investors should be aware of threats or opportunities of different markets. Romania's country rating increased after 2001 (see Table 2), as Moody's reports state. In 2006, Moody's upgraded the country risk level for Romania (Baa3) for long term credits, with only one rank below the grade considered safe by investors (investment grade). For the other categories, the prospects were also positive, Ba2 for bank deposits in hard currency, Ba1 for long term local debts. Despite the worst economic crisis after WWII, Moody's agency has affirmed in 2009 the Romania at Baa3; outlook stable[1]. However, Kenneth Orchard, analyst Moody's Investor Service, predicted at the and of 2008 in an interview for Money Channel TV an economic recession for Romania in 2009 with a GDP decrease of 0.3% (a mild forecast…)[2].

The agency took into account the global lack of liquidity and the decrease in growth of the main European economies.

Table 2

Evolution of country risk for Romania according to Moody's agency

Date	Rating for long term credits	Trend	Rating for bank deposits in foreign currencies	Trend
06.03.1996	Ba3		–	
23.12.1996	Ba3	stationary	B1	
14.09.1998	B1	▼	B2	▼
06.11.1998	B3	▼	Caa1	▼
19.12.2001	B2	▲	B3	▲
16.12.2002	B1	▲	B2	▲
11.12.2003	Ba3	▲	B1	▲
06.10.2006	Baa3	▲	B1	stationary
20.03.2009	Baa3	▲	B1	stationary

Source: Moody's investors service.

[1] http://www.moodys.com/

[2] http://english.hotnews.ro/stiri-business-5164715-moodys-predicts-recession-for-romania-2009.htm

3. A new tool meant for assessing the prospective of success or failure for a company trying to enter a new market by using an associative strategy

Under such a hostile environment, it becomes more and more necessary to use sophisticated tools for forecasting the risks or potential chances to develop a business at a global scale. The endeavor to enter new markets has always been a risky entrepreneurial act, but also a rewarding one, in the case of success. Producing profits from selling or producing abroad are great accomplishments for firms trying to expand their market share in foreign countries. Nevertheless, companies should think very carefully their market entry strategies, in order to circumvent the negative impact of some risks like: country risk, contractual risks, currency risk, environmental risks etc.

An useful instrument for assessing the prospective of success or failure for a company trying to enter a new market by using an associative strategy is *I*, a risk indicator defined[3] as follows:

$$I = N \times F \times \frac{1 + RI_T}{1 + RI_O} \times \frac{1 + RCE_T}{1 + RCE_O} \times \frac{V_{\text{company X}}}{CS_{\text{company X}}}$$

where the factors are:

- the country-risk of the target-market rating (*N*)
- the degree of cultural and organizational compatibility (*F*)
- the inflation rate for the target-market (RI_T)
- the inflation rate for the country of origin (RI_O)
- the rate of economic growth for the target-country (RCE_T)
- the rate of economic growth for the country of origin (RCE_O)
- the social capital of the *X* firm, the patrimonial entity that is used for settling an associative strategy ($CS_{\text{X firm}}$)
- the economic value of the enterprise ($V_{\text{X firm}}$).

If the society is listed at the stock exchange, than $V_{\text{X firm}}$ is the market value.

[3] Anda Gheorghiu, *Foreign Markets Entry Risk Management* (in Romanian), Victor Publising House, Bucharest, 2009, p. 251.

The rating N assesses the risk degree of the target-country; it can take values between 1-10 (10 for stabile countries and with a good quality of the credit and 1 for the economic crisis situation and incertitude concerning payments and disbursements).

F is a more complex factor and can have values between 0.1 (absolutely incompatible) and 100 (total compatibility).

The ratio $\frac{1+RI_T}{1+RI_O}$ reflects the monetary risks; if $RI_O > RI_T$, it is a signal that the country of origin is weaker than that of the target-market. The reasonable limits of the scale are 0 and 2; over this value, the inflation of the target-market is soaring, the market entry risk being very high.

The ratio $\frac{1+RCE_T}{1+RCE_O}$ reflects the risk of entering a market with a different rhythm of growth than that of the country from where the investment comes. The reasonable limits of the scale are 0 and 2; over this value, the inflation of the target-market is plummeting, the market-entry risk being too high.

The ratio $\frac{V\,\text{company x}}{CS\,\text{company x}}$, varies between 0 and 100.

If $V_{\text{company X}} > CS_{\text{company X}}$, the company is rich in assets, which exceed the scriptural value of the capital (most common situation), while if $V_{\text{company X}} < CS_{\text{company X,}}$ the company is almost bankrupt.

The indicator I can take positive values (from 0 t_O $+\infty$).

For a nuanced analysis, one can apply apply the logarithm over I and the result is

$$I^* = \lg I = \lg\left(N \times \frac{1+RI_T}{1+RI_O} \times \frac{1+RCE_T}{1+RCE_O}\right) + \lg\left(F \times \frac{V\,\text{company x}}{CS\,\text{company x}}\right).$$

The first term characterizes the degree of risk of the target region/country, while the second characterizes the microeconomic risk.

If $I^* < 0$ and the country risk is more than 6, the factors which characterize the external environment being in normal limits, than the company envisaged for association is either less evaluated, or almost bankrupt, vulnerable, able to be taken over very easily and changed radically, in terms of items produced.

If $I^* > 5$, under the same circumstances, than the company envisaged for association has a very good financial situation.

Therefore, five intervals of values for the I^* indicator have been settled. The extremes of this grid are:

$I^* < 0$, in this case, the optimal strategy is the direct greenfield investment

$I^* > 5$, in this case, the optimal strategy is the export, as it can be seen in the table 3.

Table 3

The evaluation of the microeconomic environment analyzed in rapport with the values on the grid of I^*

The values of $I^* = \lg(I)$	**The evaluation of the microeconomic environment**	**The optimal entry strategy**
$I^* < 0$	The microeconomic environment likely to be entirely taken over	Direct greenfield investment
$0 < I^* < 1,6$	The microeconomic environment likely to be entirely taken over by a buy of the majority of stocks and joining the management team	Acquisition
$1,6 < I^* < 2$	The microeconomic environment likely to be taken over at a equal rate to that of the partner	Mergers, acquisitions
$2 < I^* < 5$	The microeconomic environment favorable for economic cooperation	Licensing, franchising, strategic alliances, management contract
$I^* > 5$	The microeconomic environment hard to be approached through a partnership but favorable for trading operations	Export

Source: Gheorghiu Anda, PhD thesis, 2008, http://www.biblioteca.ase.ro/resurse/resurse_electronice.

4. Methods of assessing companies which are not listed at the stock exchange

How should one proceed when the targeted company is not listed at the stock exchange and its current real value does result neither from its stock exchange capitalization, nor from the balance sheet? In this case the targeted company should be approximated through methods specific to the valuation as the Adjusted Net Assets Method or Discounted Cash-Flow.

The Adjusted Net Assets Method (abbreviated here as *ANC*) requires the following steps:

a) getting the balance sheet reflecting the patrimony at the date of valuation

b) valuating the assets and debts, meaning:

- either to consider the accounting value as the true and fair one, without making any correction over it;
- or converting the accounting value of assets and liabilities at the right market value;

c) recording at the date of valuation the assets and liabilities not shown in the balance sheet;

d) computing the Adjusted Net Assets value.

The *ANC* method requires a great amount of work, because it supposes the splitting up of a company value into distinct parts and the assessment for each of them. Hence, the value of asset-based analysis of a business is equal to the sum of its parts.

The asset valuation approach is based on the principle of substitution: no rational investor will pay more for the business assets than the cost of procuring assets of similar economic utility.

Pursuant to the Generally Accepted Accounting Principles states than an asset or liability should be initially recorded and reported at its original (historical) cost; the theory is that historical costs are easier to verify than are current values, i.e., a market value can only be proven when a sale is consummated)[4]. Accordingly, companies have to book and report based on acquisition costs rather than fair market value for most assets and liabilities, most assets are reported in the books at their acquisition value, minus the depreciation, where applicable. However, these values must be adjusted to fair market value wherever possible.

The Discounted Cash-Flow Method (abbreviated here as *DCF*) is an income-based approach and a way to estimate the value of a company by using the concepts of the time value of money. All future cash flows are estimated and discounted to give their present values. The discount rate used is generally the appropriate cost of capital and may incorporate judgments of the uncertainty (of the future cash flows).

[4] Griffin P. Michael, *MBA Fundamentals: accounting and finance*, Kaplan Publishing, New York, S.U.A., 2009, p. 13

The discounted present value may be expressed as:

$$V_{DCF} = \frac{FV}{(1+i)^n} = FV\,(1-r)^n$$

where:

– V_{DCF} is the discounted present value of the future cash flow (FV);

– FV is the nominal value of a cash flow amount in a future period;

– i is the interest rate, which reflects the cost of tying up capital and may also allow for the risk that the payment may not be received in full;

– r is the discount rate, which is $i/(1+i)$, i.e. the interest rate expressed as a deduction at the beginning of the year instead of an addition at the end of the year;

– n is the time in years before the future cash flow occurs.

We have selected as a case study a company which is listed at the Romanian Stock Exchange (BVB – Bursa de Valori Bucureşti), Compa Sibiu SA, a producer of spare parts for the automotive industry and in the case of certain products it is the only domestic producer. The users of Compa's products are both domestic producers of cars, commercial vehicles, trucks, tractors, farm implements and railroad rolling stock, firms from the spare part market as well as a range of external clients from countries such as Germany, France, Italy, Hungary, Yugoslavia and U.S.A. Its clients are famous brands such Dacia Renault, Honeywell, Bosch, Piroux, Daikin, Delphi. The company has two major clients, Honeywell and Bosch, representing 63% of its sales in 2007.

Although it is not really "orthodox" to assess a company, which is already quoted over the capital market, we have chosen this approach in order to verify if the hypotheses of the proposed method are true. A company is considered as fairly evaluated over a mature market and the above-mentioned methods (*ANC* and *DCF*) should, theoretically, present as outcome similar values.

In November 2007, the company increased its capital from 14,86 million lei to 21,88 million lei (a 6,46 million euro increase). The main shareholder was the Employees Association, holding 54,59% of the shares.

The Adjusted Net Assets value resulted from the balance sheet as of December 31, 2007, is 361.656.741 lei. In the *ANC* method version, the indicator *I* becomes:

$$I = N \times F \times \frac{1+RI_T}{1+RI_O} \times \frac{1+RCE_T}{1+RCE_O} \times \frac{V_{\text{company X}}}{CS_{\text{company X}}} =$$

$$= 7 \times 1 \times \frac{1+0{,}1}{1+0{,}04} \times \frac{1+0{,}05}{1+0{,}01} \times \frac{361.656.741\,\text{lei}}{21.882.104\,\text{lei}} =$$

$$= 7 \times 1 \times 1{,}06 \times 1{,}04 \times 16{,}53 = 127.5587$$

$$I^* = \lg(I) = 2.105710084531$$

$$I = \quad 127.5587$$
$$I^* = \lg(I) = \quad 2.10571008.$$

In the case of *DCF* method, the discount rate taken into account was 5% for a 5 years time and with a residual value calculated according to the formula of Gordon-Shapiro[5]:

$$V_{DCF} = \sum_{i=1}^{n} \frac{CFNI_i}{(1+r)^i} + \frac{V_{rez}}{(1+r)^n}$$

where:

$CFNI_n$ is the net cash-flow-ul net from the year *n* (its value was taken from the Profit and Loss account at December 31, 2007) as a difference between revenues and expenses, meaning 7,570,903 lei);

g – the rate of perpetual increase of dividends, cautiously considered as 1%;

r – the discount rate, 5%.

The residual value is, therefore, $V_{rez} = \frac{CFNI_{n+1}}{r-g} = \frac{CFNI_n(1+g)}{r-g}$.

The value of the company, calculated according to the *DCF* method, was 207.360.284 lei.

$$\frac{CFNI_i}{(1+r)^i} = \frac{\text{Net profit}_{\text{reference year}}\,(1+g)^i}{(1+r)^i},\ i = 1, 2, \ldots n.$$

[5] Sorin Stan, *Business Valuation* (in Romanian), IROVAL Publishing House, Bucharest, 2003, p. 286

Of course, the analyst has to choose the most appropriate value and in this case, *ANC method* was considered as the accurate one, meaning *361,656,741 lei*. This choice was based on the fact that the use of *DCF*-type methods in an emerging economy involves many uncertainties, many risks, because the economic environment is quite unstable.

For
– an update rate of $r = 5\%$
– a perpetual dividend growth rate $g = 1\%$
– the country's rating = 7
– the cultural and organizational compatibility score = 1
– a forecasted growth rate of 5% for Romania
– a growth rate of 1% for EU
– inflation for Romania: 10%
– inflation for EU: 4%

$$I = \quad 127{,}2133818$$
$$I^* = \lg(I) = \quad 2.104532798.$$

For comparison, by processing the stock exchange data for the same company, the following results have been obtained:

$$I = \quad 92{,}36481$$
$$I^* = \lg(I) = \quad 1{,}965507.$$

So, the value of I^* is:
– 1.965507 by processing the stock exchange data
– 2.10571008 by using the Adjusted Net Assets Method (*ANC*)
– 2.104532798 by using the capitalization method – Discounted Cash-Flow (*DCF*).

So, the difference between the two methods (processing the stock exchange data and *ANC*) is 0.139026.

By considering *DCF* method, the difference is minor (0.102545 in the favor of processing the stock exchange method). Therefore, the indicator is a powerful and reliable instrument for companies motivated to enter new markets.

5. The AnBilanț software

In order to take the right decision concerning the international market entry and to choose the optimal strategy, marketers may use a software application, "AnBilanț", created by a research team from Hyperion University. It is realized under Visual Basic 6 as an executable and it runs under Windows (98/2000/XP) operating system.

Visual Basic[6] is a programming language designed to create applications that work with Microsoft framework; since it provides advanced techniques for visual programming, Visual Basic eases the quick writing of software programs. It is also able to recognize and interact with various types of data files or Database Management Systems (i.e. software systems that allows users to save retrieve and modify information) such as Microsoft Access, dBase, FoxPro, Visual FoxPro, Paradox, SQL Server etc.; it allows the access to documents and Internet/Intranet applications[7].

AnBilanț eases the decision process in the case of unlisted stock companies, which should be evaluated by using one of the assessment methods presented beforehand.

The application is structured in four areas namely:

I. *The input area of comparative parameters between the target market and the country of origin, to be exact:*

- N – the country-risk of the target-market rating with values between 1-10 (10 for financially solid countries
- F – the degree of cultural and organizational compatibility (F), with values between 0.1 (incompatibility) and 100 (full compatibility)
- RI_T – the inflation rate for the target-market
- RI_O – the inflation rate for the country of origin
- RCE_T – the rate of economic growth for the target-country
- RCE_O – the rate of economic growth for the country of origin

[6] Tim Patrick, Roman Steven, Petrusha Ron, Lomax Paul, *Visual Basic 2005 in a nutshell*, a desktop quick reference, 3-rd Edition, Ed. O'Reilly, 2006, p. 8

[7] Anca Gheorghiu and Ion Spânulescu, *Computers Programming*, Victor Publishing House, Bucharest, 2003, p. 274

- r – the discount rate, i.e. the rate at which costs and estimated future incomes of the investment are discounted to calculate the present value of it
- g – dividend perpetual growth rate.

II. The area that displays the values calculated according to the Discounted Cash Flow method (*DCF*) and Adjusted Net Asset method (*ANC*). After selecting the amount considered by the assessor as the most appropriate the software automatically calculates the indices I and $I^* = \log(I)$, which asses the market environment of the target country / region and deliver the strategic investment recommendation (see Fig. 2).

III. *The area of financial analysis* applied to items selected from the balance sheet or profit and loss account, accompanied by graphic illustration of the dynamics of the economic factors (see Fig. 2).

IV. *Copyright* (see Fig. 2 and Fig. 3).

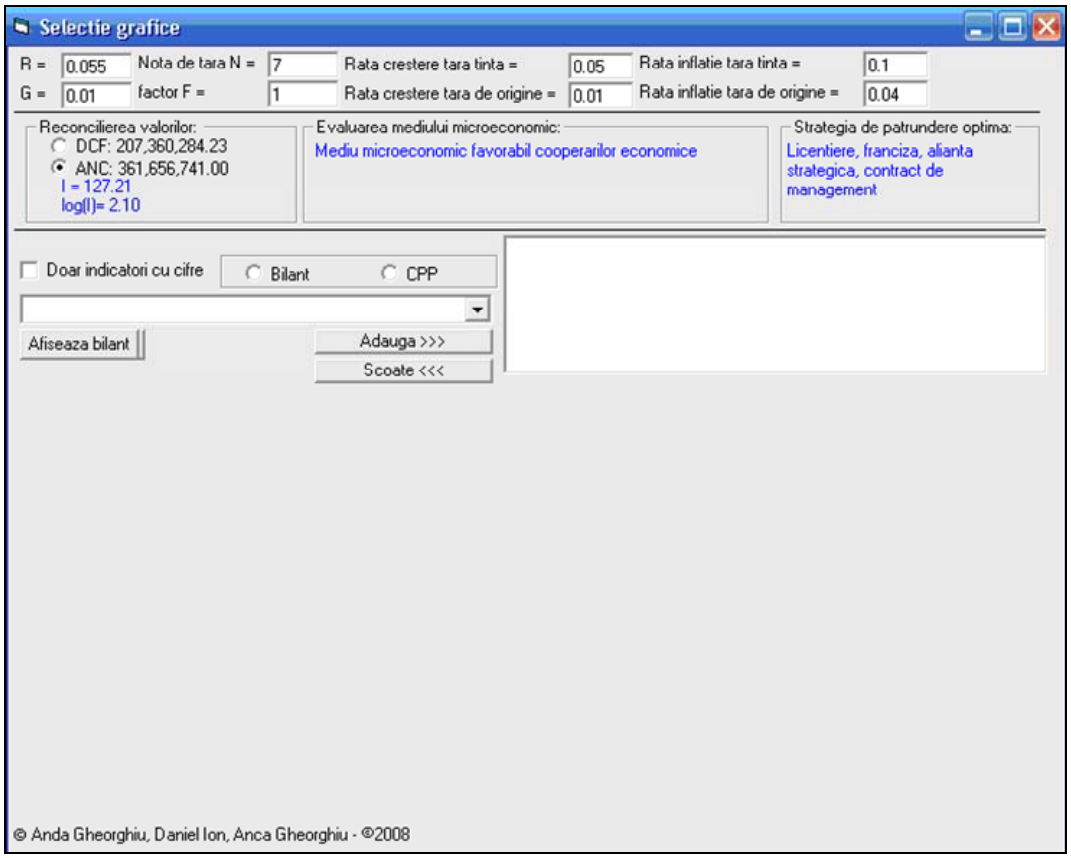

Figure 2. The visual appearance of the application AnBilanț.

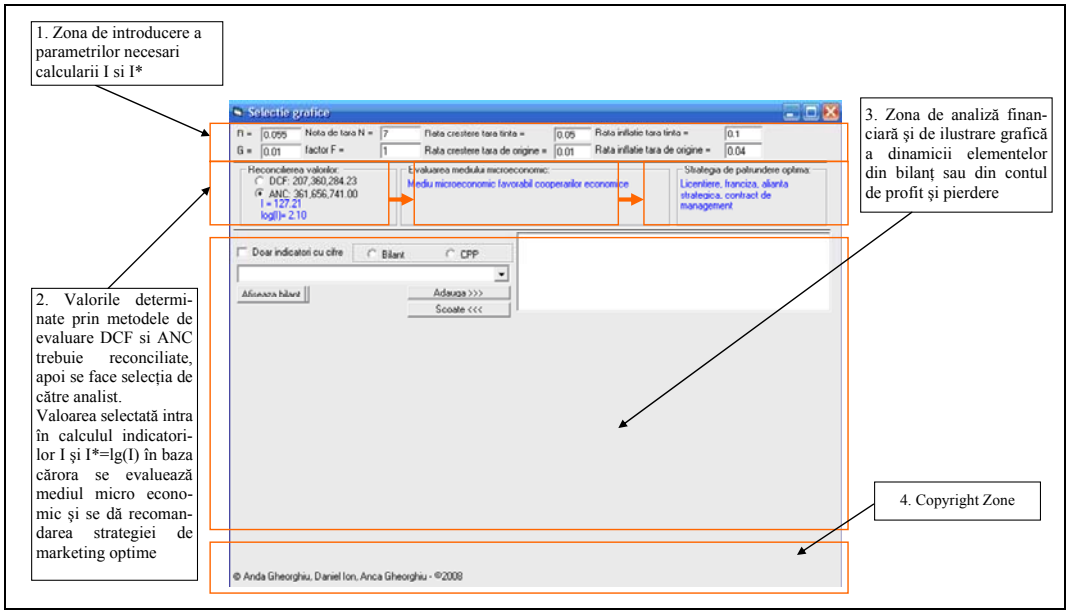

Figure 3. The structure of menu in the application AnBilanț.

The rates (*r* and *g*) and the factors which characterize the target/origin market are illustrated in the figure 4:

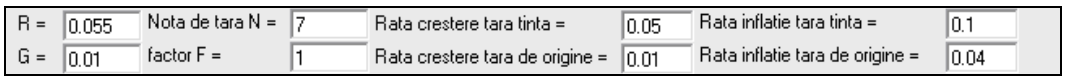

Figure 4. The area of data input of comparative parameters (target market/country of origin) in AnBilanț software.

In our case, we can notice that for different values, the recommended strategy is different. For instance, in figure 5, we notice that, if we choose the value computed with Discounted Cash Flow method (*DCF*), the optimal strategy will be the merger.

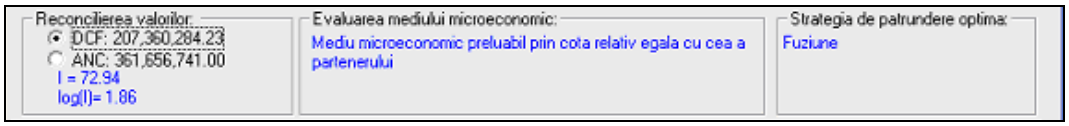

Figure 5. The area that displays the values calculated according to the Adjusted Net Asset method (*ANC*) in AnBilanț application.

In figure 6, one can notice that, if we choose the value calculated by using the Adjusted Net Asset (*ANC*) method the optimal entry strategy will be licensing, merger, strategic alliance or a management contract.

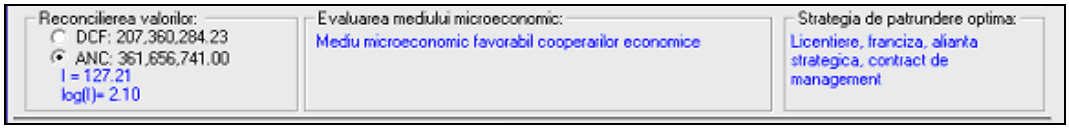

Figure 6. The area that displays the values calculated according to the method Adjusted Net Asset method (*ANC*) in AnBilanț software.

Once fixed the rates and the parameters of the two regions and after determining the value that best describes the evolution of the enterprise, one can make the selection of the balance sheet elements and study their dynamics (see Fig. 7).

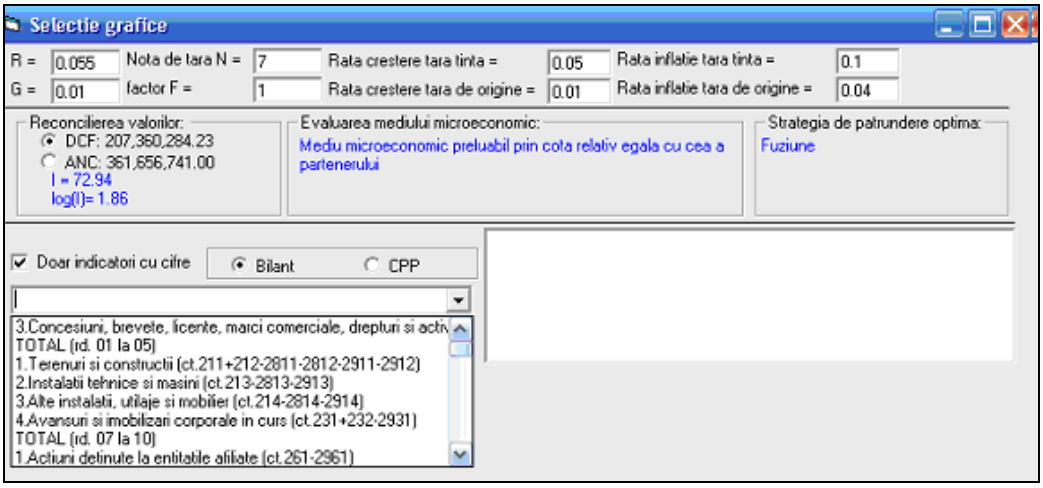

Figure 7. The area of financial analysis applied for the selected patrimonial elements from the balance sheet or from the profit and loss account.

The selected item is transferred to the box on the right hand and remains on hold until the next action (acceptance and drawing a graph or de-select and delete from the box) (Fig. 8).

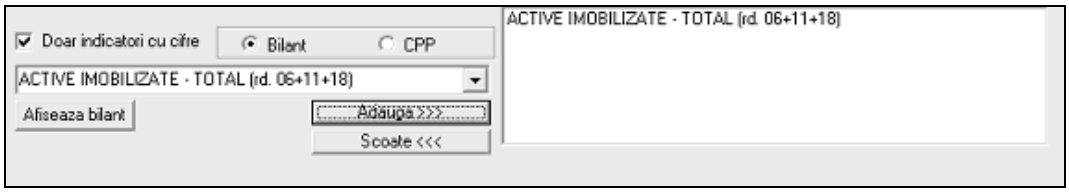

Figure 8. Selection of an element from the balance sheet or from the profit and loss account.

In the case of accepting the selected items, by typing the button "Show balance sheet", the previously selected elements are shown graphically in their dynamics (Fig. 9 and Fig. 10).

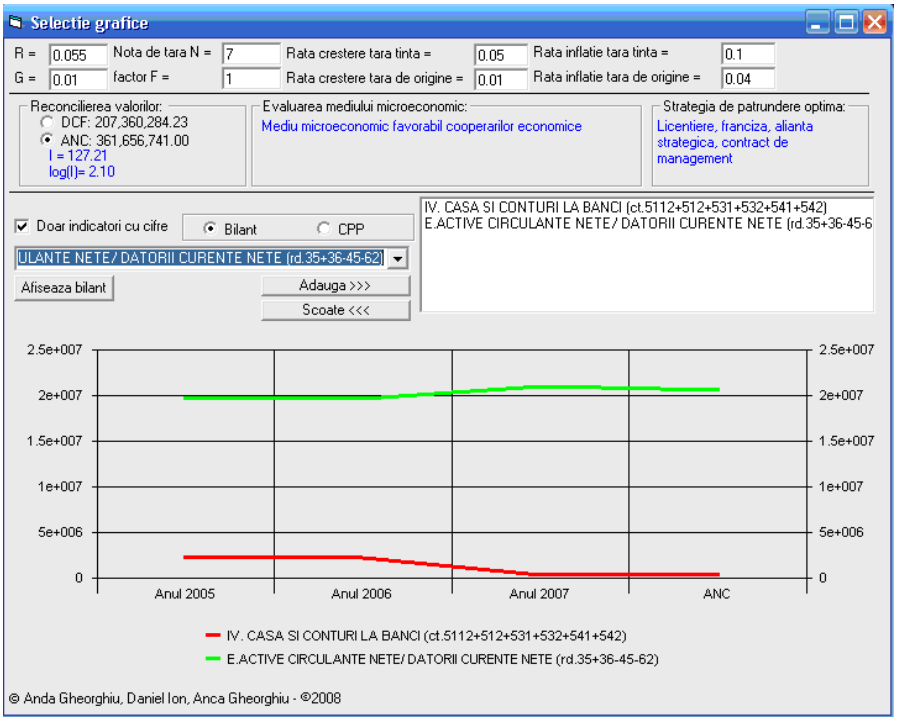

Figure 9. The graphical dynamics of the balance sheet/P&L elements (I).

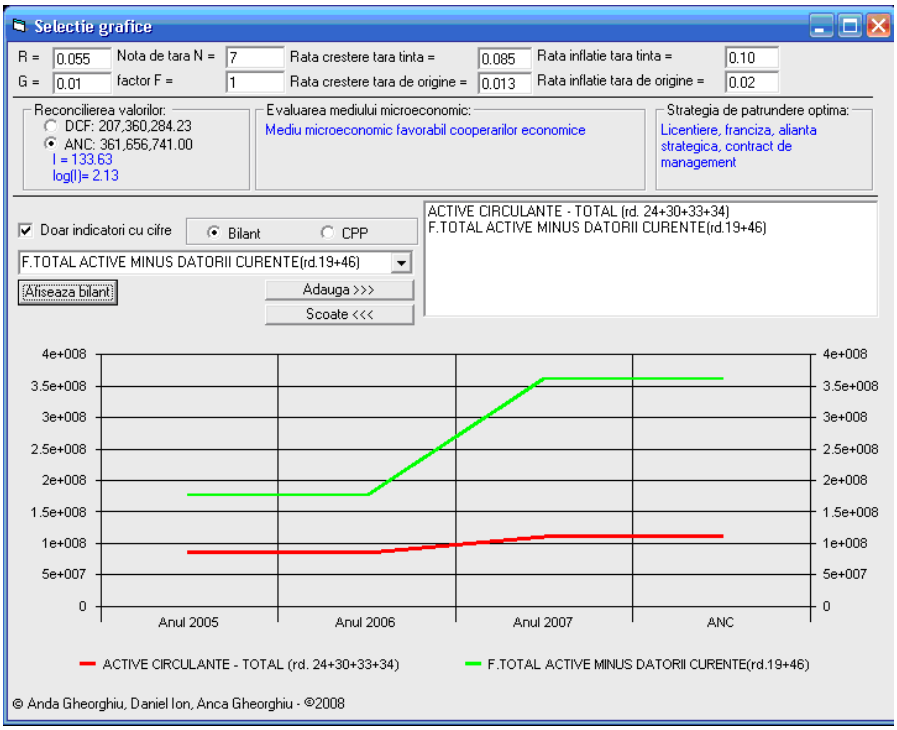

Figure 10. The graphical dynamics of the balance sheet/P&L elements (II).

6. Conclusions

The risk management domain has increasingly become a key issue for any company; in this context, the complex case of market entry is still a puzzling issue for any manager who intends to expand the business internationally. The software application "AnBilanț" is meant to be an useful tool in order to take the right decision concerning the global market entry and to choose the optimal strategy, such as export, franchising, licensing, merger/acquisition or building a shining new industrial unit from scratch. AnBilanț is a valuable, user-friendly and reliable help in the decision process, especially in the case when the unit intended to be acquired is not listed at a stock market, and, consequently, it should be thoroughly evaluated by using one of the classical assessment methods like Discounted Cash Flow or Adjusted Net Asset method.

As AnBilanț is realized under Visual Basic 6 as an executable and runs under Windows operating system, it is able to identify and interrelate with various types of data files or Database Management Systems (i.e. software systems that allows users to save retrieve and modify information) such as Microsoft Access, dBase, FoxPro, Visual FoxPro, Paradox, SQL Server etc.; it allows the access to documents and Internet/Intranet applications.

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*** www.moody.com.

ROMANIAN UNDERGROUND ECONOMY – A FUZZY APPROACH

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Abstract. *In this paper a model based on fuzzy logic in order to "quantify" Romanian underground economy was proposed. This approach starts from MIMIC model variables used by many authors in estimating underground economy in all over the world. We also assumed there can be establish a positive relation between a number of causal variables and underground economy. The model uses a set of variables whose choice is based on both economic theory and empirical observations. These variables determinate underground activities. The choice of variables can be considered subjective and the input variables set can be modified depending on the availability of data need. However, it should be noted that each of these variables have a lesser or greater contribution to underground activities development. Fuzzy logic language permits us to formulate rules such as "if the taxation rate is high, then the underground economy is large". Using statistical series it can be establish a basic "normal" value for a given period against which all the variables magnitude can be calculated. The "normal" value for each series and each year is actually an average of previous time values. Many rules can be formulated, but they depend on number and values of variables considered.*

Keywords: *fuzzy model, linguistic variables, underground economy, informal economic activities, underground economy fuzzy modelling.*

1. Introduction

Despite the concerns mostly aimed to "decoding" underground economy, no one can talk about a precisely defined area. However, we consider that underground economy concerns social relations of economic nature (including illegal ones) developed by individuals and economic units that violate the principles of economic "game". They succeed to avoid the legal and administrative regulations of any kind, they are not covered or are partial covered by formal commitments and their activity is

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generates revenues that are not included in calculation of GDP or national accounts system even if they are generating added value.

Underground economy estimation is difficult but not impossible. It is a real challenge for economic experts who concluded that any change in underground economy size is reflected by a change of main macroeconomic indicators. Based on these considerations there have been developed various models in order to facilitate the evaluation of causes and effects of informal economic activities and to estimate the size and dynamics of underground economy.

The main reason for increasing participation in the shadow economy is an economic one: the specific activities of this sector represent a real "safety net" from a social point of view. People have found this formal economy outlet and exploit it because it allows them to earn their leaving (it represents the only way to survive for many families). Anyway, we can't exclude non-economic reasons: much more free time, unlimited space, flexibility, lack of state institutions and fiscal legislation confidence, bureaucracy etc. In this context, we think that underground economy is a symptom of: high taxation, inadequate and insufficient financial and fiscal control, law weakness, lack of official state apparatus professionalism, inefficiency and incompetence, economic area professional shortage, inadequate legislative and administrative regulations, discrepancy between expectations and objective realities, changing of economic and social relationships, decline of individuals morality and mentality, corruption and political manipulation, reducing living standards and rising poverty level, lack of equal opportunity system/unequal opportunities, tacit acceptance of underground practices. However, all these, associated with lack of professionalism and corruption, with poor morality and indiscipline of civil society members create a free way for tax evasion manifestation, a special component of underground economy.

Taxation rate as a key parameter of fiscal policy is considered the main instrument of any economic stabilization and recovery program. Increasing tax rates may limit private investments and encourage business migration from formal to informal sector. The intensity of this transfer and evaluation of main parameters involved (economic and non-economic factors) represent the main purpose of underground economy modelling.

Scientific and methodological foundations focused on different models and techniques for underground economy estimations aimed: models based on surveys – the study of households behaviour by comparing revenues reported by respondents, revenues generated by main activity, revenues generated by a second declared activity and calculate a

composite factor for each household; models based on national employment rates; a global model based on labour supply method; fiscal statistic methods; simple monetary rate method (Cagan, 1958; Gutmann, 1977); money demand function (Tanzi, 1980, 1983); transactions method (Feige, 1979); energetically resources consumption models (Kaufmann & Kaliberda, 1996; Mária Lackó 1995, 1996); MIMIC model (Frey şi Weck – Hannemann, 1984) etc.

Fuzzy approach for underground economy modelling is a new and innovative method. We think that fuzzy technique presented in this paper may be an acceptable alternative to regression equations analysis.

2. Preconditions of fuzzy logic application in economics

The universe is composed of several elements that can not be strictly defined or delimited. Starting from such observation, Lotfi Zadeh (considered the father of fuzzy logic) has decided to extend the two logical values defined by the pair [0, 1] to a continuous range [0, 1] by using a gradual transition from false to true[1].

Fuzzy sets are actually an extension of the mathematical set concept. A mathematical set is a collection of same feature objects. Fuzzy sets use more than one condition to establish a belonging criterion. Let's see the set of active persons from economy. A young man of 30 years old is certainly a part of this set, but an old person is excluded. What about persons of 40, 50, 60 or even 70 years old? Zadeh introduced the concept of membership level that allows a gradual transition from a set to another. The membership degree to a set is the main feature of a fuzzy set.

The membership degree is a precisely concept, but represents a subjective indicator depending on a certain context. Linguistic variables are another feature of fuzzy sets. Similar to arithmetical variables which are numerical values, fuzzy variables are specific values as words or sentences. The set of linguistic variables is generally named terms. Each member from a set of terms is a fuzzy variable defined on a basic variable.

Binary logic has emerged with language study. Sentences are true or false assertions, but not both simultaneously. However, a fuzzy logic sentence can be true or false, but it may have an intermediate value as "almost true", for example.

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[1] Jantzen Jan – *Tutorial on Fuzzy Logic*, Technical University of Denmark, Department of Automation, Tech. Report no. 98-E 868, 19 August 1998, p. 2.

Fuzzy set theory and fuzzy functions are widely applied in computer science, systems analysis, electrical and electronic engineering and other complementary fields. Expert systems development supported fuzzy logic which has already taken place in our lives without even realize (automotive industry applications, domestic electronics etc.).

Although mostly used in sciences, the convenience of applying fuzzy logic in the social sciences has been limited for more or less psychological reasons. This is the case of economics. Timid attempts to use the theory of fuzzy sets in econometrics[2] occurred only after the mid-90s. This is the period when it has been tried to use fuzzy logic for non-linearity regression modelling and for investment behaviour prediction on a base of interest rate and transactions[3].

3. Methodological aspects

We have proposed to measure Romanian underground economy using a method not frequently exploited by economic problems analysis. We are talking about a technique based on fuzzy sets. It requires a completely different methodology than all the other methods used for the same purpose.

The method is based on inductive premises like "if GDP per capita is high, then the underground economy is large" or "if taxation is excessive, tax evasion is high". To confer a membership degree to such as subjective variables depends largely on user experience.

This approach uses some concepts taken from MIMIC model. We refer to causal variables processed, namely the share of direct taxation in GDP (DIR), the share of indirect taxation in GDP (INDIR), GDP per capita Index in USD (PIBL), unemployment rate (SOM) and the corruption index (IPC). The analysed period is 1990 to 2007. The results of fuzzy approach are represented by underground economy size for 1992-2007 periods. Data corresponding to 1991 and 1992 are use to built arithmetic and harmonic means.

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[2] First paper in economic fuzzy logic was published by Lindstrom T., A fuzzy Design of the Willingness to Invest in Sweden, Journal of Economic Behaviour and Organization, 36, 1-17, 1998.

[3] Draeseke Robert, Giles David E. A., *A Fuzzy Logic Approach to Modelling the Underground Economy*, WP, Department of Economics, University of Victoria Research Grant #38163-28200, Canada, 2000, pp. 2-3.

Choosing the variables listed above are not scientific motivated, but it is influenced by earlier models. We have assumed there are an interdependence relationship between these variables and underground economy. We consider that "if taxation is high and unemployment rate is high and corruption index is high and GDP per capita is low then underground economy is certainly large". This is only one of model specification, but we could create a lot of different versions:

- "If taxation is high and unemployment rate has a medium level and corruption index is slow then underground economy is medium size";
- "If taxation is medium and unemployment rate is slow and GDP per capita is high and corruption index is low, then underground economy is certainly insignificant";
- "If taxation is excessive and unemployment rate is high and corruption index is excessive and GDP per capita is medium then underground economy is large".

The choice of causal variables is subjective, but also subjective is fuzzy sets limits specification. The border between a "high taxation" and an "excessive taxation" is determined by personal choice.

Given the explanations above, we defined fuzzy sets for each of mentioned causal variables. Then we associated subjective levels with subjective values. The next step was to formulate decision rules and to establish the subjective level of underground economy using fuzzy operators. These steps were followed for each year of the data series.

Using moving average process we created a scale and we identified the subjective levels "excessive", "high", "normal", "low", "very low". The final level of underground economy for period 1992-1999 was subsequently adjusted because we did not take account of possible cycles that could occur in numerical data series.

The average value of the prior period was considered a "normal" value for each series. For example, the "normal" related to a variable for 2000 is the average value of the period from 1990 to 1999.

Levels around normal value were obtained as follows:

– „high": normal value + standard deviation;

– „excessive": normal value + 2 × standard deviation;

– „low": normal value – standard deviation;

– „very low": normal value – 2 × standard deviation.

In other words, the algorithm is generally as:

Very low (FS)	**Low (S)**	**Normal (N)**	**High (M)**	**Excessive (FM)**
Average value – 2*ST.DEV.	Average value – ST.DEV.	Average value	Average value + ST.DEV.	Average value + 2*ST.DEV.

Table 1 represents levels corresponding to INDIR variable (the share of indirect taxation in GDP). The calculation of levels for other variables is similar. The greeyed cells means possible membership levels for variable INDIR.

In 1992, the real value of this variable is 24.99%. This value must be properly framed on the membership levels:

Very low (FS)	**Low (S)**	**Normal (N)**	**High (M)**	**Excessive (FM)**
15.6249	19.7680	23.9111	28.0542	32.1973

Table 1

Fixing subjective levels for variable INDIR

	Very low (FS)	**Low (S)**	**Normal (N)**	**High (M)**	**Excessive (FM)**	**Original series (%GDP)**
1990						20.98
1991						26.84
1992	15.6249	19.7680	23.9111	28.0542	32.1973	24.99
1993	18.2806	21.2759	24.2712	27.2664	30.2617	28.98
1994	18.6592	22.0537	25.4481	28.8426	32.2371	18.10
1995	15.1575	19.5677	23.9779	28.3881	32.7983	11.47
1996	8.9843	15.4384	21.8924	28.3465	34.8006	11.99
1997	6.5176	13.4977	20.4778	27.4578	34.4379	19.09
1998	7.3425	13.8234	20.3043	26.7852	33.2661	15.77
1999	7.3045	13.5525	19.8004	26.0484	32.2963	15.82
2000	7.3554	13.3789	19.4025	25.4260	31.4495	14.88
2001	7.2405	13.1157	18.9909	24.8661	30.7413	11.23
2002	6.2785	12.3114	18.3443	24.3773	30.4102	10.16
2003	5.3022	11.5084	17.7147	23.9209	30.1272	11.62
2004	4.9160	11.0975	17.2791	23.4606	29.6421	10.58
2005	4.4276	10.6301	16.8326	23.0352	29.2377	9.92
2006	3.9286	10.1647	16.4009	22.6370	28.8731	9.41
2007	3.4464	9.7180	15.9897	22.2613	28.5329	6.49

Source: own calculation.

Anyone could note that the actual real value (corresponding to 1992) can be placed somewhere between "normal" and "high". What can we do? One of fuzzy logic advantage is that not required choosing a single level, but provides a choice of two or more. We established confidence rates, another subjective element. These membership degrees or confidence rates were built using harmonic mean. The assigned values for variable INDIR confidence rates are:

Very low (FS)	**Low (S)**	**Normal (N)**	**High (M)**	**Excessive (FM)**
0.0675	0.1352	0.1965	0.2551	0.3122

The associated values sum equal to 1. Observations values exceeding the upper or lower limit are treated as extreme limits. Perfect membership (complete membership) is reflected by value 1, and 0 indicates lack of belonging.

The next step is to formulate the production rules. They will determine the individual membership level for each variable. By combining these levels it will be generated underground economy size. The production rules are arbitrary.

Table 2 offers some possible production rules corresponding to causal variables for 1992.

The rules interpretation was made by using "if-then" criterion. According to rule 1, "if the share of direct taxation in GDP is excessive and the share of indirect taxation in GDP is normal (general taxation rate is high) and GDP per capita index is very low and unemployment rate is normal and the corruption index is high, then the underground economy is very high". The other rules were interpreted in the same manner. There are similar rules for each year analyzed, not exposed in this paper because the analysis is too wide. We think this fact does not affect the understanding and the relevance of the proposed approach results.

The last column of Table 2 represents the confidence rates associated to underground economy, according to the intensity of the related rule. The personal intuition and trial are involved. For example, rule 1 suggests that underground economy is not perfectly associated with level "very high". It suits this level in a proportion of 80 percents.

Table 2

Possible production rules (1992)

Rule number	Causale variables					ECINF	Membership degree (Confidence rate)
	DIR	INDIR	PIBL	SOM	IPC		
1	FM	N	FS	N	M	R	0.8
2	FM	N	FS	N	FM	ME	1
3	FM	N	FS	M	FM	R	0.8
4	FM	N	FS	M	M	ME	0.8
5	FM	N	S	N	M	ME	0.8
6	FM	N	S	N	FM	R	0.8
7	FM	N	S	M	FM	R	1
8	FM	N	S	M	M	ME	0.8
9	FM	M	FS	N	M	ME	1
10	FM	M	FS	N	FM	ME	0.8
11	FM	M	FS	M	FM	R	0.8
12	FM	M	FS	M	M	R	0.8
13	FM	M	S	N	M	ME	0.8
14	FM	M	S	N	FM	R	1
15	FM	M	S	M	FM	R	1
16	FM	M	S	M	M	ME	1

Source: own calculation

Note: DIR – the share of direct taxation in GDP, INDIR – the share of indirect taxation in GDP, PIBL-GDP per capita Index in USD, SOM – unemployment rate, IPC – the corruption index; FS – very low, S – low, N – normal, M – high, FM – excessive, E – extremely high, R – very high, ME – medium.

The last phase was to write the numerical series related to variable ECINF (underground economy). For this reason we assigned the following values (subjective values) to membership levels referred to underground economy:

– extremely high: E = 0.5;

– very high: R = 0.35;

– medium: ME = 0.20;

– low: S = 0.10;

– very low: FS = 0.05.

We mentioned again that these values choice was arbitrary. Assigning other values to membership levels, the related underground economy values will be changed.

Table 3 presents some processed information obtained by using fuzzy operators MIN and MAX:

Table 3

Setting underground economy size (ECINF)

Rule number	Causal variables					Minimum causal variables value*	ECINF
	DIR	INDIR	PIBL	SOM	IPC		
1	FM	N	FS	N	M	0.026986	R
2	FM	N	FS	N	FM	0.038350	ME
3	FM	N	FS	M	FM	0.030680	R
4	FM	N	FS	M	M	0.026986	ME
5	FM	N	S	N	M	0.026986	ME
6	FM	N	S	N	FM	0.030680	R
7	FM	N	S	M	FM	0.038350	R
8	FM	N	S	M	M	0.026986	ME
9	FM	M	FS	N	M	0.033732	ME
10	FM	M	FS	N	FM	0.030680	ME
11	FM	M	FS	M	FM	0.030680	R
12	FM	M	FS	M	M	0.026986	R
13	FM	M	S	N	M	0.026986	ME
14	FM	M	S	N	FM	0.038350	R
15	FM	M	S	M	FM	0.038350	R
16	FM	M	S	M	M	0.033732	ME

Sursa: own calculation

* represents MIN function values multiplied with confidence rate.

4. Estimating Romanian underground economy

In this paper we calculated the maximum value recorded by variable ECINF (for the year 1992) on each membership level, as follows:

- Level R (very high): max (0.026986, 0.030680, 0.030680, 0.038350, 0.030680, 0.026986, 0.026986, 0.038350) = 0.038350;
- Level ME (medium): max (0.038350, 0.026986, 0.026986, 0.026986, 0.033732, 0.030680, 0.026986, 0.033732) = 0.038350.

These maximal values were multiplied with confidence rates values corresponding to underground economy:

Level	Maximal value	Memmership level value
R	0.038350	0.35
ME	0.038350	0.20

Finally, we determined the size of underground economy corresponding to year 1992 (as a share of GDP):

$$\frac{0.038350 \times 0.35 + 0.038350 \times 0.20}{0.038350 + 0.038350} = 0.275.$$

In 1992 Romanian underground economy represented 27.5% from official GDP.

This working procedure has been applied to all years of the analyzed period. Summary results are presented in figure 1.

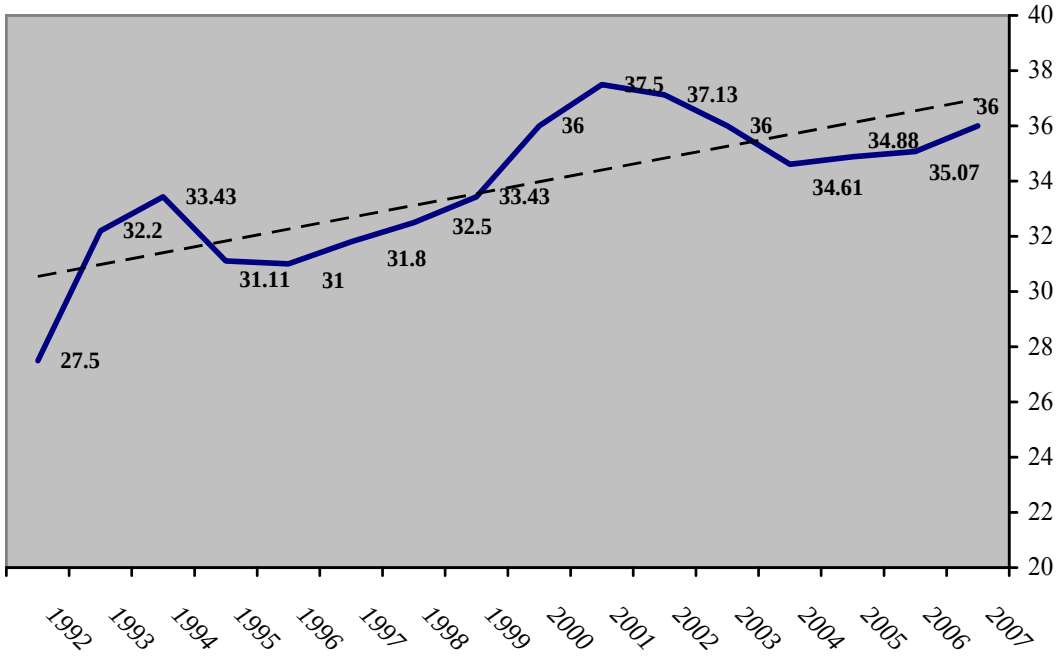

Figure 1. Romanian underground economy evolution (fuzzy model).
33.76% is the average value of underground economy in Romania in the period review.

Source: own calculations.

5. Conclusions

No one can sustain that a method or a model for underground economy is better than other. No one can determine which methods provide the best solution, the best value or the highest confidence degree for underground economy size estimation. Why not? The nature of underground economy stays uncertain itself. However, we can believe that fuzzy technique presented here may be an acceptable alternative to regression equations analysis.

Due to its clandestine or hidden nature, underground economy measurement is an uncertain and difficult matter. The fragility of methods, lack of measuring instruments and also the inherent of phenomenon nature make it difficult to use both quantitative and qualitative analysis, giving only approximations and uncertain figures. The question is if these values may be consider being normal for Romanian economy or exceeding the limits and endanger very seriously our national economy. The answer is given by international comparisons with similar economic structure countries.

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PHILLIPS CURVE
CASE STUDY – ROMANIA

Tiberiu DIACONESCU*

Abstract. *During modern history of economics, many have tried to find different models that are capable to emulate, and even predict various macroeconomic aspects. One of the most painful problems of the twentieth century, and probably for a long after, was control of unemployment in relation to inflation. Every country desires not to be unemployed, but at the same time, if possible, to achieve this without excessive costs. Alban W. Phillips did not tried to solve this, instead he tried to find the fundamental relationship between the two indicators, in order for governments to adjust theirs fiscal and monetary policies so they can achieve this goal.*

Keywords: *unemployment rate, wage rate, inflation rate, trade-off, stagflation, the natural rate of unemployment, NAIRU.*

1. Introduction

One of the most painful problems of the twentieth century was control of unemployment in relation to inflation.

In order for governments to adjust their fiscal and monetary policies depending on the situation, a fundamental model was needed to be discovered.

A.W. Phillips was among others, who tried to solve this problem. He managed to find a relationship between inflation and unemployment, wide on the longrun would have been perfect for any government. Unfortunately his relationship was very much dependent on data, and more over, was not valid for any country studied.

Many economists after him tried to adjust this relationship but with very little success.

Within this paper a study case is offered, for Romania showing that, during 2007, such a relationship is possible.

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2. Generalized Phillips Curve

Alban William Phillips, an economist born in New Zealand, wrote a paper in 1958, entitled, *The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom 1861–1957*, which was published in the quarterly journal *Economica*.

In his paper, Phillips argues, using data series from U.K., that there is an inverse relationship between unemployment and wage rate cast roll. This relationship, according to Phillips, would hold both on long and short term. As time passed, however, other economists who were interested also in this phenomenon, have shown (empirically) that while there exists a relationship between the two components, it is unlikely to be the one that Phillips thought of.

The basic idea that stands behind the Phillips Curve is the relationship between wage growth rate and the size of unemployment. Thus, when wages increase rapidly, unemployment begins to reduce itself, and conversely, if unemployment increases wages remain constant for a short period of time, and then they begin to decline.

The line that joins representative points formed by change rate of wages (OY) and unemployment rate (OX) – is the Phillips Curve, which in fact represents the best approximation of the relationship between the two components [Best Fit] (Fig. 1).

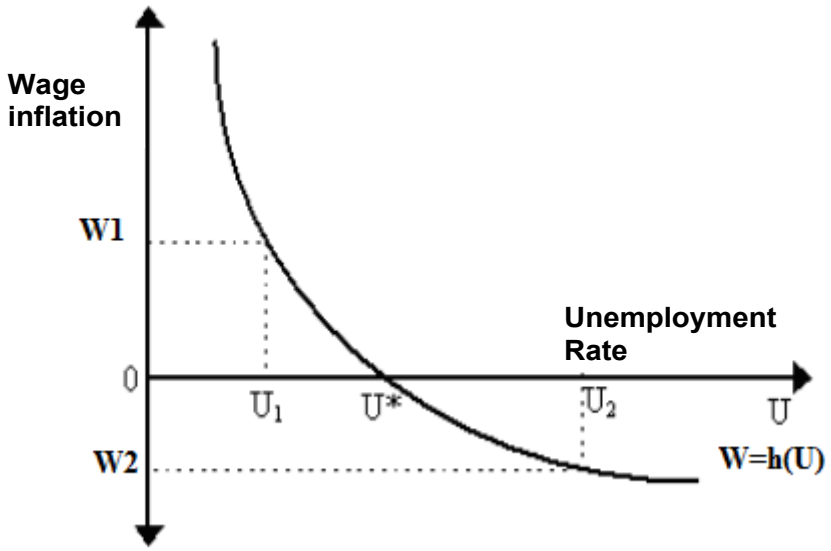


Figure 1. W function depending on unemployment rate, U.

The equation describing this relationship, based on empirical methods using data from 1861-1957, according to Phillips, is:

$$g_w + 0.9 = 9.64\, U_t^{-1.39},$$

or:

$$\ln(g_w + 0.9) = \ln 9.64 - 1.39 \ln U_t$$

where g_w – is the rate of increase in nominal wages, U_t – is the level of unemployment.

In general, we set g_w as percentage rate of growth, and the relationship becomes:

$$g_w = g_w^T = f(U). \tag{1}$$

This equation suggests that the growth rate in nominal wages increases along a trend (as indicated by „*T*") and falls with the unemployment rate (*U*). This function is assumed increasing monotone along *U*, so that depreciation of nominal wages by unemployment rate, is suggested by the presence of the negative sign in the equation.

After several years, the publication of Phillips work was adapted by economists, replacing the rate of change of wages with the inflation rate. They established, also, the inverse relationship, which came to be so appreciated by the highly industrialized governments, allowing them to implement the necessary policies of control for both inflation and unemployment, along the Keynesian thinking school.

The tool at the basis of these changes, was that, when wages were changed (not necessarily increased), labor costs changed (usually, increasing). Even more, total costs changed, which draws an immediate change in prices, too (obviously, up). Along high prices inflation occurs. Thus, the link was created between inflation and unemployment.

Starting in 1970, the equation changed, introducing inflationary expectations (g_p^{ex} – expected inflation rate), transforming the Phillips Curve into a curve of expectated wages:

$$g_w = g_w^T - f(U) + \lambda * g_p^{ex}; \tag{2}$$

λ (is considered constant during any period) represents the degree to which employees can receive an increase in their nominal wages, in order to keep up with the expected inflation. Usually this parameter is unitary in the long term.

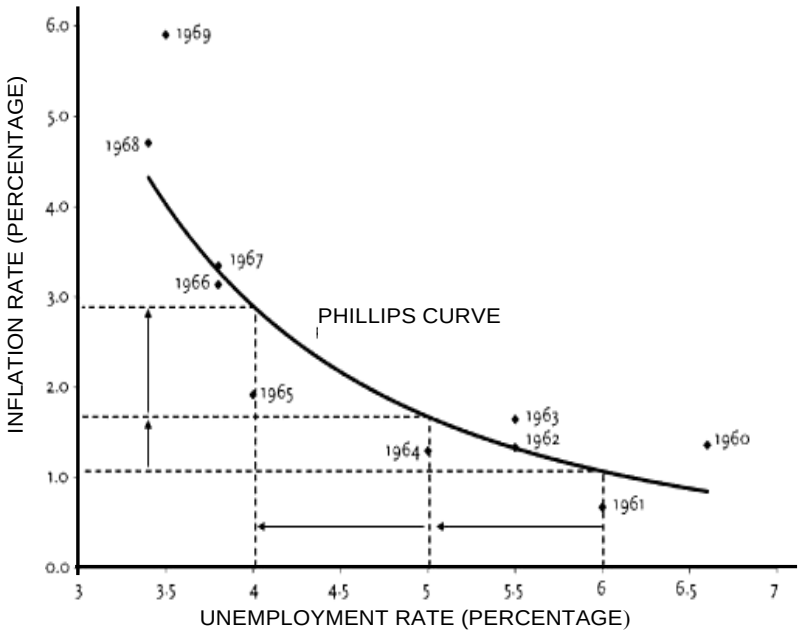


Figure 2. Phillips Curve.

Here is an example (Kevin D. Hoover – "Phillips Curve"), in order to understand the trade-off between inflation and unemployment. In the figure 2 a typical Phillips Curve derived from data, U.S.A. 1961-1969 is represented. The close correlation between the estimated curve and the empirical data pushed several economists to use the Phillips Curve as a guide for future policies. For example, for a given rate of unemployment of 6%, the government could stimulate the economy so as to obtain a value of 5%, at a cost of just over half a percentage point in inflation. If the government would want even lower rate of unemployment, the costs would suddenly become considerable: for a reduction in unemployment from 5% to 4%, that would imply and increase of more then double in the inflation rate – about 1 – 1¼ percentage points.

Between 1970-1980, U.S.A. experienced a time of crisis – the energy crisis. This fact led to an extremly unpleasant phenomenon both for U.S. and for other highly industrialized countries – that is, a strong shift in the supply curve, towards left, which meant that with higher inflation comes even higher unemployment rate (stagflation). Up to this moment, Phillips Curve only considered a motion in aggregate demand (always to its right), and the aggregate supply was neglected (it was considered almost always constant).

According to Phillips' theory this should not have happened. This is the moment where economists started to contest Phillip, and governments

started to re-think the way policies were made – from interventionist policies to free market.

One of the contesters, Milton Friedman argued that if employees would be well informed and understand basic economic principles, then, they would negotiate their wages on a real basis not at a precentage one. This would further push the balance between supply and demand on the employment market; thus the unemployment could be maintained along a fixed line within the apreciation of real wages. Friedman along other economists have reached a conclusion: it was necesary to distinguish between various adaptations of Phillips' Curve – for long and short term.

A strong example of this is the LRAS[1] Curve. A graphical representation of long-term relationship between real output (out-put level) and price level, keeping all factors of influence for the aggregate supply, constant (caeteris paribus). The curve shows us, the lack of cause and effect between real output and price levels, at certain periods. First, with increasing prices, real output remains constant for maximum employment occupancy (full-employment), up to a certain point. Second, due to price flexibility, the same level of real output would be generated for any price level (i.e., constant prices). In other words, if the output would increase, we would not experience any changes in price levels (Fig. 3).

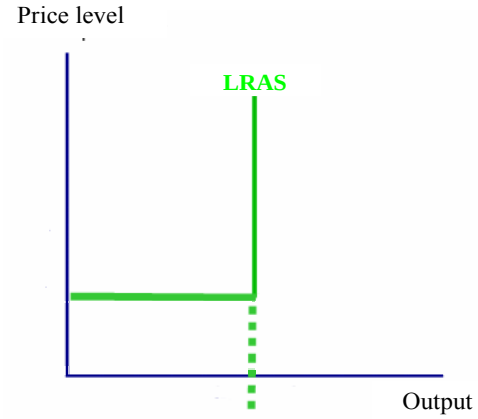


Figure 3. Long-Run Aggregate Supply Curve.

The influence of aggregate supply, will be almost nonexistent within the direct relationship to the price, until obtaining maximum production, after which, however, it will generate inflation (pay higher prices for the same amount of output) (Fig. 4).

[1] LRAS – Long-Run Aggregate Supply Curve

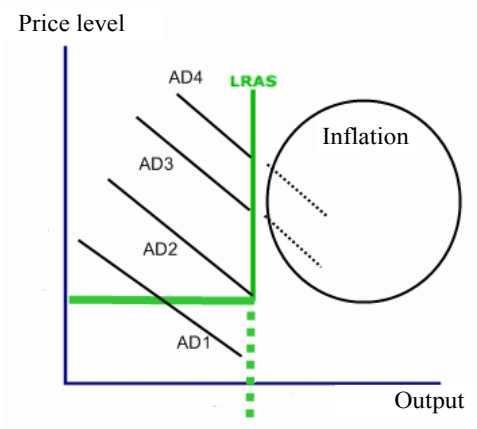


Figure 4. LRAS depending an aggregate demand.

In practice, we already know, that on the OY axis we measure price levels and on the OX axis the level of output. Thus, price levels are calculated using the GDP deflator[2], and the output through real GDP[3].

Thus, various economists, like Friedman and Phillips, came to realize that on long term, always – on average – we will remain at a fixed level of unemployment (Fig. 5).

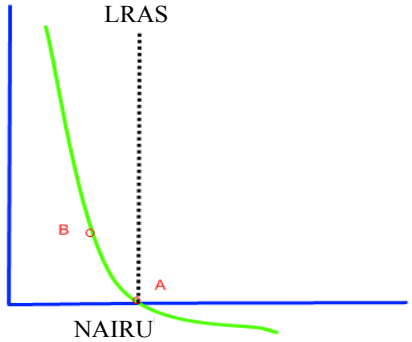


Figure 5. NAIRU – Represention.

That point, is represented in figure 5 – NAIRU –, and it stands for "Non Accelerating Inflation Rate of Unemployment", that is, a rate of inflation which remains constant for a given rate of unemployment. The idea is that the actual rate of unemployment cannot fall below NAIRU, and

[2] Price index used to eliminate inflation out of GDP is the GDP deflator. This is a weighted average of prices for all goods inclued in GDP, the weight of each good is equal to the procentage of its importance in total GDP. ***P = nominal GDP/real GDP***.

[3] Real GDP eliminates price fluctuations within the nominal GDP and it represents GDP in constant prices.

that price levels will rise faster (accelerate) during favourable economic periods, when, naturally, the demand for labour is much higher.

The function *f* from (2), has been modified so it can contain NAIRU as well:

$$g_w = g_w^T - f(U - U^*) + \lambda * g_p^{ex} \tag{3}$$

where U^* represents NAIRU.

Thus, if $U < U^*$, inflation tends to accelerate; if $U > U^*$, inflation tends to slow down. We assume $f(0) = 0$, so, when $U = U^*$, f is no longer a part of the equation.

Within equation (3), the importance of g_w^T and g_p^{ex} seems small, but if λ is equal to one, this fact is no longer valid. If the rate of changing nominal wages is equal to zero then the fact that $U = U^*$ implies that g_w is equal with expected inflation. Thus real expected wages will remain constant.

In theory, NAIRU has some basic properties:

If U^* is NAIRU and U is the real value of actual unemployment, the theory will state the following:

- If $U < U^*$ for several years, the expected inflation will rise, thus inflation rate will accelerate;
- If $U > U^*$ for several years, the expected inflation may fall, thus the inflation rate will slow down (it can be disinflation);
- If $U = U^*$, inflation rate tends to remain constant, unless there is an exogenous shock.

3. The new form of Phillips' Curve

The equation behind the Phillips' Curve may derive from Lucas' aggregate supply functions (on short term). Rather than start from empirical data, Lucas began with a classical economic model, which fallows basic economic principles.

Starting from the aggregate supply function:

$$Y = Y_n + a(P - P_e), \tag{4}$$

where Y represents the log value of actual output, Y_n is log value of the „natural" level of output, a is a positive constant, P is the log values of present price levels, and P_e is the log value of expected price levels. Lucas assumes that Y_n has an unique value.

We can rewrite the equation as:

$$P = P_e = \frac{Y - Y_n}{a} \tag{5}$$

then, we add some unexpected exogenous shocks upon the global reserves υ.

$$P = P_e = \frac{Y - Y_n}{a} + \upsilon \tag{6}$$

if we subtract the level of prices from previous year P_{-1}, we get inflation rate.

We also have a negative relationship between output and unemployment (according to Okun's Law):

$$\frac{Y - Y_n}{a} = -b(U - U_n). \tag{7}$$

Where b is a positive constant, U is unemployment and U_n represent natural rate of unemployment (NAIRU). We reach, in the end at Phillips' Curve for short term:

$$\pi = \pi_e - b(U - U_n) + \upsilon.$$

4. Study Case for Romania

If we take data, on a monthly basis for 2007, we can observe that we almost have a Phillips Curve (Fig. 6).

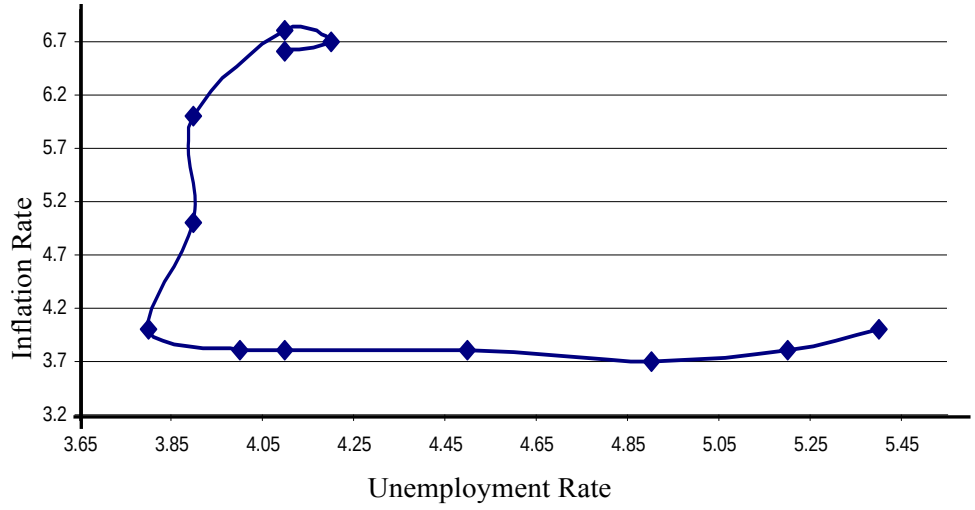
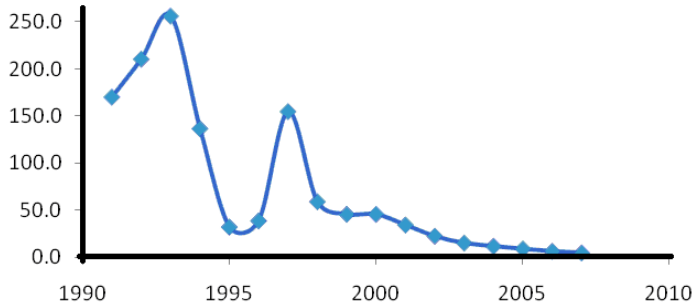


Figure 6. Phillips Curve, Romania 2007.

In Romania, after 1989, the inflation rate had an irregular evolution. During first years after the revolution (the communism was overthrown, democracy came in place), the values of inflation were way above 100%, reaching the level of 256% in 1993. Only from 1998 we can say that Romania had a normal evolution. The main reason for this stabilization was the desire of Romania to adhere to European Structures. Thus, the monetary and fiscal policies were changed for this purpose only; the final victory was registered during 2007 when Romania has finally reached a single number rate of inflation (9% – 2005). The last ten years, shows a close fight with inflation, getting from 59,1% rate in 1998 to 4,8% rate in 2007 (Fig. 7).



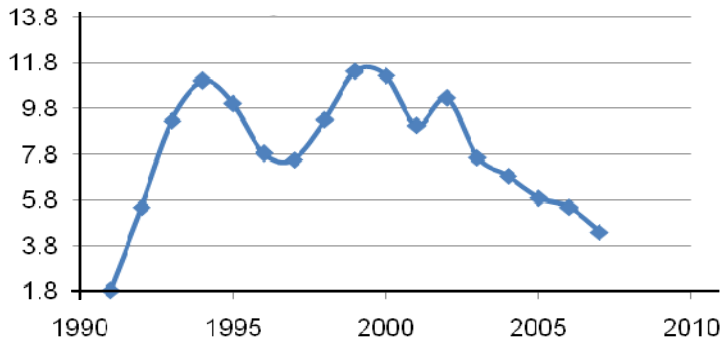
* The data were gathered from the NIS – Romania.

Figure 7. Yearly inflation rate in Romania.

Economists have agreed upon certain levels of inflation and unemployment as targets, thus for Europe they were set somewhere between under 4% for unemployment and inflation near 2-3%. The question remains, what will happen if inflation can be mentained at the desirable level, but unemployment rises above the 4% level.

The European Commission forecasted for 2009-2010 that recession will continue. The number of jobs will be reduce with at least 3,5 million reaching a 8,75% rate within EU and 9,25% within euro (exchange) zone. Inflation in 2009 was predicted by EU at 1,2%, as aginast 3,7% in 2008 and somwehere near 2% in 2010. This can only mean one thing: new methods for stimulation economy are mandatory. The first step was already made, when interested rates were lowered almost in all European countries. This should stimulate businesses, encourage credits, and last, investments. Along low interest rates, saving was the main target. The second step was made through fiscal policies. The governments can create themselves jobs, through increasing government expenditures.

For Romania, the facts are represented in figure 8.



* The data were gathered from the NIS – Romania.

Figure 8. Yearly unemployment rate in Romania.

Using Eviews program, one can see the following two line-unemployment rate in blue, inflation rate in red – the period considered was January 2006, Decembre 2008, monthly data (Fig. 9).

We can almost see the trade-off between the two components, somewhere at the end of 2006 and the beginning of 2007.

Along the drop in unemployment from 6% to 4%, the inflation rate grew from 4% to 7%, and continued over the 2008 period, up to 9%. This movement seems to suffer from lag, at almost 2 quarters of a year. This is almost natural for a country like Romania, where fiscal policies are changed on a yearly basis, and coherence and consistency of these measures can often be questioned. The only type of policy, which remains constant, is the monetary one, where National Bank of Romania has, still, some degree of freedom.

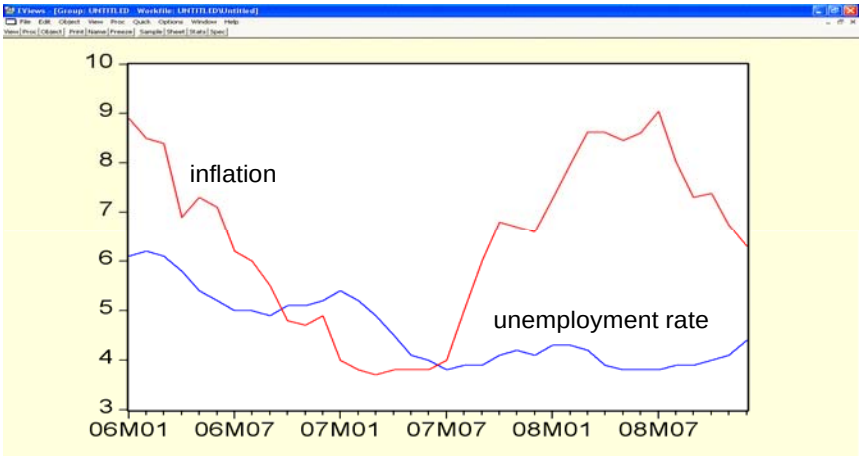


Figure 9. Unemployment rate and inflation representations.

5. Conclusions

In practice, in order to study Phillips Curve, one needs many data, preferably on a year basis, not monthly or quarterly – these can provide mix information, or even worse and no Phillips Curve will be present. This alone, unfortunately, will not guarantee, the presence of Phillips Curve, but this should not stop us. Where there might not be an inverse relationship, exactly as Phillips presented, one may find other types of relationship. The only real fact that remains is, at some level, inflation and unemployment go together.

Further study will be made in future papers, with the main goal to find specific parameters for Romania, and perhaps for other countries.

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KNOWLEDGE AND COMMUNICATION. ETHICS AND VALUES IN THE KNOWLEDGE ECONOMY

Valentin COSTINESCU*

Abstract. *In today context of society orientation in a more accentuated way to a knowledge economy, it becomes more and more interesting an approach of communication from the point of information internalization in social plan, by increasingly large masses.*
Communication regarding the creations from cultural, arts, literature fields, has had always, one way or another, formative message for different categories of population to which has addressed.
In the stage of Knowledge Economy, the classic production factors which have determined the development of human society, work, land, and capital have been outmatched, as importance, by the information factor. Knowledge constitute now, the main form of capital.
In this context, ethics and values become more and more important as a social and economic development frame.

Keywords: *new economy, knowledge economy, ethic markers, social communication, social security.*

1. Introduction

The society orientation to a Knowledge Economy makes the mass communication to come about an important factor to administrate the people relationship, to effect the control of people feed-back from a certain stimulus, without any formal estabilished organization in social or economic structures. The cultural implications of social communication bring to mass communication special socio-philosophical challenges which push the consumption to the cultural creation area and try to be instruments to overtake the ethics and cultural values creation crises.

Beyond the cultural-philosophical aspects of social communication, its implication in economic development is implacable, the New Economy being a Knowledge Economy.

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In a same context, in which the communication is running as a tool for gestion economic and social matters on the scale of large collectivities, the values and ethics proper to the new realities of society are imposing like a compass to the new economies.

2. Information and communication

In today context of society orientation in a more accentuated way to a knowledge economy, it becomes more and more interesting an approach of communication from the point of information internalization in social plan, by increasingly large masses.

Mass communication becomes a predilection subject of sociologist, economist, and ideologist from field of culture, politics, administration, cults, pedagogy, and psychology.

That it is owed to the appearance and rapid development of modern technologies of communication and of political, social and administrative structures interest of orientating and even direct important aspects of human behavior.

On one hand modern technologies of mass communication are capable to capture more important mass of auditors.

First signs of interest in this field has manifested in United States, country which has outmatched all the others in this field.

In 1932 Harold D. Lasswell specialized especially in psycho-politics sociology, publishes an article in which were prefigured the theories, which were exposed a year later in famous paper, regarding the effects of radio over the opinion. In 1940 the radio and journalism were inspiring Paul F. Lazarsfeld, mathematician of Austrian origin, that become the founder of quantitative sociology in the United State.

In 1933 W. W. Chartes published a study regarding to the effects of cinema over the young.

The press and radio influence over the presidential election constitute in 1944 the subject of a published paper in common by Paul F. Lazarsfeld, Bernard Berelson and Hazel Gaudet.

Berelson, specialist in content analysis, was proved to be one of the great parents of mass communication.

This generation has known two phenomenons which market her profoundly: psychological war and brutal development of television.

That is the reason why her attitude influences, even today, informational and communicational sciences which reflect a ideological craving, an anxiety in the face of general change which escapes traditional

analysis, every day more and more from instauration in the last fifteen years of internet domination. Words – key of knowledge sociology, overcoming the social and informational spheres, have become cultural archetypes and are already unanimous internalized: opinion, leader, influence. Preferred method in developing information sciences – secured quantification – has become study subject already classic for all the schools that are preparing communication specialists in all the fields of organized activity, at social level.

In 1936, George Gallup has predicted exactly the election results – election through which Roosevelt was maintained in power – with the help of a statistic survey method, which after the war spread around the world with a well known success. Regardless its indubitable merits and alike usage, the survey realizes the image of a predictable society and in the same time non informational, so somehow less worrying. The election result of some few thousand town councilors or even of some few hundred deputies is much harder to predict, but much more significant then the binary choose between a "yes" and a "no" or the option between two candidates. Much easier could be calculated, in this case the incertitude difference and so of information. As the "palette" of a survey is larger, so the citizen is surer of his freedom.

So, beside the first manifestations of mass communication sociology, it exist the desire to break through and to know how can be influenced these millions of men and women, which are hidden behind the camera or the microphone.

It was obvious that, without realizing the phenomenon profoundly, we can already know which are the mass parameters in which we can sell a general product, if the man or political party, as a product, is already quantifiable as marketing product.

Therefore, beside the fact that modern technologies of communication were proved to be able to affect increasingly important mass of population, appears on another hand in an inherent way (not to say necessary) a more aggressive manifestation of all medias interested in promoting ideas, products, services and influences related to them, for utilizing the new orientations regarding methods of information and communication sciences. How could it be ignored the secured quantification of informational and communicational nature phenomenon in economic, cultural, religious fields?

In approaching the mass communication problem, the fundamental problem in communication matter is the crossing from group to mass. We must observe that the group can be described as a communication

subsystem. But “mass”, through its variation of relations and through the raised level of entropy that characterizes it, seams, alike, to oppose communication, reducing in necessary way, the finest strategy at orders of elementary simplicity. Otherwise, a coherent communication of ideas as a mass communication can not exist.

Thus we will meet, at modern theorists of communication the tendency to define “mass” through negative peculiarities that distinguish the groups between them; these peculiarities are referring to stereotypic marker and at the appreciation if the respective group is more consumer then producer of information. Hereby, it is accepted the next definition of “mass”:

“The word mass denotes in sociology, a great number of individuals which compose a very diversified population, not having an social organization but still answering uniform to certain stimulus”.

3. Communication and culture

Communication regarding the creations from cultural, arts, literature fields, has had always, one way or another, formative message for different categories of population to which has addressed. This message integrates, with time, more and more in the anterior specified method, respective the secured quantification. On one hand the individual captures creation put at his disposal in an “innocent” way through media channels, on another hand, media administrators from different levels, supervise in a rigorous way the audiences and relations between the individual and the spiritual creation to which he accesses. Considerations regarding the administrative way of such relations are difficult to formulate, the access to such information being very pretentious.

In such conditions an informational and communicational theory can only acknowledge the objective existence of informational production in poetics and esthetics – the output and the input of a black cassette of which function can not be explained. It is sufficient to define an object that is the creation.

The opera, creation and, in the same time, stake of a confrontation, of a fight over influence between the one that produces it and the one that perceive it, provokes in both the supreme pleasure.

It is objected sometimes, that the entropy notion has nothing in common with this supreme pleasure, as we can read a hundred times a book, for example, we can watch a hundred time a picture or a sculpture, we can listen a hundred time a musical piece or we can watch as many

times a cinema production or a promotional advertise and still, although we know them, or we have the impression we know them by heart or in the smallest detail, we can try every time a new pleasure. It is easy to say that the pleasure must be new every time, and it can be new because the verb "to know" does not have an immovable sense, as every lecture, every artistic observation, every audition or view constitute a new experience, that does not deplete the mystery of the respective creation. The word "mystery" can seam, for some, more acceptable then the word entropy, although they are synonymous. We are really taking awareness of the creation, as of any animated or unanimated object of our entourage, only if we are making through that a linear exploration defined in time. To say about a creation that lives, means to recognize the fact that lasts in its entropy, which can be exhausted in a moment, in other circumstances, through a different exploration that ransacks new stimulus and request inedited responses.

This is somehow similar to game cards in which a card, which has been already drawn, is put back in the pack, although the game mechanism is infinitely complex. The creation, as the game cards, it is a source without memory, but as a difference to this is that is not constitute as a finite automat; imagine, speech, text, show, melody, suites messages which emits – are related to the language. It contains so much unpredictability as its lecture claims – in theatre or music case for example – mediation of a interpreter, or the interaction of an audience and a interprets group.

It does not exist another serious criterion for what we could call "value of a creation", but the number and variety of lectures, views or auditions which can be permitted without the exhaustion of its entropy. In this sense, a bad book is the one that gives all its restricted unpredictability from the first lecture and we are nicely arranging it on a shelf. But that does not necessarily mean that it said its last word.

A reader that saw everything or thinks he saw everything from just one look, could have been very well a shortsighted reader, or maybe, who knows, the angle from were he was looking was not favorable. Other generation can come and disturb the library dust and resuscitate strange palingenesis. What was transparent in one century can fill with entropy in another, based on historical context. "The best thing a writer can hope – said Kipling – is that his work survives at least a bit, from where the world can sip with zest later, in order to sustain and to beautify the reaffirmation of some ancient truth or the elevation of a primitive joy". In principal, after the author puts on circulation his work he can not really influence its faith; the impetuous evolution of marketing as a scientific discipline has shown,

at least in same remarkable cases, that beside its value manifested outside the utilization of a mix marketing adequate method, a spiritual creation can become a real market boom through using of efficacy and efficient marketing politics (the Harry Potter case is eloquent).

And still, we can deny the fact that, from efficacy information transmission reasons, it is taken in consideration more and more mass communication orientation to a "close communication". Consequently, mass culture tends to orientate to a "request culture", in context of more spectacular possibilities of choice of cultural act which we want to attend.

The defect of such an analysis is that it is placed in a certain society type, which in the second half of the last century was desired to be called "consumption society"; its characteristics regarding the abundance and a facile and in great quantities consumption of products and services for satisfying all human needs, especially regarding basic needs, it is found today in what we call a knowledge society in which the abundance and importance of information exceeds the abundance of products and services with material character.

In this context, we could describe as consume the cultural activity. Reality imposes us to get rid of an innocent cultural communication idea. As I have suggested we communicate to act over a social relation, to attend, in a way more or less aware, a certain society project. So, the idea expressed by Englishman J. L. Austin over then forty years ago – "to say means to do" – must be pushed to her last consequence.

In a necessary way, is questioned the problem of exceeding supervised freedom of mosaic culture in order to get to productive freedom, capable to discard the lack of creativity. That can only be realized in a cultural revolution. The fundamental idea of such a revolution is the deletion, not only of the notion, but also of the fact of "cultural consumption" in order to replace the two terms with "cultural production" extended to all the groups and group-assembly of society. One of the hardest psychological obstacles to be defeated is, without a question, the one regarding the solution of the contradiction which opposes the barrier culture, generalized communication, which is permitted and reclaimed by the modern means of information diffusing. The conquest of the cultural means of production, of communication networks, of devices, of techniques that everybody to be somebody else, different from others through others, with equal weapons, with equal chances to affirm their individuality or offering everybody the possibility of a productive lecture: here is what can constitute the object of such a revolution.

4. The New Economy – a knowledge economy

The accelerated development of productions factors from the second half of the last century has imposed a new stage in economic development on international plan – knowledge economy. In this stage, the classic production factors which have determined the development of human society, work, land, and capital have been outmatched, as importance, by the information factor. As the information is more efficient and innovative processed, so much the social economic development is more accelerated. The acceleration processes of social economic development can have place without integration in a whole new phenomenon, respective globalization.

The knowledge becomes the key to economic social competitiveness and success. This adds massive value to economy production, through productivity growth and through new technology and ideas application so much through invention activity development, as through new modalities of utilization existent technology bringing revolutionary changes on all markets and economic social sectors.

Knowledge economy is an economy which creates, disseminates and utilizes information in order to intensify, especially her development and competitiveness.

World Bank has formulated the next standard directions regarding helping countries to adapt transition to a knowledge economy:

- An economic and institutional regime which assures support for efficient using of resources and new information and for developing market initiative for an outstanding number of economic agents.
- A prepared and educated population to create, to share and to use adequately knowledge.
- A dynamic informational infrastructure facilitating effective communication, dissemination and processing of information.
- An efficient system of companies innovation, research centers, universities, consultants and other organizations which can offer rapid access information stocks which are in continuous growth, which can assimilate information and can adapt to local necessities and can create new technologies.

For the countries from worldwide economy avant-garde, the equilibrium between knowledge and resources has been adjusted so efficiently so that the knowledge has become probably the most important of factors which determinates the standard of living – more important then natural

resources, work means or work. Today, the most higher of technological point of view are actually based on knowledge.

In the last two hundred years neoclassic economy prepared to acknowledge, unanimous, only two production factors: work and capital. Knowledge, productivity, education and intellectual capital were seen as exogenous factors, placed outside system.

American economist Peter Drucker is the one which, in 1966 in his book The Effective Executive lunches for the first time the concept of Knowledge Economy emphasizing the differences between "the manual worker" and "the knowledge worker".

Later, other economist Paul Romer (Stanford University) lunches in the 80's of the last century The New Growth Theory, which takes in consideration work as a principal factor of productivity. Romer and others from his school have been concerned with the springs of development on long term. Continuing the work of economists as Joseph Schumpeter, Robert Solow and others, Romer proposes a modification of the neoclassic model taking in consideration the technology (and the knowledge on what is based) as an inner part of the economic system. The knowledge are so taken in consideration as the third productivity factor in develop economies.

The technology and knowledge are now key factors of production process.

In this presentation we must specify that the Romer theory is different from the neoclassic economic theory in several points as fallows:

- Knowledge constitute now the main form of capital
- Even thou the new technology seems to appear random and without a significant immediate practice, Romer considers that the new developed technologies beside their immediate impact, being insignificant through itself, can create real technique bases for future innovations and that the effect of this bases can sustain and direct scientifically the economic growth.
- The success technologies are the base for investment recover, which explains why the developed countries can sustain the development processes and way the economies in development process, even those with great potential of work and capital force, can not develop. Traditional economies offer diminished possibilities for investment recover.

  Theorists of New Growth explain this through the fact that the quality and sustaining effects offered by the new technology can

lead to economic growth even in conditions that the technology investment recover rate is not spectacular.

- The investment can bring the contribution of high technology and high technology creates conditions of development of investment politics. After Romer, this virtuous cycle so resulted can determine, in a permanent way, an economic development rate in continuous growth.
- Romer's arguments regarding innovation technology development are important in providing efficacy motivations to the companies to invest resources and development for technology innovation.

The concept of Knowledge Economy appears in a context in which Paul Romer develops The Theory of New Growth.

At the moment of 80's was not placed the problem of "shift" between the two schools of thinking and it was not discussed the Knowledge Economy in terms developed later with the contribution of Romer.

Just like that today we are faced with a theoretic approach which reunite in a consensual way the Romer school and that of Drucker's, approach impose by practice circumstances of knowledge impact on economic development. We need to add that in a general signification, Knowledge Economy is that in which generating and exploiting knowledge has the predominant role of creating welfare.

Information, communication and culture characteristics regarded from a logic and integrative perspective, as were presented here, are to be found in standard directions as formulated earlier by World Bank.

We are living in an environment in which states are developing:

- An economic and institutional regime which assures a more rigorous support for efficient using of resources and of new knowledge, and for market initiative developing, for an outstanding number of economic agents. More then that, it is developing a real engineering for mass communication, in order to serve with priority, the development of any kind of market.
- A prepared and educated population to create, to share and to use adequately knowledge. And that regarding mainly the developing of the same markets. The ordinary man, without knowing some things of the vocabulary, language and culture of countries with a decisive role on the market, can not satisfy in acceptable way even a good few primary needs as they were defined by Abraham Maslow with many decades ago, that says a lot, not only regarding such a desiderate, but even regarding the way in which the economy type defined as Knowledge Economy imposes implacably,

even tough and sometimes cynic, in social plan. The culture import is distributed through media channels and through free circulation of products to every one of us without being asked if we want or not. Yet the more accelerated appropriation of import culture is a reality for every one of us; until this knowledge economy, we have not registered such a modality to realize mass culture.

- A dynamic informational infrastructure facilitating effective communication, dissemination and processing of information. We do not want to buy books? At work or in a business we will not be accepted without necessary knowledge. Today is hard to "steal" occupation without reading. To read is what you "need" in an inherent way. The first concern of the state, for its employs and for the ones from private sector, is to obligate them to periodically specialize in a form or another.

  The computers and office internet (not necessarily from home) do not represent "a dynamic informational infrastructure facilitating effective communication, dissemination and processing of information"?
- An efficient system of companies innovation, research centers, universities, consultants and other organizations which can offer rapid access information stocks, which are in continuous growth, that can assimilate information and can adapt to local necessities and can create new technologies. Do we buy products or services which have not been upgraded, even superficially for insignificant functions, in the last months? Of course not. Every body innovates; how to make the product, how to sell it, how to replace it, what need to create in the market, how to oblige in any way the potential buyer, either if provides or not a product or a service. A choice does not exist: if we do not innovate the concurrent firm will, and then will be harder to survive and it will be harder to exist as market players.

5. Ethics and values in The Knowledge Economy

In this presentation we observe two categories of values associated to the concept of Knowledge Economy:

- The values formulated as standard directions by World Bank, in order to help countries to adapt transition to a knowledge economy – values recognized in practices of World Bank and appropriated in political plan by the countries participating to worldwide

economic circuit, through intern legislation, through international treats and concords.

- Values deriving from New Growth Theory promoted by Romer as a context of developing the concept of knowledge economy. These are enunciated in the present paper as differences reporting to the neoclassic economic theory. The neoclassic theories values regard the evolutions of economic liberalism and underlie, already for a hundred years, the political economic positions of governments, which register sustained economic development and relatively rapid, accompanied by growth of living standards, representative for each period.

Related to promoting these values, the knowledge economy development it is realized in a logic way, with taking in consideration of the next ethic markers.

a) *Production and commerce*

Production and commerce development in knowledge economy takes place in a specific way.

From a certain perspective we are confronted with phenomena with impact over social and economic environment, which can not be influenced directly by the individual.

On another hand, production and commerce in a such economy are covered by rules at governmental and intergovernmental level, through legal rules which are in the end the expression of ethical principals which are generally accepted at social level, including:

– Liberal and neoliberal values: The values itself of free market and, in the same time, its value as a motor of economic growth at county level as at international level. Generally these values are found together with privatization and tax reduction, subsidies and state protection, otherwise one of the main purposes of World Trade Organization.
– Development is an economic process of growth which is beneficiary because brings to individuals more economic freedom and expands the choice possibilities in day to day life.

The criticism regarding these ethic markers concern reducing the possibilities of attending welfare for persons which desire material support form state, based on tax collected from population, which in this kind of a system are limited, and the permit to obtain a dominant role of entities, which obtain excellent results in the free concurrence system, poorly

controlled by the state. The same considerations are invoked in market worldwide level, where non competitive countries are bound to accept positions that are not favoring their welfare. Also, it is invoked the reducing of values and traditional communities importance which see themselves bound to obey an economic, social and cultural homogenized system, and to overcome the old values, with which have lived hundred of years to this stage.

b) *Environment and resources*

Obtaining welfare without resources use is unconceivable. The resource use in the Economy of Consumption, developed in the second half of the last century, has impoverished a good part of the traditional reserves of the countries, so their economy was put in the situation to discover alternative resources. Even so, the energetic crises, for example, occurred long time started with developed countries of the world.

An ethic marker in the new knowledge economy has become the protection and rational use of natural resources of the globe.

Tight related to the resources problem is that of the environment. The accelerated rush after economic results in The Consumer Economy has lead to an uncontrolled degradation of the environment, which threatens already even the natural existents of society.

That way, the environment protection is one of the ethic markers of Knowledge Economy.

c) *Population health*

The culture liberalization and the free circulation of goods and persons have been accompanied by the extending effects of transmissible illnesses, at planetary level. AIDS it is already an emblematic example. It is useless to bring in discussion the diseases determined by alcoholism and drogue use.

Within this context, new ethical markers are found in Knowledge Economy related to maintaining and promoting health at social and global level and of management in social plan the affected person's problem.

d) *Creation and culture*

Such avalanche of spiritual creation which provide for developing the Knowledge Economy is without precedent. The human society is yet to see a similar experience. This is realized in a context of social economic evolution of neo-liberal type, which permits free access to information and culture even with silent acceptation by the states of breaking of access order established through rules.

The problem in this direction is how to protect creation rights regarding, for example, intellectual property.

On a hand the protection and the promoting of this rights is a essential condition for development of Knowledge Economy, and on another hand use of such creation even outside the regulated rules of there protection, potentate sometimes, considerably, the economic and social development in a lot of sectors.

The imminent dilemma: what is the smallest harm? We are in a ethic markers crises. What are these markers? The one's recognized by states through acts or the one's accepted or tolerated by professional organizations, human right protection organization, and other civic organizations?

e) *Social security*

In a knowledge economy we do not die from hunger. The state assures through specialized mechanisms, including the ones attracted from civil society, minimal conditions of subsistence for citizens which can not assure day to day consumption for basic needs. At state system level a permanent and stubborn fight is given for a better allocation of resources between economic development fields and the social protection services including public health.

f) *Defense sectors*

Economic systems type "Knowledge Economy" is developing today in conditions, which neither "class enemy", neither antagonist military blocks are not pursuing the state or individual freedom. The war, which was feared, especially by the ideological media, has suddenly ended before it began. Its danger has been propagated in every form, through all means, in all media and in all civilized countries more the fifty years. It is true, all this time has taken place armed conflicts of small dimensions but the countries were preparing for another kind of war. This did not take place and it will certainly not take place in expected forms. The danger of such war was recently been replaced with unpredictable terrifying challenge, in the forming which has appeared at the beginning of this millennium: terrorism.

In such strategic context, Knowledge Economy is in a situation to develop.

There for the ethic markers which must be taken in consideration when it is projected and develop social, cultural, economic, technical, informational, medical technology, energetic assurers, environment protection and not at least human rights protections processes.

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SALES FORCE STRUCTURE DURING THE CORPORATE LIFE CYCLE IN DISTRIBUTION FOR FOOD PRODUCTS COMPANIES

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Abstract. *Distributions Companies have a lifecycle and undergo very predictable and repetitive patterns of behaviour as they grow and develop. The sales force structure that works during start-up is different from what works when the business is growing, during its maturity, and through its decline.*

The aim of this article is to explain how the management team could develop the best sales force structures for each of the four stages of the business life cycle. Specifically, companies for distribution for food products must alter four factors over time: the roles that the sales force and selling partners play, the size of the sales force, the sales force's degree of specialization, and how salespeople apportion their efforts among different customers.

Keywords: *corporate lifecycle, sales, sales force, efficiency.*

1. Introduction

The first challenge for leaders who wish to grow their organizations is to understand what phase of the organizational life cycle one is in.

Leading an organization through lifecycle transitions is not easy, or obvious. The same methods that produce success in one stage can create failure in the next. Fundamental changes in leadership and management are all required, with an approach that delicately balances the amount of control and flexibility needed for each stage. Leaders who fail to understand what is needed (and not needed) can inhibit the development of their companies or plunge them into premature aging.

The challenges that every organization must overcome at each stage of development first manifest themselves as problems that arise from the growth and success of the company and from external changes in markets,

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competitors, technology and the general business and political environment. Problems are normal and desirable. Problems are the natural result of change. The only place on the lifecycle curve where there are no problems is the place where there is no change, which is Death.

The "age" of a company in terms of its lifecycle is not related to its chronological age, the number of employees, or the size of its assets. Instead, the lifecycle age is defined by the interrelationship between flexibility and control.

There is no pre-set timescale for this corporate life-cycle and one key difference between the lifecycle for human beings versus organizations is that living things inevitably die, while organizations need not.

2. Corporate life-cycle

Different experts agree that are five phases of the organizational life cycle as following:

- Start-up (or Birth);
- Growth. This is sometimes divided into an early growth phase (fast growth) and maturity phase (slow growth or no growth). However, maturity often leads to;
- Decline. When in decline, an organization will either undergo;
- Renewal or;
- Death.

Each of these phases present different management and leadership challenges that one must deal with.

The Start-Up Phase

In this phase, we see the entrepreneur thinking about the business, a management group formed, a business plan written. For entrepreneurs needing money to kick start the business, the company goes into the growth phase once the investor writes the check. For those which don't need outside funds, the start-up ends when you declare yourself open for business.

The Growth Phase

In the growth phase, one expects to see revenues climb, new services and products developed, more employees hired and so on. The management textbooks love to assume that sales grow each year. The reality is much different since a company can have both good and bad years depending on market conditions. That's why many companies have different types of programs relating to organizational development in place.

The Decline Phase

Many organizations will enter decline the decline phase unless there are is in place a rigorous program of transformational leadership development. If senior leaders can detect the symptoms of decline early, they can more easily deal with it. Some of the more obvious signs include: declining sales relative to competitors, disappearing profit margins and debt loads which continue to grow year after year.

However, by the time the accountants figure out that the organization is in trouble, it takes tremendous leadership to get the organization to change course.

Reasons For Decline[1] that resulted from a study made over 1900 company which were in trouble: too much debt (28%), inadequate leadership (17%), poor planning (14%), failure to change (11%), inexperienced management (9%), not enough revenue (8%).

The Renewal Phase

Decline doesn't have to continue, however. External experts have focused on the importance of organizational development as a way of preventing decline or reducing its affects.

One way to reverse dry rot is through the use of training as a way of injecting new knowledge and skills. One can also put in place a rigorous program to change and transform the organization's culture.

This assumes, though, that one **has enough transformational leaders to change the status quo**. Without the right type of leadership, the organization will likely spiral down to bankruptcy.

Death

As many as 80% of business failures occur due to factors within the leadership's control. Even firms close to bankruptcy can overcome tremendous adversity to nurse themselves back to financial health.

In Ichak Adizes vision[2] the corporate life cycle has ten fazes: Courtship, Infancy, Go-Go, Adolescence, Prime, Maturity, Aristocracy, Early Bureaucracy, and Death. The life-cycle stages that Ichak Adizes describes in his model provide a useful basis for understanding a fundamental perspective of organisational change, and the principle that organisational ageing, with all that this implies, is inevitable. The following diagram illustrates the corporate lifecycle in Ichak Adizes vision.

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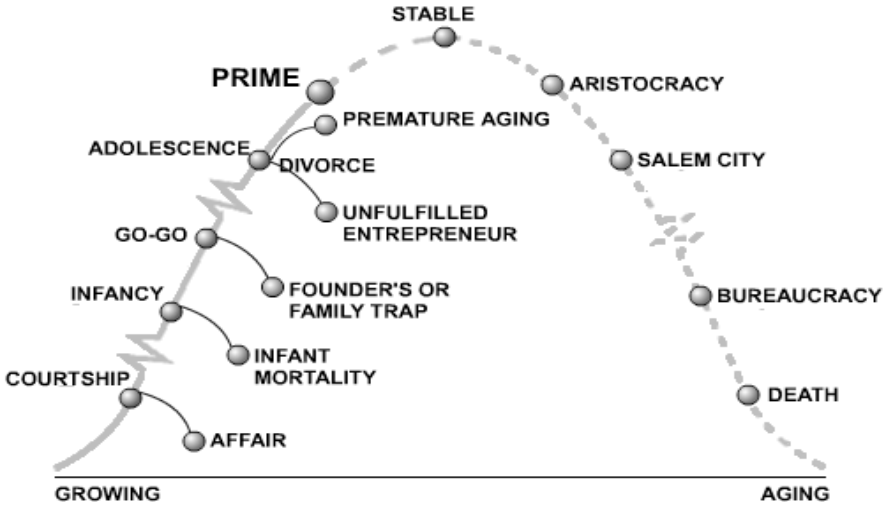

Figure 1. Corporate life cycle in Ichak Adisez vision.

Studying the small and medium enterprises, Amedeo Istocecu[3] presents the main specific criteria used for an apropiate understanding of small and medium sized organisation's life cycle. In his opinion there are eight phases of an organisation's life cycle: the foundation of the company, effectively getaway, grouth, the consolidation of the company position on the market, expansion, maturity, decline, the backdown from business.

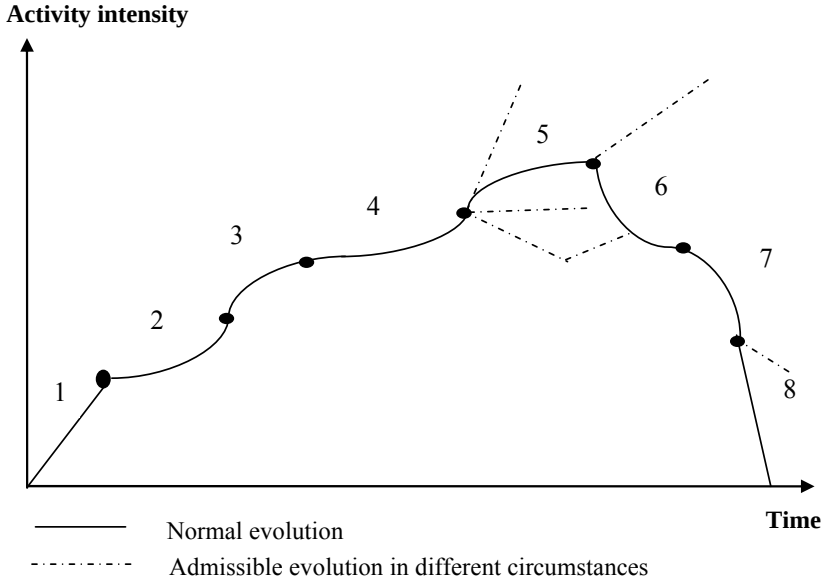

Figure 2. Corporate life cycle in Amedeo Istocescu vision.

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3. Distribution Company – an Organization Based on Knowledge

Distribution companies are very close to a market structure based on knowledge, having as main resource the human resources.

The number of employees is relatively low and the relations with external stakeholders are extended, basically the activity of the distribution company is mostly based in this kind of relations.

The development of the company in the future is based on the enhancement of knowledge and expansion of the knowledge sphere in order to turn into good account the opportunities that max come up on the market in a better way.

Human relations have a strong informal character. The company is made of many teams (especially sales teams) and there is cohesion inside the teams and between them.

The number of low-level and medium-level managers is much reduced, as people work together, the interest being a common one, people get willingly involved, creating an environment of consultation and participation. Distribution companies focus on the rewarding and motivation of the whole staff, but individual reward are also used, depending on the performance of each person, but this type of reward is closely related to the global rewarding in order not to affect cohesion inside the teams. The main promotion criterion is that of professional competence.

The culture of distribution companies is open, it favours relations with external stakeholders (their cultivation and practice of participative relations) – it has the tendency of having each time dimmer borders with the external environment, keeping at the same time its individuality. Culture is also innovative – it stimulates people to have and apply ideas.

In a changing social and labor environment, the increase of the efficiency of the distribution companies significantly depends on the attention paid to human resources inside the company. The distribution activity involves direct contact between people. No matter how good the client service strategy, people will be the ones that must put it into practice, and clients' perception on the provided services will lead to the failure or success of the organization.

Human resources management in a distribution company must take into account the fact that the key of success is people's involvement. This means that people must analyze results, not activities. What I do is not important. What I get is important!

Basically, the base of human resources management in a distribution company (in which we have a rather linear organizational chart) is the client service strategy chosen by the management of the organization. It I very easy to substantiate a client service strategy addressing a well-prepared and/or experienced manager, but the challenge of the human resources management in a distribution company consists in getting people to be committed, especially those that have daily contact with the clients. The whole methodology of personalization of the client service strategy consists in turning service into an activity as pleasant as possible for the people providing it, by offering rewards meant to stimulate them. This does not mean only real rewarding, but also creating working conditions that bring them satisfaction and professional fulfillment.

The supervisors of a distribution company must be accessible, a management through direct contact with the people must be practiced – in other word team supervisors must not inspect how the sales agents carry out their tasks, but rather support them directly in the development of their activities. People must feel that the positions they hold concretize in results, not only in activities. For this, people need to know the results of their work and the results of their work must be recognized.

Human resources management must impose a leadership style focused on information, education and support given to the employees, not on defining restrictions, limitations through rules or policies[4].

Sales agents that have direct contact with the clients must be treated individually so that they are capable of treating clients in an individualized manner too.

No strategy will work if it is not personalized, the management team must really be interested in people, the motivation of the managers (respectively supervisors) and employees at each hierarchical level is the key of the success of the distribution company.

Sales personnel are the company's link to the customers. Salesperson gives information about the customer to the company. Any company's survival and existence depends on the market and hence the sales force which maintains that link deserves the deepest thought in terms of setting objectives for it, strategy for it and structuring it.

Typical objectives for sales force could be specified in customer coverage and product coverage. Sales persons spend 80% of their time with current customers and 20% with prospects. The objective in terms of

[4] Lupu Felicia, *Efficient management strategies for distribution for food products companies in knowledge society*, Investment and Economic Recovery, ASE, 2007

products is that 85% of sales have to come from established products and 15% have to be from new products[5].

The selling methods vary depending on the situation. In a simple case, sales occur through a sales person interacting with a buyer. In a more complicated way, a sales person may have to meet many persons to make a sale. In more complex way, sales team has to interact with a buyer group. Conference selling is involved when many complex things are to be explained to a large number of persons in the buying organization.

To attract qualified and quality sales people, the company has to develop an attractive compensation package in comparison to the "going market price". The compensation will have four components, a fixed amount, a variable amount, expense allowances and benefits. A popular rule is to have 70% as fixed and 30% as the remaining portion[6]. At the stage of recruiting the sales force, companies have to make sure they get the right persons that subscribe to the company's objectives and values.

According to Douglas J. Dalrymple[7], a sales person have to be compulsive wooer, an individual who has a strong need to hold the affection of others and win them as friends, must have a high level of energy, abounding self confidence. Sales parsons have to be trained in effective presentations and interaction with customers, have to know the company's products, need to know customers' and competitors' characteristics, has to know the field procedures and responsibilities and most of all need to identify with the company.

4. Sales force structure during the corporate life cycle

Strategy determines sales force structure. An appropriate strategy for the organization is arrived at first and then any changes required for the existing structure are carried out so that the structure is capable of executing the strategy.

The distribution for food products company is selling many products to many types of customers, so the company would use a territorial sales force structure and a product specialized or market specialized sales force structure. The structure needs to be changed by established companies as they expand and economic conditions change.

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[5] Anderson Rolph, *Essentials of Personal Selling: The New professionalism*, Prentice Hall, Englewood Cliffs, 1995

[6] *Idem*

[7] Douglas J. Dalrymple, *Sales Management: Concepts and Cases*, John Wiley, New York, 1994

The sales force structure that works during start-up is different from what works when the business is growing, during its maturity, and through its decline. If we consider the renewal and death as being a single phase, the four life-cycle phases aren't mutually exclusive because some companies display characteristics of more than one stage at the same time. Referring to nowadays society, when new technologies or markets emerge, companies can also move inconsequentially through the life cycle stages, businesses tend to go through these phases more quickly than they used to, which makes it even more important to have a flexible sales force.

During start-up, smart companies focus on whether they should depend on selling partners or create their own sales forces. If they decide to set up sales organizations, they pay a lot of attention to sizing them correctly.

Other distribution companies can enter markets rapidly by working alongside companies (suppliers) that have sales expertise, influence over sales channels, and relationships with potential customers.

Companies that decide to outsource sales function should segment the market and develop sales processes that meet each segment's needs. Then they should select a partner, or partners, that will implement those selling processes effectively. To succeed, a company needs its selling partners' attention. Start-ups must develop partner management systems that include marketing programs and incentive schemes and appoint partner managers who provide selling partners with encouragement, process assistance, sales analytics, and end-user data. All too frequently, companies rely on money to motivate partners, not realizing that incentives aren't a substitute for systems and supervision. Companies should track performance closely, quickly terminate agreements with partners that don't perform well, and shift to selling directly when it's in their long-term interest to do so.

Many businesses depend on their selling partners for too long. When companies outsource the sales function, they don't control the selling activity, have little power over salespeople, gain no channel power, and don't own customer relationships. As time goes by, it becomes more, not less, difficult to reduce dependence on selling partners. Many firms become stuck in partnerships that inhibit growth.

Although outsourcing is popular today, we're convinced that companies should use selling partners only if they stand to gain strategic advantages as well as cost benefits.

During the start-up phase, sales forces have to educate potential customers about products and change customers' buying processes before they can generate sales. Salespeople also must chase down and make every

possible sale in order to drive business. Although it's a lot of work, new organizations have limited capital to invest in attracting and developing good salespeople. As a result, many new businesses adopt an "earn your way" approach to sizing their sales forces-they start small and add more feet on the street after they have generated the money to pay for them.

In our opinion we agree with that sales leaders who invest cautiously when they are short of cash or if the future is uncertain, but the trouble is that most companies don't increase their investments in sales forces even when the future becomes clear.

On the flip side, start-up divisions of existing companies often over invest in salespeople. Their desire to be competitive results in sales forces that, given the nature of the business opportunity, are too big to be profitable.

As companies grow, sizing issues become even more important. In addition, executives must decide when to invest in specialist sales forces.

During the start-up stage, many companies' portfolio lines are narrow, and they operate in a small number of markets. As businesses grow, their product portfolios expand, and their sales forces have to call on prospects in a broader set of markets. This presents sales managers with two challenges: specialization and size.

In the growth phase, salespeople need to master multiple products, markets, and selling tasks at this stage. Sales become a larger proportion of sales, customers will require service and support, adding to salespeople's workloads. As tasks grow beyond the salespeople's capacity to perform their jobs, they are likely to drop the customers, products, and selling activities that are most difficult to manage. Unfortunately, what they drop may be lucrative or strategic opportunities for the business. At this point, companies need to set up specialist sales forces.

Some specialist sales teams focus on products, others on markets, and still others on customer segments. Sales forces can also specialize in certain activities: Some salespeople concentrate on acquiring customers and others on servicing existing customers. Every kind of specialization has benefits and costs. For instance, specialization by markets reduces salespeople's focus on products, while product or activity specialization forces customers to deal with multiple salespeople. Many companies therefore create hybrid structures that include a mix of generalists as well as market, product, and activity specialists.

The transitions from a multipurpose sales force to a specialized one are always tough. The work changes considerably, and customer relationships are disrupted. Sales forces may need to adopt team-based

selling techniques, making coordination and collaboration vital. The people who succeed in a team-based setting are likely to be different from the lone wolves who do well in a traditional sales force. Consequently, companies may have to recast parts of their sales forces.

Growth is usually a happy time in the evolution of a sales force. Sales come in relatively easily, and salespeople are full of optimism. Even so, companies often make critical errors in sizing their sales forces. They continue to under staff, and as a result, they're unable to capitalize on all the opportunities that exist.

Most companies invest conservatively in salespeople because they don't realize that increasing the size of the sales force has short-term and long-term consequences. When new sales people come on board, they initially generate small revenue increases. As time goes by, their impact gets bigger. That happens for several reasons. First, new salespeople are not as effective as they will be when they become veterans. Second, in markets with long selling cycles, it taken months of effort before salespeople clinch sales. Third, many purchases, especially in business markets, are not onetime orders but multiyear contracts. Finally, carryover sales-sales that accrue in the future but are the result of sales efforts in the present-vary across products and markets, but they represent a significant portion of every company's long-term revenues.

When a company increases the size of its sales force, it doesn't maximize sales or profits at first. Over time, however, the company will make more profits than if it had started with a smaller sales force.

Companies must revisit sizing issues when they move from generalist sales forces to specialist ones. On the one hand, specialists will have to cover larger distances than generalists did in order to call on the same number of customers and this means they'll lose time in travel. The company will therefore need more of them to cover its customer base. On the other hand, specialists are more effective than generalists are, so each sales call will be more profitable.

Sales leaders must set expectations early, so that salespeople realize from the outset that, as the business grows, there will be changes in territories and compensation. Some companies periodically reassign accounts between territories to maintain the right balance. Others set lower commission rates on repeat sales, or pay commissions, after the first year, only after a salesperson's revenues exceed a certain level. These tactics give companies the flexibility to expand territories and sales forces in the future.

A company should determine the most appropriate size for its sales force by evaluating the probable size of the opportunity and assessing the potential risks of pursuing an aggressive or conservative approach. An aggressive strategy is appropriate when the business has a high likelihood of success and management has confidence in the sales projections. A more conservative strategy works when greater uncertainty surrounds the business's success.

Two types of sizing errors are common. First, if sales force growth is aggressive, but the market opportunity is moderate, the company will end up having to reduce its sales force. Second, if sales force growth is conservative, but the market opportunity is large, a business may forfeit its best chance to become a market leader. To make better decisions about sales force sizing, companies must invest in market research and in developing forecasting methods and sales response analytics.

When businesses hit maturity, the emphasis shifts to making sales forces more effective by appointing account managers and better allocating salespeople's resources, and making them more cost-efficient by using less expensive people.

In the maturity phase products and services start to lose their advantage, competition intensifies, and margins erode.

At this stage, sales leaders must rely more on resourcefulness than on increasing the scale of the sales effort.

Their strategy should emphasize retaining customers, serving existing segments, and increasing the efficiency and effectiveness of the sales force.

In the maturity phase, companies must focus on optimizing the sales force's effectiveness.

Companies often don't optimize the allocation of their sales resources for several reasons. First, they use the wrong rules. For instance, executives often target customers with the highest potential even though these customers prefer to buy from competitors. Smart companies allocate more resources to products and markets that respond well to salespeople. Second, businesses frequently don't have data on the sales potential of accounts and territories or the responsiveness *of potential customers to sales efforts.*

There are no shortcuts on the road to effectiveness. Organizations can allocate resources best if they measure how responsive different products and markets are to sales efforts. Executives can do that by comparing sales result among similar-sized customers to whom they allotted different levels of effort. That analysis allows a company to evaluate the financial implications of different allocation scenarios. The company can then manage its

sales force, even offering incentives on occasion, so that salespeople expend effort in the most productive ways.

Many a business discovers in the maturity stage that the use of product specialists is posing coordination problems and confusing customers that must deal with several salespeople. Smart companies appoint managers for the largest accounts. These account managers coordinate the sales effort and bring in product specialists when customers need expertise. In addition to increasing revenues, the appointment of account managers boosts customer satisfaction and often reduces selling costs.

Finally, as **organizations go into decline**, sales leaders' attention shifts to reducing the size of sales forces and using even more cost-efficient ways to cover markets.

Many organizations will enter the decline phase unless there is in place a rigorous program of transformational leadership development. If senior leaders detect the symptoms of decline early, they will be able to deal with it more easily. Some of the most obvious signs include: declining sales relative to competitors, disappearing profit margins and debt loads which continue to grow year after year.

However, by the time the accountants figure out that the organization is in trouble, it takes tremendous leadership to get the organization to change course.

Some businesses know their decline is temporary. They plan to boost revenues and profits in the not-too-distant future by launching new products or by merging with other companies. However, turnarounds often demand different sales force structures than the ones companies have. A smart company therefore determines what kind of structure it will need for the sales force to achieve its new goals. Then it identifies and preserves elements of the current structure that are consistent with the one it will need. Companies often downsize sales forces to save costs in the short run, although they may need more, not fewer, salespeople to implement new strategies.

Many sales leaders take advantage of temporary declines to eliminate mediocrity in their sales forces. Once the turnaround starts, they hire salespeople who are more qualified than the ones they let go. Sometimes what looks like a misallocation of resources is really mediocre performance.

When a turnaround isn't likely and further decline is inevitable, sales organizations can only ensure that companies remain profitable for as long as possible. Businesses should use their salespeople to service the most

profitable, loyal, and strategically important customers, and service other accounts through low-cost selling resources (external partners).

In the opinion of some specialists[8] there are four factors for a successful sales force: size of a sales force, role of sales force and selling partners, degree of specialization, sales force resource allocation.

Among sales management priorities, revising the sales process isn't far behind the top priority of generating more leads. Having a process is not the same using a process.

Tuba Ustuner and David Godes[9] view the sales process as having four distinct stages: identifying prospects, gaining buy-in from potential customers, creating solutions, and closing the deal. In the earliest stage, a diverse marketplace network is best for identifying new leads. In the next stage, cultivating a prospect company network for access to the decision makers will help a salesperson gain buy-in. The third stage is all about coordination: Here the sales people need to forge ties among contacts in his intra-organizational network so they will work together to device solutions for his prospect's unique problems. And to close the deal, the salespersons need contacts from his customer network that can vouch his good reputations. Companies looking for better results should help their sales their sales teams built better networks.

5. Conclusions

It is very important to understand the challenges sales leaders face during the company life cycle and how they are responding to these challenges, and what actions yield positive results.

Sales executives have to understand that the new selling context has real implications for how they hire, train, manage, coach and retain sales people.

We can say that sales leaders who try to match sales force structures with the business life cycle face different challenges at every stage. The common thread, though, is that they must overcome organizational resistance at each step and sacrifice short-term profits to secure their companies' success over time.

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[9] Tuba Uster, David Godes, *Better sales Networks*, Harvard Business Review on Strategic Sales Management, Harvard Business School publishing Corporation, 2007

Every company should conduct a break-even analysis to check if its sales force has the right size, revising permanently the sales process and built better networks according with the stage of the corporate life cycle.

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