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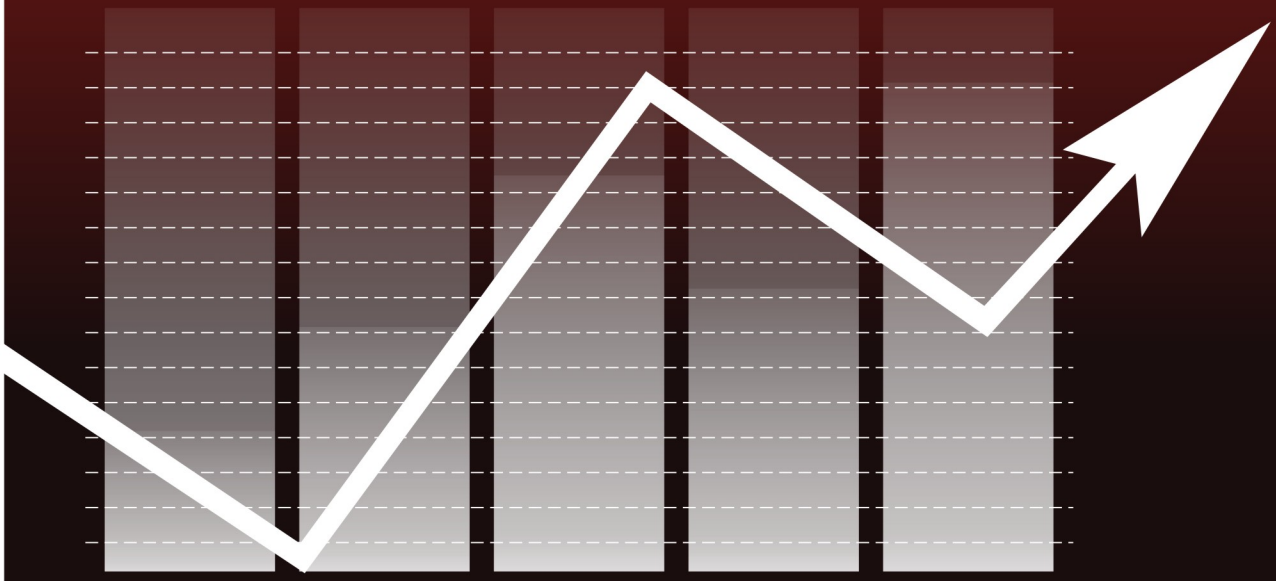

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MARKET EFFICIENCY, ANTICIPATION AND THE FORMATION OF BUBBLES-CRASHES

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Abstract. *A dynamical model is introduced for the formation of bullish or bearish trends driving an asset price in a given market. Initially, each agent decides to buy or sell according to its personal opinion, which results from the combination of its own private information, the public information and its own analysis. It then adjusts such opinion through the market as it observes sequentially the behaviour of a group of random selection of other agents. Its choice is then determined by a local majority rule including itself. Whenever the selected group is at a tie, i.e., it is undecided on what to do, the choice is determined by the local group belief with respect to the anticipated trend at that time. These local adjustments create a dynamic that leads the market price formation. In case of balanced anticipations the market is found to be efficient in being successful to make the "right price" to emerge from the sequential aggregation of all the local individual information which all together contains the fundamental value. However, when a leading optimistic belief prevails, the same efficient market mechanisms are found to produce a bullish dynamic even though most agents have bearish private information. The market yields then a wider and wider discrepancy between the fundamental value and the market value, which in turn creates a speculative bubble. Nevertheless, there exists a limit in the growing of the bubble where private opinions take over again and at once invert the trend, originating a sudden bearish trend. Moreover, in the case of a drastic shift in the collective expectations, a huge drop in price levels may also occur extremely fast and puts the market out of control, it is a market crash.*

Keywords: *renormalization group, sociophysics, opinion dynamic, finance.*

1. From the idea of each agent to the opinion of everyone

In this paper, we apply sociophysics [1, 2, 3] to the analysis of the aggregation of opinions in financial markets. A simple model is shown to describe the movement of a stock price far away from its fundamental value, through a process of iterations of individual decisions made by agents who interact by groups of odd or even size. Under certain social

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psychological configurations of the market, and depending on the parity of the size of the local groups, individual opinions combination can lead the stock price to reflect its fundamental value or be fundamentally different from it [4].

A theoretical basis is thus provided to Keynes view that stock prices can and actually differ from their fundamental values [5, 6]. Some models used in physics appear to be well adapted to the formalization of this perspective [7, 8, 9,10] along a huge collection of works in economy [11, 12, 13, 14] with much attention being devoted to the formation of bubbles and crashes [15, 16, 18, 19, 20, 21, 22, 23].

The novelty of the model presented here lies in the use of a single frame which embodies both the market efficiency and the formation of bubble as well as their burst. Although very simple, our scheme is able to explain two important insights by Keynes on how individual opinions combine and lead to a collective bullish or bearish behaviour, and how expectations by agents can, in some cases, compromise the efficiency of the market pricing process, then reducing drastically the impact of individual information on the global outcome of the market process. However the distortion of the market efficiency is bounded and beyond some gap, the efficiency is brutally restored spontaneously. The model relies on our earlier works on opinion dynamics in social issues [24, 25].

1.1. Microstructure of the market and aggregation of individual opinions using the local sharing of information

Generally speaking, this approach is part of a broader increased attention to the aggregation of individual opinions in the last twenty years or so, especially on market microstructure and the way personal individual information are combined by the market equilibrium. Generally, these works are based on the hypothesis of lags in knowledge acquisition between agents. This leads them to influence and imitate each other in featuring mimetic behaviours. In this context, sociophysics adds to these works by analyzing decision-making processes among groups of individuals with financial operators being divided into local groups like traders, portfolio managers, arbitrageurs and others. The model explains how the structure of these groups governs the way of information processing by the market.

As done by usual models of market microstructure [26], the fundamental hypot hesis is here that if one could gather all the information held by all agents, one should be able to come up with a price that equals the

fundamental value. In other terms, we suppose that the market is efficient in the usual meaning. However, one agent alone never has all the information, and thus is not able to come up with the fundamental value by itself alone. Only the financial investors taken as a whole are able to fairly price an asset. More precisely, if V is the fundamental value of a firm, we suppose that V is close to the amount estimated by each agent $Vi = V + vi$. This fundamental hypothesis implies then that the expected value of vi is zero by aggregation of all agents i. From this perspective, market efficiency means here the capacity of the market pricing process to reveal the fundamental value that would be known by financial investors as a whole.

Furthermore, we assume that the market clearing price is fixed according to some rule based upon excess of demand or supply. In particular, when they are equal, the market price does not change. Any supply (demand) excess will lead to a decreasing (increasing) change of the market price, while the change process stops whenever the market reaches a down (up) limit when all the agents wish to sell (buy). In fact, modelling the market microstructure is beyond the scope of this paper and is left to a further exercise [27, 28].

1.2. Common beliefs and the market pricing process

The approach consists in modelling agents which get and process information in some iterative learning way. This process can drive the actual stock price to move substantially away from its fundamental value. Under certain circumstances, the market seems then inefficient. We will show why and for what reasons a market that is expected to be efficient in treating all personal information can lead instead to a stock price that reflects collective beliefs that diverge from the fundamental value.

In the first case the market seems efficient whereas in the second case, it seems inefficient, even though similar mechanisms are in play. In fact, in the first case, the market is a machine that discloses the true value of a firm, whereas in the second case, the market is a mechanism that produces baseless financial representations of that value.

My simplified model aims to describe in a coherent and homogenous way the formation of speculative bubbles and market crashes enlightening the role of common beliefs in the process of stock prices formation. The goal of this paper is to illustrate the conceptual contribution of sociophysics to the formation of speculative bubbles.

1.3. Modelling the Learning Process

Consider a population of N agents, each having a different opinion based on its information about a given stock in a given market. We suppose that the aggregation of all the information held by every agent would provide the fundamental stock price.

In order to describe a complex reality, two essential processes are distinguished in individual decision making. Every agent is supposed to go first into its own personal analysis using its own information around selling or buying the stock. Then, because its information is incomplete, it will adjust its own opinion to take into account those of other agents. But, in order to avoid mimicking potentially bad decisions from others, it will proceed sequentially through successive steps and vary the group of agents that it consults. Each agent keeps reproducing this process until it gets a clear-cut buying or selling signal.

We further suppose that all agents have the same power of influence on each other. There is no leader or guru. In addition, buying or selling decisions are all made simultaneously by all agents. Accordingly, one agent cannot postpone its decision to wait for a favourable time to buy or sell. The iterative process is imposed to all agents. Such iterative process is then exogenous, not endogenous, although it is internal to the agent community.

The first mechanism starts with the market opening, each agent having made its own personal decision to buy or sell. The opening price results from all these decisions. Then a quest for the fundamental value begins through a sequence of local optimizations in which agents will collectively determine their choice by a rule of majority. This is why the model is iterative and describes an interactive learning process by the decisions of other agents.

At the end of the day, when the market closes, two configurations are possible. Either there is still a split between the agents about their decision to buy or sell, or all agents end up with the same decision. In the first case, the stock exchange closes up or down, this change being justified by the fundamental stock value. In the second case, the stock cannot trade because all agents are either buyers or sellers, the stock has then attained its up or down limit. The next morning, every agent adjusts its position to take into account the latest closing stock price. In the following, we shall see how a market can prove efficient or inefficient depending on conditions that are specified below.

2. Distinctive stock market dynamics

2.1. The case of efficient market

Consider a stock whose fundamental value in a given day is above its market price. For instance, if 60% of information gives a bullish signal and 40% of information gives a bearish signal, there will be a 20% discrepancy around the fundamental value. However, no single agent knows all the information required to value the stock. On the contrary, each agent has only two guesses or positions to be chosen, i.e., bullish or bearish. Hence at the opening time, 60% of agents would buy and 40% would sell.

We introduce then a partition of the trading day in a certain number of interactions. Time is measured by these interactions. Thus, between the beginning $(t = 0)$ and the end of the day $(t = T)$, at each interaction time, there is a proportion of buyers p_t and sellers $1 - p_t$, no inactive agents being included. At the beginning of the day, there are p_0 buyers (in the previous example p_0 = 60%) and $1 - p_t$ sellers.

The dynamic to compute p_t, i.e., the proportion of buyers at each time t as a function of the initial proportion of buyers p_0 has thus to defined. As explained before, agents sequentially adjust their decision by observing decisions by others. To do that, each agent interacts within a certain group of agents around it. The parity of the size of this group is crucial. For sake of simplicity, we consider here only the two cases of groups of size three and four.

Groups of odd size in the case of odd size with three agents, each agent compares its decision with 2 other agents taken randomly among all agents. Agents are thus grouped by three. Inside each of these groups, a common decision is made according to the local majority of the initial decisions of the three agents. If two agents are buyers (sellers) and one is seller (buyer), the seller (buyer) changes its mind and decide to buy as the others wish to do. The following relation holds then between p_{t+1} and p_t :

$$P_3(p_t) \equiv p_{t+1} = p_t^3 + 3p_t^2(1 - p_t). \qquad (1)$$

Thanks to this relation, the evolution of the buyer's share p_t with respect to the time t can be observed during a trading day. At the end of the day, we suppose that all agents make their own decisions to buy or sell the

next morning, taking into account the latest closing stock price combined with their respective private information.

The dynamic produced by Eq. (1) is monitored by its fixed points, which are obtained by solving the equation $p_{t+1} = p_t$. The solutions are $p_s = 0,\ p_{c,3} = 0.50,$ and $p_B = 1.$ The first fixed point results from a drop in the stock price until a state denoted the down limit because all agents conclude with the same decision to sell. The last fixed point results from the rise of the stock price until a symmetric state is reached with an up limit. The fixed point $p_{c,3} = 0.50$ results from a perfect equilibrium of the market with exactly as many buyers as sellers. The stock price remains stable, and so does the fundamental value.

Stability of equilibria. Studying the stability of the fixed points $p_{c,3}$ is found to unstable whereas p_S and p_B are stable. If p_t goes slightly away from p_S or p_B, Eq. (1) makes it go back towards it. On the contrary, if p_t moves a bit from the fixed point $p_{c,3}$, Eq. (1) takes it even further in the same direction. Around $p_{c,3}$ a buyers excess will generate the appreciation of the stock price, while a sellers excess will result in a stock price decrease.

Figures 1, 2 and 3 illustrate different aspects of this phenomenon.

Figure 1 illustrates how the market treats fragmented pieces of information in the right direction. If at the opening time, there are more bullish than bearish signals, the stock will go up during the day. The market is efficient at the informational level. Figure 2 shows the variation of p_t during the day for different starting shares of buyers among the whole population with $p_0 = 0.48.0.50.0.52, 0.54,...,0.98, 1.$ For instance, $p_0 = 0.48$ yields 12 interactions to have the market reach its state of down limit. The proportion $p_0 = 0$ is then reproduced endlessly.

Symmetrically, 12 iterations are also required to reach the state of limit up but starting from $p_0 = 0.52.$ Only at exactly $p_0 = 0.50$ the proportion is invariant under an infinite number of iterations.

Finally, Figure 3 illustrates the variations of p_{t+1} in function of p_t. The arrows indicate the direction of the buying flow. For an initial proportion below $p_{c,3} = 0{,}50,$ p_t goes towards the attractor state of down limit, while it goes towards the attractor state of up limit for a proportion greater than $p_{c,3} = 0.50.$

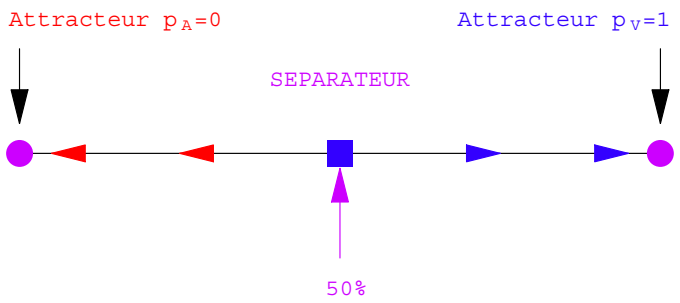

Figure 1. An efficient market: 2 attractors at 0 and 1, and a separator at 0.

We have therefore obtained a market that works efficiently by transforming information into prices by successive steps, this transformation leading the stock price toward its fundamental value. If the mechanism starts with private information leading to a majority of agents being bullish (bearish), it implies by assumption that the fundamental value of the stock is lower (higher) than its market price. Thus, as interactions go on, the resulting stock market pricing process should and will, push the market higher (lower) in the direction of the fundamental value. However, if an attractor is reached, the dynamic loses contact with the fundamentals of the stock, and the market gets to its up or down limits. It is important to notice that, in this model, a state of down limit down can happen without any previous rise of the stock price.

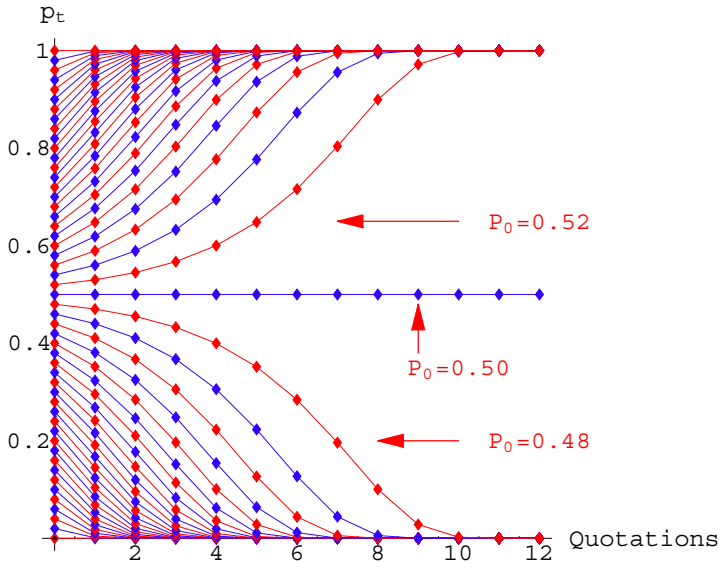

Figure 2. An efficient market: variation of p_t for groups of size 3 in function of p_0.

What happens the next morning when the market opens again? After a rise (drop) justified by the fundamental value of the stock, a lower proportion of buyers (sellers) will usually occur, leading the stock price to reach the separator that is its fundamental value. This adjustment allows avoiding the perpetuation of up or down limits over time that would lead eventually to a market crash or a bubble.

Alarm signals for market breakdowns. In this model, the discrepancy between the fundamental value and the market price determines the number of interactions required to reach either one of the two attractors. The more the initial proportion of buyers is far away from the separator, the smaller this number is, and the more likely is a crash or a bubble to occur. This number can be computed to be approximately as:

$$n \simeq \frac{\ln | p_{c,3} - p_0 |}{\ln(3/2)}. \qquad (2)$$

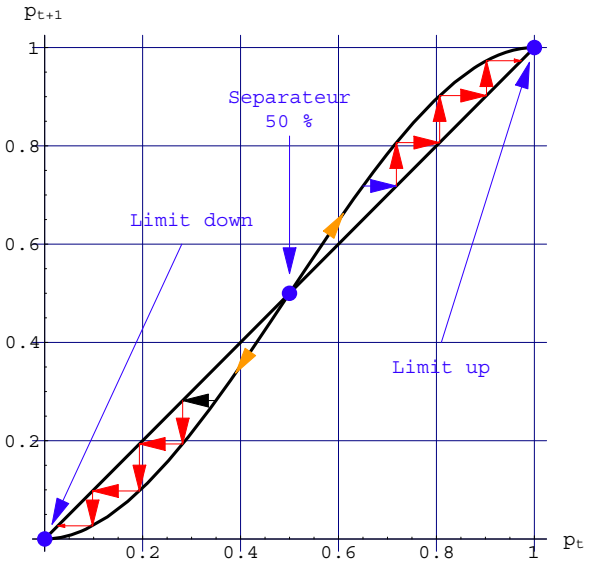

Figure 3. An efficient market: variation of p_{t+1} in function of p_t for groups of size 3.

Above number is approximated up to the greater integer. It is noticed that n is always a small number as Figure 2 shows. For instance, if $p_0 = 0.45$, the formula (2) gives $n = 8$ meaning that starting from an initial proportion of buyers of 45%, the market reaches a state of limit down after only 8 transactions. In other terms, if there is a 5% lack of buyers of the stock, the driving mechanism of the stock price will push the market lower

until it reaches a state of limit down after 8 interactions. This implies a cumulative amplification of the difference between the number of sellers and the number of buyers. The number of buyers decreases according to Eq. (1).

Starting from the initial value $p_0 = 0.45$ we successively get as proportions of buyers the values $p_1 = 0.42$, $p_2 = 0.39$, $p_3 = 0.34$, $p_4 = 0.26$, $p_5 = 0.17$, $p_6 = 0.08$, $p_7 = 0.02$ and $p_8 = 0.00$. At the 8^{th} interaction, there are no more buyers; the state reaches the down limit and the process stop.

The formula (2) therefore enables to simulate the behaviour of buyers and to predict the occurrence of a brutal drop of the market price (up to its down limit). However, the formula is less efficient for proportions p_0 of buyers that would be already closed to attractors, depicting a market process potentially stopped. In such situation that is too close to a market stop the number of interactions which separates the market from a state of down or up limit has to be evaluated by an explicit iteration of Eq. (1). The Figure 4 is an illustration of this phenomenon. The number of iterations does not become equal to zero for the proportions $p_0 = 0$ and $p_0 = 1$. Actually, in the vicinities of both attractors, the formula (2) has to be adjusted by the quantity ln(1/2)/ ln(3/2).

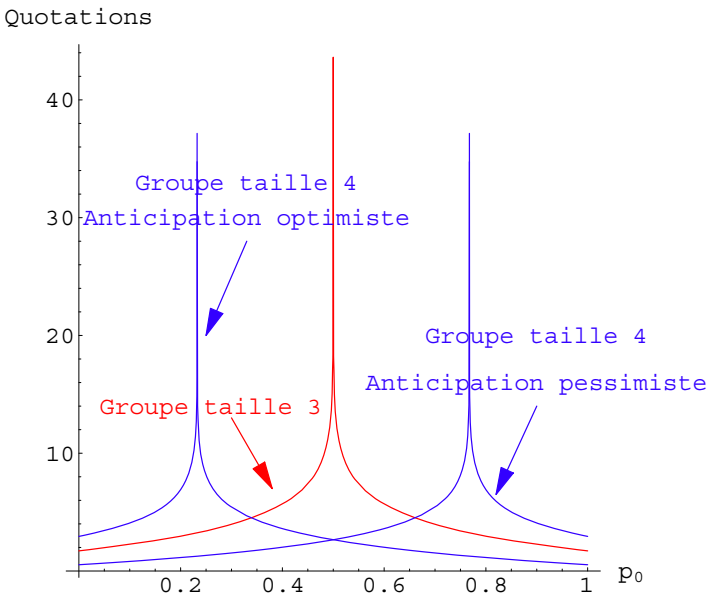

Figure 4. Number of iterations required to reach an attractor from an initial proportion of p_0 for groups of size 3 and 4. In the last case both optimistic and pessimistic anticipations are shown.

2.2. The case of market inefficiency

So far, the model has described an efficient market, since the market mechanism makes the stock price reaching its fundamental value from the confrontation of buying and selling by partially informed agents. Moreover, the market dynamic that results from their aggregation is perfectly symmetric whether the stock price increases or decreases. This shall be no longer the case when groups of even size are considered.

Groups of even size and the formation of a doubt. Lets consider now a different market situation. Instead of interacting with two other agents, every agent now considers the decisions from three other agents. The market population is then organized by groups of size 4. In this case, a new possibility emerges when there are as many buyers as there are sellers in a group (2 buyers and 2 sellers). The majority choice cannot solve this situation.

Accordingly the agents in such a group must find another way out of this paralyzing doubt.

We make the assumption that, in a situation of doubt, a collective decision to buy or sell is made based on the collective current consensus for the economical sector the stock belongs to, that is, the socio-psychological mood of the market in that sector. If the consensus is optimistic, the group of agents collectively decide to buy, otherwise it sells. This assumption allows studying the effect of this collective expectation subsuming the current mood of consensus, on the efficiency property of the market. In order to do so, Eq. (1) needs to be rewritten with a further determination of the novel location of the separator.

To take into account the psychological collective mood, we introduce a new parameter *k* which measures the optimism level for the sector the stock belongs to. Thus, $k=1$ depicts a completely optimistic atmosphere, leading all doubting groups to buy in case of a local doubt. On the contrary, $k=0$ depicts a completely pessimistic mood, leading people to sell in case of a doubt. More realistically, *k* can take values between 0 and 1. Following the ongoing changes in the mood, this value can vary day by day, slowly or quickly. The general mood, which used to be optimistic, may then become abruptly pessimistic or vice-versa. With the introduction of this confidence parameter, Eq. (1) is generalized as follows:

$$P_4(p_t) \equiv p_{t+1} = p_t^4 + 4p_t^3(1-p) + 6kp_t^2(1-p_t)^2. \qquad (3)$$

Like Eq. (1), this equation gives the proportion of buyers p_{t+1} at time $(t+1)$ in function of the proportion of buyers p_t at time *t*.

Changes in the proportion of buyers. Fom Eq. (3) the equation $p^* = p_4(p^*)$ yields again the two previous attractors $p_S = 0$ and $p_A B = 1$, but the separator $p_{c,4}^k$ has shifted from the middle point with $p_{c,4}^k \neq 0.50)$ at a value given by:

$$p_{c,4}^k = \frac{(6k-1) - \sqrt{13 - 36k + 36k^2}}{6(2k-1)}. \tag{4}$$

This value depends on *k*, the degree of optimism of the market. The complete optimism $(k = 1)$ gives:

$$p_{c,4}^1 = \frac{5 - \sqrt{13}}{6} \simeq 0.23, \tag{5}$$

while the complete pessimism $(k = 0)$ gives the separator value:

$$p_{c,4}^1 = \frac{1 + \sqrt{13}}{6} \simeq 0.77. \tag{6}$$

Above two values represent the two bounds between which the separator can vary. This means that, in a frankly optimistic atmosphere, it suffices to have 23% of buyers instead of 50% in an efficient market, to modify market equilibrium. Reciprocally, a very pessimistic atmosphere requires 77% of buyers to influence market equilibrium against 50% in an efficient market.

As expected, for a balance collective mood, i.e., $k = 0.50$ yields $p_{c,4}^{0.50} = 0.50$ as in the previous model. Figure 5 shows the varying range of the separator.

What happens to the efficiency property of our market? When $0.50 < k < 1$ the psychological mood is optimistic. Therefore, even if the buyers' proportion p_t is less than 50% down to the limit of 23%, the power of the collective belief, which is optimistic with respect to the future of the asset, pushes the stock price up. In the same way, in a negative psychological mood, as long as the proportion of buyers remains below 77%, the stock price will be driven down.

In other words, a separator away from the middle value 0.50 makes the market inefficient since the stock price can go in an opposite direction to what the majority of agents taken individually would think it should go. Such uncertainty makes the market process dependent on the market atmosphere.

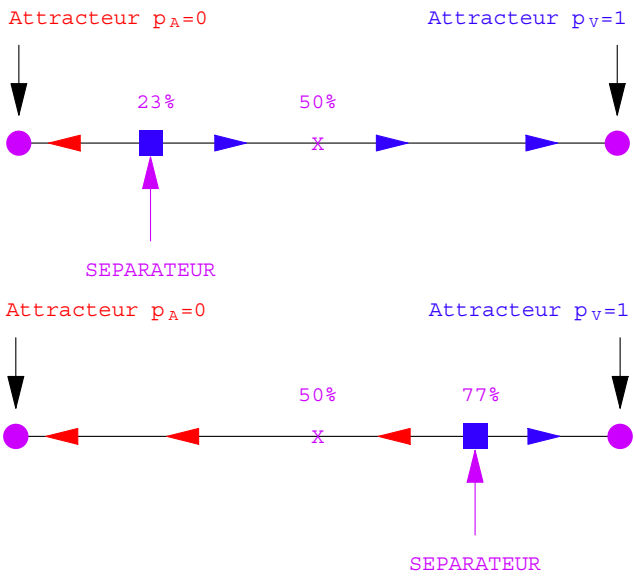

Figure 5. Direction of the dynamic of sequential change of the proportion of buyers, with two attractors at 0 and 1 for groups of size 4. On top, the anticipation is fully optimistic with $k = 1$, which sets the separator at 23%. On bottom the anticipation is fully pessimistic with $k = 0$ setting the separator at 77%.

The psychological mood may, in certain situations, bias significantly the market dynamic. The aggregation of all pieces of information by the market may then lead to the wrong conclusion by the majority of agents. Figure 6 illustrates this mechanism.

In particular, the market will push higher an already overvalued stock, as illustrated in Figure 6, in the case of a totally optimistic common belief $(k = 1)$. In all situations where the general market mood is determinant, only the neutral value $k = 0.50$ makes the market efficient with $p_{c,4}^{0.50} = 0.50$.

However, the market inefficiency has well defined limits. For instance, in a speculative bullish market, private information can become so negative that it can re-establish the market efficiency by successfully counterbalancing the bias created by the market atmosphere. In this case, the market will start to be driven down after a continued and unjustified bullish period. The market mechanism eventually overcomes the distortion implied by the psychological anticipation and proves efficient again. This process of readjustment may be partially smooth and stay under control as shown in Figures 7 and 8. On these figures. the initial proportion of buyers or sellers are very close to the separator $p_0 \simeq 0.23$ that exhibits the limit of the inefficiency of the market.

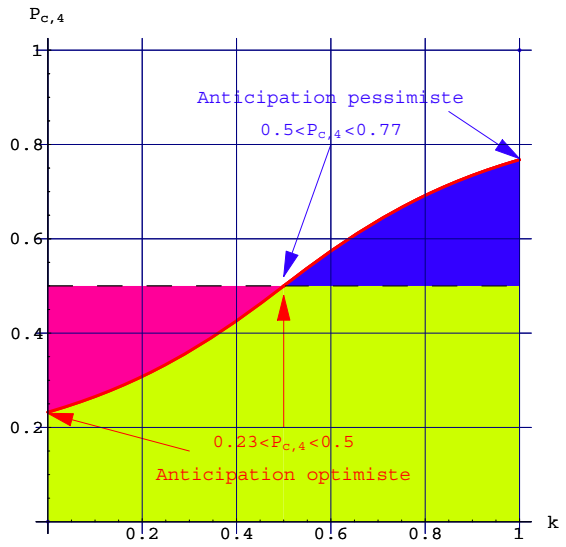

Figure 6. Location of the separator $p_{c,4}^{k}$ as a function of the psychological mood k. An optimistic mood $(0.50 < k \leq 1)$ yields $0.23 < p_{c,4}^{k} < 0.50$ whereas a pessimistic mood $0 \leq k < 0.50))$ gives $0.50 < p_{c,4}^{k} < 0.77$. The discrepancy between $p_{c,4}^{k}$ and 0.50 is the source of the market inefficiency as shown in the area on each side of $p_{c,4}^{0.50} = 0.50$.

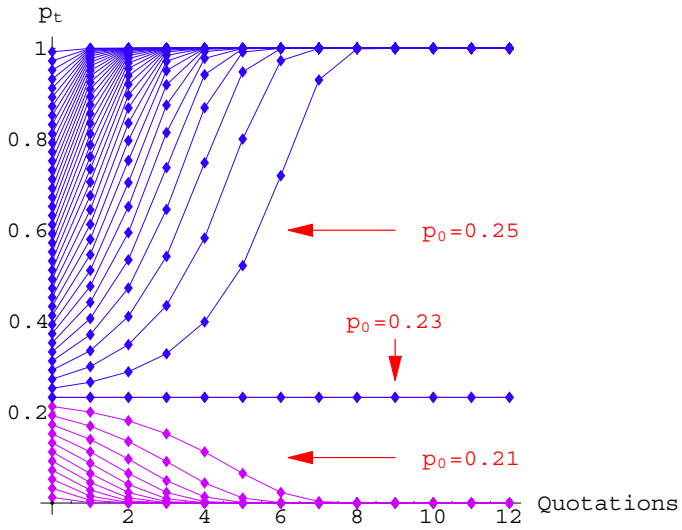

Figure 7. Variation of p_t for groups of size 4 in a very optimistic collective mood $(k = 1)$ as a function of the initial proportions of buyers. The initial proportions vary from $p_0 = p_{c,4}^{1} + \mu \times \delta \times 0.01$ with $p_{c,4}^{1} \simeq 0.23$ and $\delta = 0.1, 2, \ldots, 77$ for $\mu = +1$ and $\delta = 0.1, 2, \ldots, 23$ for $\mu = -1$.

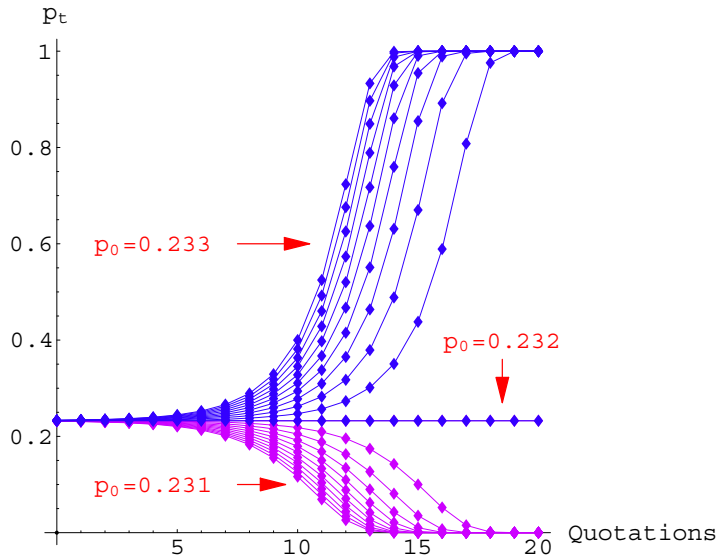

Figure 8. Variation of $p(t)$ for groups of size 4 in a very optimistic mood $(k=1)$ as a function of initial proportions of buyers which vary from $p_{c,4} \pm 0.001 \times \delta$ with $p_{c,4}^1 \simeq 0.23$ and $\delta = 0, 1, 2, , 10$. That is the limit of malfunctioning of the market: a correction in the stock price remains smooth.

2.3. Speculative bubbles and crashes

Change in collective beliefs and sharp corrections. We have analyzed the limits of the inefficiency of the market in this model. We can now study the conditions for which the market beaks into a crash. Such a drastic event is naturally obtained within our model. Indeed, we have considered so far the market atmosphere constant with time. However, changes in the general market mood can occur for a variety of reasons with as well its direction as its intensity.

For instance, in the previous case of a very optimistic mood $(k=1)$ with a separator set at $p_{c,4}^1 \simeq 0.23$ we saw that the market can regain its efficiency if it goes too far in the wrong direction. However, it is possible that, before the market starts to correct itself, the general anticipation brutally changes to shift into a very pessimistic mood $(k=0)$ after having been very optimistic.

In such a situation, the drop of the stock price is not a smooth process anymore. In that case, the separator jumps at once from $p_{c,4}^1 \simeq 0.23$ up to

$p^0_{c,4} \simeq 0.77$. It may then take only two or three update sequences for the market to reach a state of down limit. The extreme speed of the stock move thwarts the rebalancing of the next day and a self-increasing panic appears.

Figure 9 illustrates the evolution of such a scenario for different initial proportions of buyers.

In the case of an optimistic expectations, the market regains its previous bullish dynamics except for $p_0 = 0.23$, which leads to a smooth decrease of the stock price. On the contrary, if expectations are pessimistic, the decrease of the stock price is brutal, especially when the initial proportion of buyers is small compared to 0.5. To illustrate this mechanism of rupture, consider a market with an initial proportion of buyers $p_0 = 0.43$ or 0.33 under an optimistic climate. Even if less than half operators are bullish, the stock price will go up. But if the general mood of operators happens to change, the stock can violently crashes as seen from Figure 9.

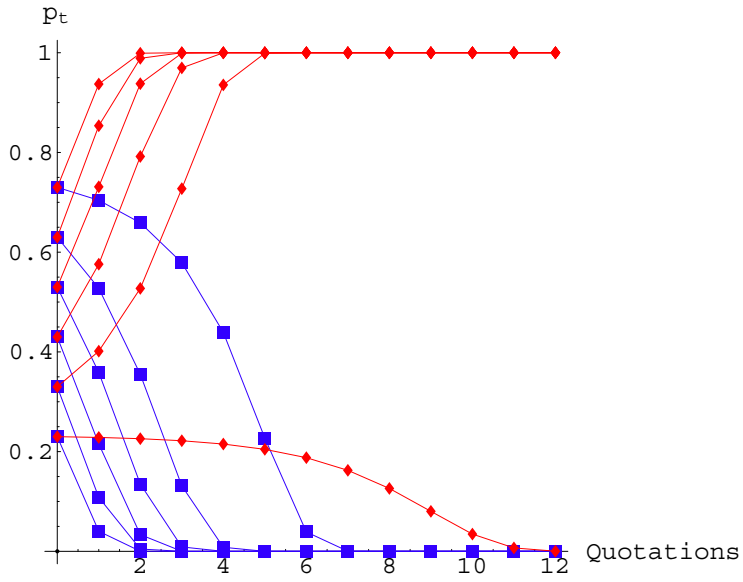

Figure 9. Variation of p_t for groups of size 4 with both optimistic and pessimistic moods. Different initial proportions of buyers are shown, which all lead to a bearish market for $k = 0$. For $k = 1$ on the contrary, they all lead to a bullish market except for $p_0 = 0.23$. A change in the psychological anticipation triggers the crash.

3. Conclusive remarks

We have shown how a simple sociophysics approach can disclose important features which are instrumental in the making of the stock market dynamics. In particular, these features shed light on the influence of collective beliefs on stock price formation paving the way to the study of mental representations in play in speculative mechanisms. However, the same features produce the limit of common beliefs on biasing the market efficiency.

Two distinctive mechanisms characterizing the stock market have been singled out. The first one exhibits the aggregation of the agent private information through the market to treat all scattered and incomplete information to reproduce the fundamental value. At this stage we have been able to build an efficient market. The second mechanism is more subtle trying to embody the effect of the collective beliefs regarding the future stock price evolution into the process of the agent decision making. On this basis we have shown that in case a gap occurs between a strong belief and the fundamental value, the market becomes inefficient with the emergence of a speculative bubble. However, the general belief can only bias the market up to a certain point beyond which private information is so unbalanced that its drive back the stock price toward its fundamental value. This process, if accompanied by a shift in the general belief, can be extremely brutal and leads to a market crash.

In upcoming work we will introduce different types of agents like contrarians and inflexibles in the market dynamics. They were found to have drastic effect on the landscape of the opinion dynamics of social systems [29, 30, 31]. We hope my results could be helpful for a better understanding of the fundamental trends of the market even though they are not an accurate description of the reality.

Acknowledgement

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COEXISTENCE OF OPPORTUNISTS, CONTRARIANS AND INCONVINCIBLES IN BINARY OPINION NETWORKS

Karl E. KÜRTEN*

Abstract: *We study a model for the emergence of collective decision making heuristics, consisting of four different classes of interacting agents, whose opinions are described by binary state variables. In particular, a subtle interplay between opportunist, contrarians and inconvincibles sticking stubbornly on their opinion, leads to phase transitions which abruptly can change the outcome of a public debate. At a critical density the inconvincibles reduce the fraction of an initial majority such that the initial minority wins the debate.*

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

1. Introduction

Applications of methods earlier used in the area of statistical physics to social phenomena such as opinion formation, socio – and economic dynamics have been extremely successful during the last few years. [1, 2, 3] The present study extends the analysis of the dynamics of randomly assembled threshold networks to social phenomena [4]. In the context of socio physics this may help to understand under which conditions special shocking events or propaganda are able to influence the results of public debates. In this model, each agent i is assigned K randomly chosen agents who discuss a topic in order to convince agent i arrive at a final decision, in favour or against.

The dynamical decision making process is based on the majority – and minority rule such that each individual may adopt the opinion of the majority or minority, respectively. In this report the heterogeneous model is extended to two other groups of agents, who never change their opinion,

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the so called inconvincibles who either always stick to the YES or always stick to the NO state. The model thus describes how agents with different backgrounds try to convince each other, in either their or the opposite direction expressing their desire to identify with one of four distinct social groups or to differentiate themselves from them.

In particular, we study the effects of opportunists and contrarians as well as both sided inconvincibles with interactions based on only four behaviour schemes expressed by simple cellular automata rules which are able to generate rather complex behaviour. One focus of this study is the determination of critical network parameters, where the network undergoes transitions from the existence of two attractors, the YES and NO attractor, to one single stable attractor [5, 6].

2. Four prominent cellular automata rules

The model network consists of a population of N agents of a democratic community who are characterized by a specific opinion on a particular subject. The opinion of agent i is described by an Ising spin variable σ_i, only capable to take the value +1 or 0, i.e. to say YES and NO, to buy or not to buy, or to vote Party A or Party B, respectively. We assume that each agent i can be influenced by K other agents of the community with $1 \leq K \leq N$. These so-called "neighbours" are chosen randomly according to a uniform probability density distribution.

The basic principle of the majority/minority rule model often applicable in the real life context was originally proposed by Galam [3]. The model mimics public debates, where at each time a discussion group of K agents step is selected at random and all agents take the opinion of the majority inside the group. If K is odd, there is always a majority in favour of either opinion. If K is even instead, there is the possibility of a tie. For simplicity we will further concentrate on K odd, although the formalism for K even will be similar. Agents which follow the majority rule can be considered as opportunists who always adopt the opinion of the majority with respect to their neighbourhood. The second group of individuals the so-called contrarians always adopt the opposite opinion of the majority and follow the minority rule. They usually have no own opinion, they simply want to be opposite in order to be opposite. Agents which follow the minority rule can be considered as contrarians who always adopt the

opinion of the minority. The third and fourth groups of agents consist of inconvincibles who always stick stubbornly on their opinion, supporting either the YES or the NO opinion [6]. Accordingly they follow the tautology rule which says always YES, and the contradiction rule which says always NO independent of their input stimulus. These Boolean behaviour functions can be given in terms of cellular automata rules. The representation for $K = 3$ input units is shown in table 1 where we represent majority (232), minority (023), contradiction (000) and tautology (255).

Table 1.
Cellular automata rules according to the Wolfram notation.

in	232	023	000	255
000	0	1	0	1
001	0	1	0	1
010	0	1	0	1
011	1	0	0	1
100	0	1	0	1
101	1	0	0	1
110	1	0	0	1
111	1	0	0	1

Note that the dynamical evolution for the majority/minority rule could also be written in terms of a linear threshold network widely used in models of neural and genetic networks [7, 8, 9], where the interactions are ferro – or anti-ferromagnetic, respectively and take the form:

$$\sigma_i(t+1) = \pm\theta\left(\sum_{(j)} \sigma_j(t)\right) \quad i = 1,...,N. \tag{1}$$

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

$$m(t) = \frac{1}{N}\sum_{i=1}^{N} \sigma_i(t). \tag{2}$$

The time dependent magnetization describes the degree of support of the YES state before a debate, one of the competing states YES or NO are

monotonically approached after a short transient. The system relaxes to $m=1$ or $m=0$ in the case of consensus, or to $m=\frac{1}{2}$ in the case of a tie.

3. Mean-field approach

In the thermodynamic limit of asymptotically large *N*, statistical predictions for the time evolution of the magnetization $m(t)$ Equation (2), as well as the time evolution of the Hamming distance $d(t)$ [7, 8, 9] can be derived analytically, provided that:

(i) Every agent has exactly *K* incoming connections from *K* distinct input agents *j* chosen with uniform probability among the other $N-1$ agents.

(ii) The interaction or rules of behaviour are chosen randomly according to a given probability density distribution.

(iii) The network is sparsely connected (*K* ~ log *N*).

Eventually, for $K = 3$ input units, the magnetization, i.e. the probability that a randomly chosen agent is in the YES state in the next time step is given by the iterative map:

$$m(t+1) = 3m^2(t) - 2m^3(t) \tag{3}$$

for the opportunists and:

$$m(t+1) = 1 - (3m^2(t) - 2m^3(t)) \tag{4}$$

for the contrarians. Eventually, the time evolution of the magnetization for the third group, the inconvincibles ist trivially:

$$m(t+1) \equiv 1 \text{ or } m(t+1) \equiv 0 \tag{5}$$

for those who are in favour of the YES, and the NO, respectively.

In all cases, for the majority and the minority interaction rule as well as for tautology and contradiction damage spreading remains confined and it is easy to show that an arbitrary initial distance $d(t)$ decreases monotonically to zero [4].

4. Mixtures of all four classes of agents

Be p_O the fraction of opportunists, p_C the fraction of contrarians, and p_A and $p_B = p_A + \varepsilon$ are the fractions of the inconvincibles with

respect to the YES and the NO state. Here $\varepsilon > 0$ is in favour the NO state, while $\varepsilon < 0$ favours the YES state of the inconvincibles. The magnetization $m(t+1)$ is a superposition of all contributions to the YES state and takes the form:

$$m(t+1) = p_O(3m^2(t) - 2m^3(t)) + p_C(3m^2(t) - 2m^3(t)) + p_A. \quad (6)$$

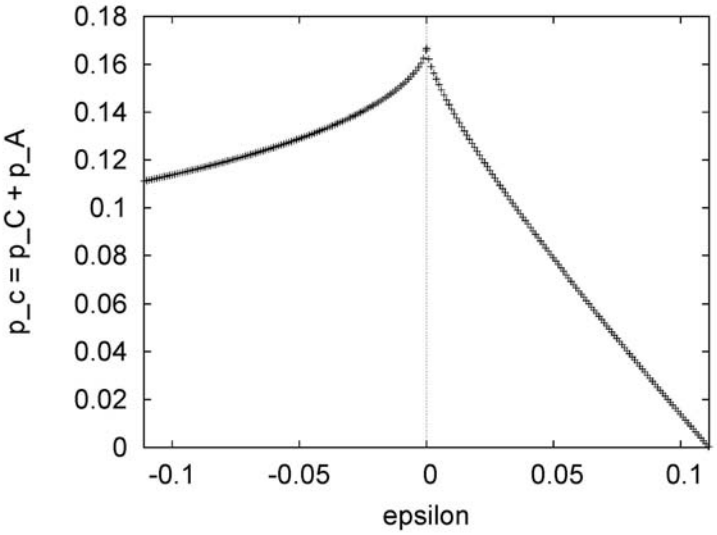

Figure 1. Critical p_C as a function of ε for $-\frac{1}{9} \le \varepsilon \le \frac{1}{9}$.

Making use of the normalization condition and eliminating the quantity p_O:

$$p_O + p_C = 2p_A + \varepsilon = 1 \quad (7)$$

we have:

$$m(t+1) = (1 - 2p - \varepsilon))(3m^2(t) - 2m^3(t)) + p \quad (8)$$

where the quantities $p = p_C + p_A$ and ε serve as control parameters. The long time behaviour is determined by potential stable fixed points of the cubic equation in m^*:

$$m^{*3} - \frac{3}{2}m^{*2} + \frac{i}{2(1-2p-\varepsilon)}m^* - \frac{p}{2(1-2p-\varepsilon)} = 0. \quad (9)$$

According to the Cardano formula the nature of the solutions depends uniquely on the sign of the discriminant D which specifies the number of real solutions. For $D > 0$ we have two stable attractors separated by the

unstable solution which specifies the basins of attraction of the attractive fixed points. For $D < 0$ one finds one unique stable solution. Figure 1 shows the critical line p_C associated with $D = 0$ as a function of ε. Note that $p_C = 0$ for $\varepsilon = \frac{1}{9}$ and $p_C = \frac{1}{9}$ for $\varepsilon = -\frac{1}{9}$. This critical line is of crucial importance, since the existence of only one unique attractor leads to the victory of the YES or NO decision independent of the initial condition.

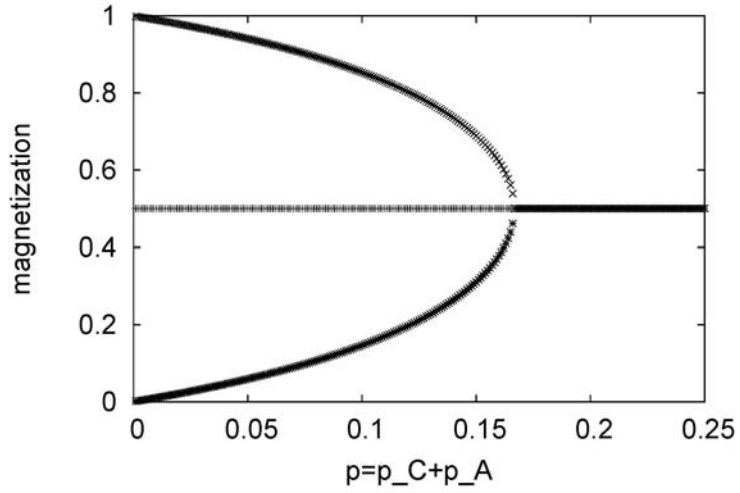

Figure 2. Time evolution of the magnetization $m(t)$ for an equal fraction of inconvincibles $p_A = p_B$.

Provided that $\varepsilon = 0$ we find the critical $p_c = p_C + p_A = \frac{1}{6}$, where the two stable fixed points undergo a backward bifurcation with the three fixed points:

$$m_1 = \frac{1}{2}\left(1 + \sqrt{\frac{1-6p}{1-2p}}\right) \quad m_2 \equiv \frac{1}{2} \quad m_3 = \frac{1}{2}\left(1 - \sqrt{\frac{1-6p}{1-2p}}\right). \tag{10}$$

Figure 2 shows that essentially we recover the familiar results of the model studied earlier [4], where for $p_c < \frac{1}{6}$ we find two attractors for the YES and NO states (top and bottom curve), while for $p_c > \frac{1}{6}$ we have the tie situation, where we have a fifty-fifty equilibrium with a unique attractor $m^* = \frac{1}{2}$ (middle curve).

4.1. The case ε ≠ 0: Unbalanced fractions of inconvincibles

Let us now consider the case, where more inconvincibles are in favour of the YES state than in the NO state, or vice versa. It is quite obvious that provided that the fraction of the inconvincibles in favour of the YES the NO will be able to win the debate even with an initial minority since the critical separating line will be shifted above or below the values $\frac{1}{2}$. Indeed a low order expansion of the corresponding fixed point for small p and small ε yields:

$$m^* \approx \frac{1}{2} + \varepsilon(1 + 6p + 36p^2). \tag{11}$$

In principle, this expansion reflects that the outcome is already explicitly put into the model as an assumption. We have three fixed points, where the middle one, which is unstable, plays the role of the separator. Figure 3 depicts the stable as well as the unstable fixed points of Equation (9) for $\varepsilon > 0$, where the NO opinion is favoured. The lower curve, which signals the victory of the NO opinion, is stable over the whole range. The separator (middle line) is always unstable. The upper line which coalesces with the separator at the critical p_c signals the victory of the YES opinion and is only stable for subcritical values of p.

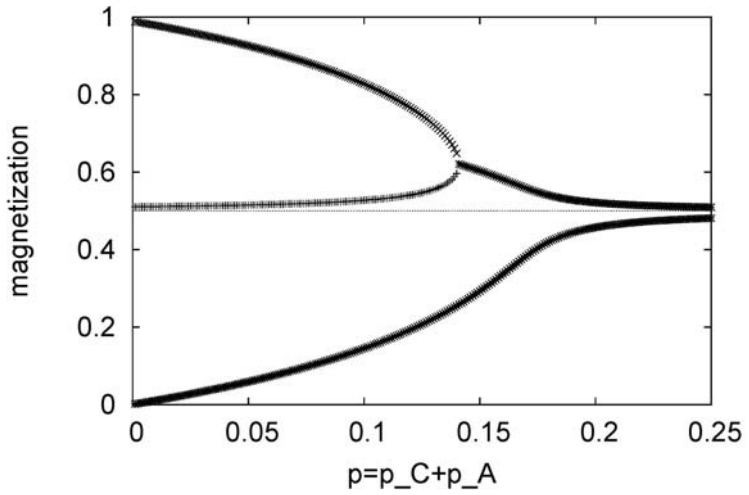

Figure 3. Magnetization m^* as a function of the concentration $p = p_C + p_A$ for $\varepsilon = 0.01$.

With increasing values of ε the bifurcation point moves to the left until it reaches $m^* = \frac{1}{4}$ at $p = 0$ for $\varepsilon_c = \frac{1}{9}$. For $\varepsilon < 0$ the situation is analogous, however with the restriction:

$$p = p_C + p_A > |\varepsilon| \tag{12}$$

as depicted in Figure 4, where the role of the upper and lower fixed point is reversed. Note however that the relevant critical line begins at $p = p_C + p_A > |\varepsilon|$ with the upper $m^* = 1$. In analogy to the case $\varepsilon > 0$ the bifurcation point moves to the left with increasing absolute value of ε until it reaches $m^* =$ at $p = \frac{1}{9}$ for $\varepsilon = -\frac{1}{9}$.

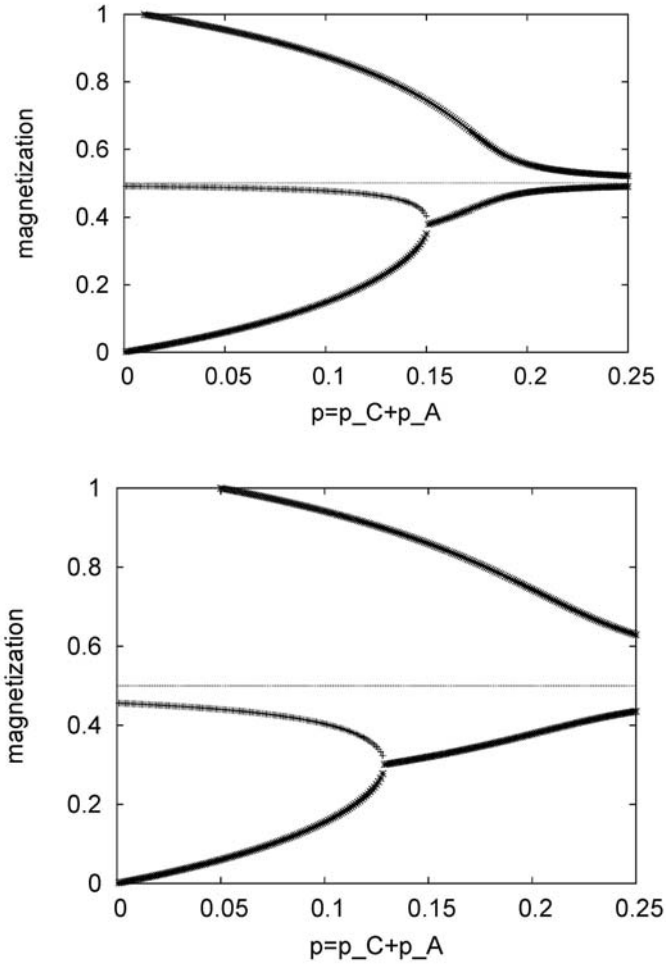

Figure 4. Magnetization m^* as a function of the concentration $p = p_C + p_A$ for $\varepsilon = -0.01$ (upper figure) and $\varepsilon = -0.05$ (lower figure).

5. Discussion

We have presented an agent-based model consisting of four prototypes of characters in order to study the subtle balance of opportunistic, contrarian as well as inconvincible behaviour in the dynamics of opinion spreading. We determined a critical parameter $p_c = p_C + p_A$ specifying the fraction of contrarian and inconvincible agents as a function of the control parameter ε which specifies the fraction of the inconvincibles in favour to the NO state. At low concentrations of the inconvincibles we find two stable fixed point configurations with a more or less clear YES or NO majority. Beyond the critical point we find a unique stable YES or NO decision depending on the balance between the YES and NO inconvincibles. We can conclude: increasing the fraction of the inconvincibles which are on the respective side is quite more advantageous than convincing the opportunists. Even the smallest difference in inconvincibles can turn the system over by shifting the separator to a lower or higher value in order to push the YES or NO decision, respectively. In any case, one should not try to convince the inconvincibles. On the other hand, once the inconvincibles have reached a critical threshold the victory to the YES or NO becomes certain.

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A STUDY OF METHODS FROM STATISTICAL MECHANICS TO INCOME DISTRIBUTION

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Abstract. *Research developed so far in Econophysics was dedicated to the analysis and prediction of financial data, financial markets, and financial products using methods and laws from Physics. More recently, a new direction was developed towards the study of macroeconomic aggregates and in particular to the income distribution within the boundaries of a state. The purpose of our endeavour is to form a database regarding income from different countries both developed and underdeveloped, and apply methods from Statistical Mechanics to make the analysis of these data and to establish definite causes of macroeconomic evolutions and financial crisis, and establish analogy with physical phenomena. We tried to analyse the data from six countries: France, Finland, Italy, Romania, Italy, and Hong Kong by using very reliable sources such as National Institute of Statistics or National Bank in each case. The data used were the distribution of income per capita divided by deciles in two variants: mean income and upper limit on income measured on annual bases. Each national economy was assimilated to a grand canonical ensemble, while particles were considered individuals or households. Having made these assumptions, we tried Fermi-Dirac distribution, Bose-Einstein distribution, and occasionally Boltzmann-Gibbs distribution in order to determine which is optimal for income distribution. The best fit to the data was observed in the case of Fermi-Dirac distribution, for which the coefficient of determination showed the best goodness of fit to the data. Using this distribution for data (spun throughout more years), we obtained the underlying critical parameters of annual income distribution such as chemical potential and temperature. The next step was to explore the evolution of income using economic analogues to chemical potential and temperature. Using as background the Yakovenko's analogy between temperature from thermodynamic systems and nominal income from Economics, we found other analogies that would allow further analysis and explanation of income.*

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Chapter I. Applications of Fermi-Dirac distribution to income distribution

I.1. Introduction

The word *econophysics* was first used at an international workshop held in Calcutta in 1995, while the first book containing the word econophysics in its title is authored by Mantegna and Stanley [1] [2].

However, the systematic relationship between Economics and Physics commenced at least 130 years ago, when the Marginalist school began to make massive use of mathematics, borrowing their tools from Physics. Thus, Alfred Marshall and William Jevons, the main theoreticians of the Marginalist school, envisaged making Economics as a second-Physics, while the fundamental notion of utility was to be treated as a Mechanics of human interest. Implementation of this interdisciplinary field was necessary to overpass the limits of Economics, given that mechanical epistemology influenced to a large extent the modern economic thinking. The limitation was determined, primarily, by the fact that economic activity is influenced decisively by human behaviour and human interrelations, which change throughout the time, being impossible to explain it with mechanical-type methods and laws [3].

Econophysics emerged as a consequence of the application of methods from Statistical Physics to financial markets, but subsequent scientific works in Econophysics focussed on three areas. The first area is about prices on capital market, currency exchange rates, and the prices of goods. The second one is about size of firms, macroeconomic aggregates, individual income and wealth. The third one is about analysis of economic phenomena using network type models [4] [5].

I.2. Short Literature Review and Theoretical Background

There are several trends which worth to be mentioned for a better understanding of the problems that come across the income distribution models. Most important, there is no model for an income distribution which would allow figuring out the features for the whole income range [6].

The income distribution seems to exhibit two regimes of behaviour. For low and middle income population, which is represented from 90% up

to 99 % of the population, the income may show according to different authors and papers, lognormal, gamma, Boltzmann-Gibbs distribution or other exponential-like functions [7]. For higher income part of population, which accounts up to 10% of the entire population, the income exhibits a power law of Pareto type. The only distribution which is claimed to fit the entire range is Tsallis [8].

Authors are often confused about the meaning of between wealth and income. Wealth evolution can influence the income by way of assets prices which evolve throughout the time and the financial yield that they give. Income can add to the already existing wealth. Also, wealth is considered to be a stock while income is considered a flow [9].

Data are considered to be by many authors a big problem which reflects on the accuracy of their results. However, more and more reliable statistical data are provided.

Most of the authors did not tackle the evolution after the beginning of the crisis. The only exception is [8], which claims there are some changes in the income distribution for years when the recession started to affect to a large extent the Argentinian economy.

I.3. Data Description

The data used for analysis is mean income and upper limit on ranges of income divided into deciles of population/households (equal bins of 10 % of the population/households). Thus, for France, Finland, and Italy we were able to get the data both for mean income and upper limit on income. The latter term for income is in accordance with the term used by National Institute of Statistics of Finland to describe the upper value of each income decile. For Romania and Mexico, we were able to obtain mean income, while for Hong Kong we used for the analysis mean monthly median income from different years. Also, the data were made available in different formats as follows: for France and Finland, the data were with regard to individuals, whereas for Romania, Mexico, Italy, and Hong Kong the data were about households. The data were considered in different monetary units. For example, in case of France they were expressed in euro for the entire time period considered. Italy was considered both for lire, which was national currency before euro (last year considered for lire in of

Italy was in year 1998) and euro starting from year 2000. In the case of Finland, the data were altered such that the numerical value for each year income according to last year considered, making the data more reliable and realistic. In Romania, the data were expressed in leu which was the currency until July 2005, when a new currency was introduced called heavy leu. The ratio between 1 heavy leu = 10000 leu. In Mexico, the data were expressed in US dollars, making the data more accurate given the relatively low inflation in the USA. Finally, in Hong Kong the figures were expressed in Hong Kong dollars depending on the purchase power parity in the final year considered (2001), which is just another method (just like in case of Finland) to alter the data in order to make them more accurate and reliable for analysis purpose.

The income considered can be gross income which is the revenue obtained from different kind of sources such as wages, dividends, rents, and so forth. Generally, the income of 90 % of the population depend almost entirely on wages, whereas the income of upper 10 % (or sometimes even less) depend on the prices of the assets.

The income analysed can be also disposable income or net income which is defined as the income which an individual or household have available to spend or to save after taxes are paid and/or social benefits are received [10]. The National Institute of Statistics from France calls it income before redistribution.

$$\textit{Net (Disposable) Income} = \textit{Gross Income} - \textit{Taxes} + \textit{Social Benefits} \quad (1)$$

Thus, most of the income data analysed in this paper is about net income, except a set of data regarding inactive people's income, income before redistribution, and mean wealth provided for France, which will be analysed as well.

The upper limit on income comprises 90% of the population, as for the upper 10 % data were not provided. In the case of mean income, the data cover the entire population as it is possible to calculate the mean income for the richest part of the population. For three countries (France, Finland, and Italy), we were able to get both upper limit on income and mean income which can lead to supplementary results. In case of France, more data were made available such as income distribution for non-active persons, mean wealth, and income before redistribution.

The data provided are very reliable especially for France, Italy, Finland, and Romania being provided by National of Statistics for most of them and in case of Italy by the National Bank. Besides, different bodies of the European Union double-check the accuracy and veracity of the data provided. In case of Mexico and Hong Kong the data where provided by different national bodies which analyse this.

I.4. Methodology

The paper analyses the distribution of net income, gross income, and median income of the population according to allocations specific for a market economy in equilibrium, under similar conditions for thermal equilibrium in thermodynamics. The analogy with thermodynamics used here is grand-canonical ensemble, where both number of individuals/particles and the amount of energy/money are hold constant but the average for both variables is the same for a longer period of time. The other two cases are micro-canonical ensemble (fixed number of particles/individuals) and canonical ensemble (fixed number of particles/individuals and variable amount of energy but the average of energy is fixed) which do not comply with reality of a national economy [11]. Grand-canonical ensemble is the best approximation for a national economy as population varies slowly over long period of time, so it can be approximated as constant. Also, the average is considered to be constant for a certain amount of time.

Fermi-Dirac distribution is the best model that can be applied considering that is highly unlikely for a person or a household to have exactly the same income, especially in the case of net income. While for gross income this is more likely (two people working in a public institution – where wages are less flexible – working in a similar position with a similar background), for net income there other things that differentiate it among various people (such as taxation level, payment for different credits granted, different transfers from public budget).

Since all the countries analysed have populations of millions of persons and each person has virtually a different income within an interval

of tens of thousands of monetary units of income, this can be approximated as a continuous interval. Subsequently:

$$n(x) = \frac{c}{\exp\left(\frac{x-\mu}{T}\right)+1} \tag{2}$$

where $n(x)$ is the number of fermionic particles within some energy interval or in economic terms is the number of individuals having an amount of money within some level of income.

We tried to apply Fermi-Dirac distribution and Bose-Einstein distribution to the data described before. The main criterion to judge on how applicable is each distribution was the coefficient of determination (R^2). Subsequently, we were able to determine that Fermi-Dirac distribution has a better fit to the data. Subsequently, in the following paper, we will present only the results from the application of Fermi-Dirac distribution.

I.5. Data analysis

The preferred method for data description is cumulative method instead of normal method. This implies that for zero income the percentage of the population is 100%. Thus, the more the level of income increases the cumulative percentage of probability of income distribution decreases.

In order to analyse the data from each country considered, we will try to assess goodness of fit for Fermi-Dirac distribution by taking into account the minimum and the maximum value of the coefficient of determination for an annual set of data. The year with the highest coefficient of determination will be represented graphically. Of the six countries analysed, we selected the most illustrative for this kind of distribution: Finland and France. Finland has the highest coefficient of determination for the data analysed (partly due to the conversion of all values in euro 2009) and has the longest time interval analysed (1987-2009) both for mean income and for upper limit on income of disposable/net income. For the rest of the data analysed, Tables 1 and 2 present the outcomes. The graphics presented below in the following section are in log-log scale (natural logarithm).

I.5.1. Finland

Data were provided by National Institute of Statistics from Finland [12].

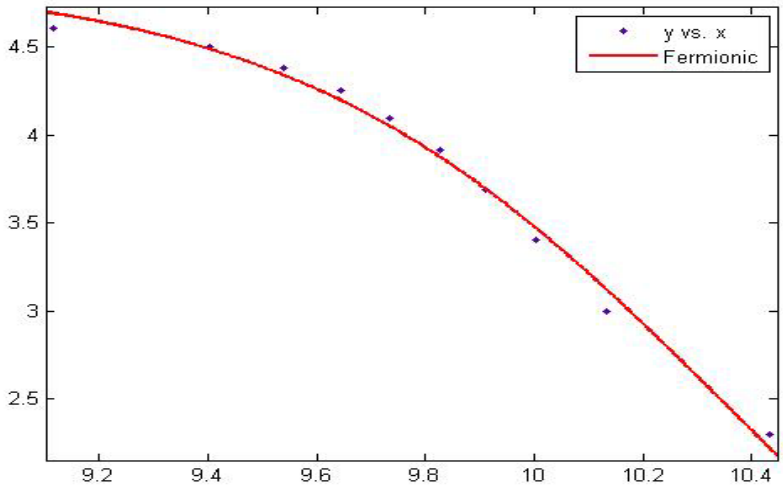

Figure 1. Cumulative probability distribution for mean income in Finland in the year 1990.

Characteristic parameters for the graphic were $T = 0.4007$, $c = 4.9$, $\mu = 10.36$, and $R^2 = 0.9909$. On the *x*-axis we represented logarithmic values for income deciles, while on the *y*-axis we represented logarithmic values for the cumulative probability.

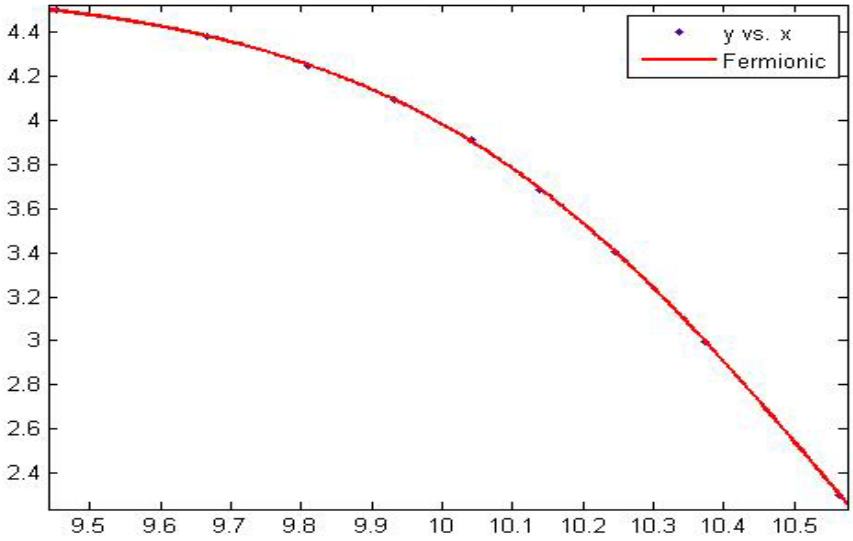

Figure 2. Cumulative probability distribution for upper limit on income in Finland in the year 2008.

The most illustrative analysis was considered to be the one from 1990, as the coefficient of determination was the highest for the entire period analysed. The analysis with the lowest coefficient of determination was in the year 2007, with $R^2 = 0.9755$.

Characteristic parameters for the graphic were $T = 0.3074$, $c = 4.621$, $\mu = 10.56$, $R^2 = 1$. On the *x*-axis we represented logarithmic values for income deciles while on the *y*-axis we represented logarithmic values for the cumulative probability.

The most illustrative analysis was considered to be the one from 2008, as the coefficient of determination was the highest for the entire period analysed. The analysis with the lowest coefficient of determination was in the year 1994 with $R^2 = 0.9997$.

Of all countries analysed both for mean income and upper limit on income, Finland exhibits the best fitting to the data using the fermionic distribution. A possible explanation for this is that all income figures were adjusted to the euro value from last year analysed (2009), which ensures a better representation of income unaltered by inflation or currency depreciation. Also, Finland is a country with low share of black market even compared to other developed countries. In addition, values for the coefficient of determination are higher throughout the entire period analysed for upper limit income than in the case of mean income.

I.5.2. France

Data were provided by National Institute of Statistics from France [13].

Characteristic parameters for the graphic were $T = 0.3959$, $c = 4.577$, $\mu = 10.47$, and $R^2 = 1$. On the *x*-axis we represented logarithmic values for income deciles, while on the *y*-axis we represented logarithmic values for the cumulative probability.

We chose the cumulative distribution probability from the year that presented the best fit to the data regarding annual mean income before redistribution in France during 2003-2009. The lowest coefficient of determination for all annual mean income distribution was 0.9996, in the year 2008.

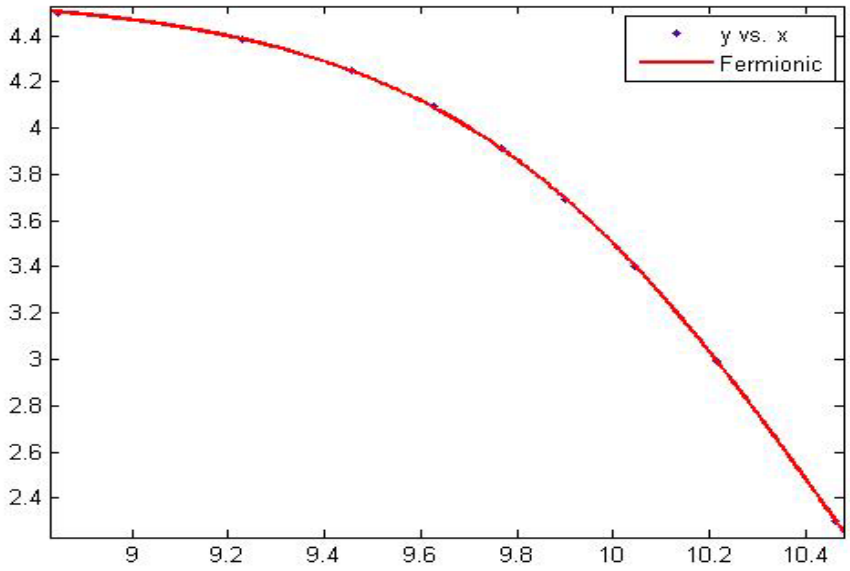

Figure 3. Cumulative probability distribution of mean income before redistribution for France in year 2003.

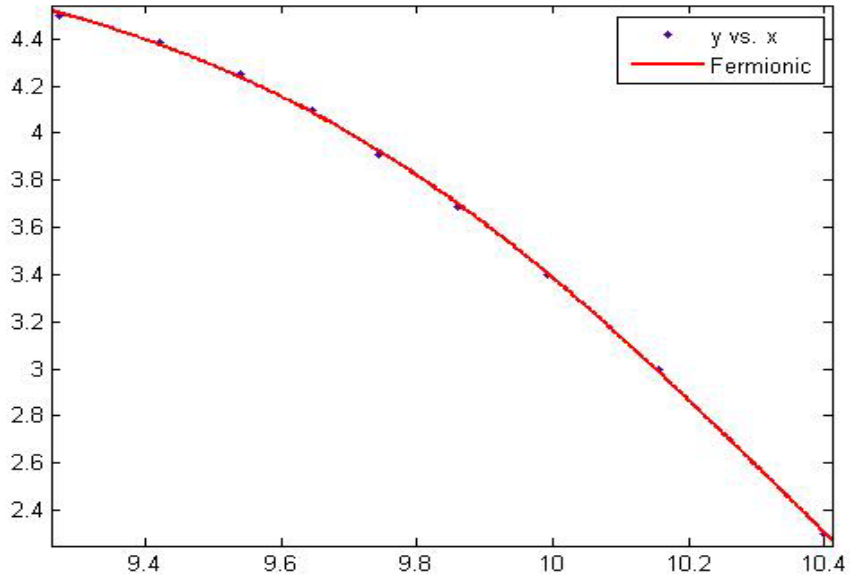

Figure 4. Cumulative probability distribution of inactive peoples' mean income for France in the year 2003.

Characteristic parameters for the graphic were $T = 0.4315$, $c = 4.88$, $\mu = 10.35$, and $R^2 = 0.9998$. On the *x*-axis we represented logarithmic values for income deciles while on the *y*-axis we represented logarithmic values for the cumulative probability.

We chose the cumulative distribution probability from the year that presented the best fit to the data regarding annual mean income of inactive people in France for the time interval 2002-2009. The lowest coefficient of determination for all annual mean incomes of inactive people was 0.9994 in the year 2008.

We consider this to be the most interesting finding as the income distribution among inactive individuals is not achieved thorough market mechanism but through public regulations and (in the case of France) the pensions and social benefits are managed by state administration. These two characteristics are completely different from income of the active people which are mostly are market driven. A possible explanation for this is that social aid and pensions are awarded based on the work performed by each individual and a fair contribution to the pension fund from those.

Annual values for the coefficient of determination (R^2) for Fermi-Dirac distribution on income distribution on population/households deciles (cumulative method) (Table 1).

Table 1

Year	Upper limit on Income			Mean income				
	Finland	France	Italy	Finland	France	Italy	Romania	Mexico
1987	0.9998	-	-	0.9924	-	-	-	-
1988	0.9999	-	-	0.9905	-	-	-	-
1989	0.9998	-	-	0.9899	-	-	-	-
1990	0.9999	-	-	0.9909	-	-	-	-
1991	1	-	-	0.9892	-	-	-	-
1992	1	-	-	0.9874	-	-	-	-
1993	0.9998	-	-	0.9855	-	-	-	-
1994	0.9997	-	-	0.9868	-	-	-	-
1995	0.9999	-	-	0.9854	-	-	-	-
1996	1	-	-	0.9893	-	-	-	-
1997	0.9999	-	-	0.9845	-	-	-	-
1998	0.9999	-	-	0.9818	-	-	-	-
1999	0.9999	-	-	0.9746	-	-	-	-
2000	1	-	0.9986	0.9752	-	0.9927	-	0.9885
2001	0.9999	-	-	0.9789	-	-	-	-
2002	1	0.9998	0.999	0.9784	-	0.9939	-	0.9904
2003	0.9999	0.9998	-	0.9796	0.9853	-	-	-
2004	0.9999	0.9998	0.9992	0.9782	0.9833	0.9927	-	0.9874
2005	0.9999	0.9997	-	0.9769	0.9813	-	0.9932	0.9864
2006	1	0.9996	0.9989	0.9772	0.981	0.9917	0.9943	0.9896
2007	0.9999	0.9997	-	0.9758	0.9815	-	0.9942	
2008	1	0.999	0.9993	0.976	0.978	0.9937	0.9913	0.9892
2009	0.9999	0.9996	-	0.9798	0.9816	-	0.9896	-
2010	-	-	-	-	-	-	0.9894	-

Annual/monthly values for the coefficient of determination (R^2) for Fermi-Dirac distribution on income distribution on population/households deciles (cumulative method) (Table 2).

Table 2

Year	France annual values for income before redistribution	France annual values for income of inactive people	Hong Kong monthly values for median income
1991	-	-	0.9999
1996	-	-	0.9999
2001	-	-	0.9999
2002	-	0.9998	-
2003	1	0.9998	-
2004	0.9999	0.9998	-
2005	0.9999	0.9996	-
2006	0.9998	0.9997	-
2007	0.9999	0.9997	-
2008	0.9996	0.9994	-
2009	0.9999	0.9999	-

Data were provided by [12], [13], [14], [15], [16], and [17].

I.6. Discussions and Conclusions

I.6.1. Conclusions regarding data analysis

Fermionic distribution is a very good distribution regarding mean income, upper limit on income, and median income by deciles group for the countries analysed. Coefficient of determination (R^2) is extremely high when it comes to the fitting of data to this type of distribution. The absolute lowest value for this coefficient is 97% for the data regarding income in the countries considered. Also, compared to other distributions from relevant literature, goodness of fit provided by this type of distribution is at least similar if not better.

This paper studies for the first time the possibility of applying Statistical Mechanics methods to upper limit on income and median income by deciles group, unlike papers which consider only the distribution of population mean income. What is more remarkable is that Fermi-Dirac distribution has a higher coefficient of determination for the same year and country in the case of upper limit on income in comparison to the case of mean income.

In the analysis of the data considered in this paper, we tried to see goodness of fit in the case of Bose-Einstein distribution. The results yielded a lower coefficient of determination, the approximate value for most of data analysis being about 60-70%. In comparison to Fermi-Dirac distribution, in the overall value and in each particular value regarding goodness of fit to the data, Bose-Einstein distribution shows an inferior capacity to describe the distribution of population income in a country/state.

Fermi-Dirac distribution applied to income/money distribution proved to be robust especially in the case of Hong Kong and Finland data. In the case of Hong Kong, the data consisted of monthly median income (not the usual data expressed on annual bases), and the lowest coefficient determination was 0.999. Also, the Hong Kong dollar is linked to US dollar which implies a stable exchange rate and a low inflation. In case of Finland, of all the countries analysed, has the lowest share of black and grey market, which makes the data provided to be very reliable and realistic. Also, all the values are expressed in euro for the value in the year 2009.

The only exception for the scope of the application of Fermi-Dirac distribution is about the time and the countries characterised by highly inflationary processes. In our data set, this process occurs in Italy before the conversion to euro in the year 2000 and in Romania before the conversion to heavy leu in the year 2005. The total incapacity of this distribution to analyse and study these periods is not singular, as we tried to apply unsuccessfully Boltzmann-Gibbs and Bose-Einstein distributions. The main probable cause for this is that fixed earnings, which are represented by 90 % low-income part of the population, were more affected by inflation than the 10% upper income population income which is affected by the assets prices primarily. Subsequently, the share of each decile in total income changed. Also, we attempted to fit Fermi-Dirac distribution to data regarding the mean wealth distribution for France. Unfortunately, we could not fit the distribution to the data. Also, we got the same result for Bose-Einstein and Gibbs-Boltzmann distributions.

I.6.1.1. Fundamental causes of inequality

In addition to the causes already identified in the literature pertaining to this subject, we would like to emphasize the whole background affecting

wage distribution, not only the direct causes but some of the fundamental phenomena.

Social benefits are considered to be the main way to counterbalance the increasing inequality among population. However, social benefits are increasingly affected by the mainstream economic view regarding the relationship between national competitiveness and social welfare system. According to this, the higher the amount of funds allocated for social protection the higher is taxation level, hence less money disposable for companies to serve as a competitiveness-enhancer. The most illustrative case is the European Union, where social welfare system is unparalleled in the world. However, the EU competitiveness decreased to a large extent compared to USA and Japan, its economic contenders. Therefore, on the agenda of governments, especially the ones from the EU, there is a tendency for the roll-back of the welfare systems in order to increase the competitiveness. Subsequently, this roll-back involves a reduction in social benefits, which implies an inequality increase given that poor are the most affected by these.

One of main causes for increasing inequality is considered to be the higher capital gains of the high-income share of population. Level of taxation on capital is driven by a veritable race for capital among countries, as this is the main contributor to general welfare and prosperity. Therefore, countries tend to reduce taxation on capital by means of direct taxes on profit and other types of capital. In order to counterbalance the reduced earnings from taxes on capital, states increase labour taxes and indirect taxes such as consumption taxes, VAT for example. Subsequently, companies tend to redeploy their business in countries with lower taxes, especially capital taxes. Because of this, the high-income population earnings (which are influenced by capital gains and asset prices) had a reduction of their taxes, which in turn caused a considerable increase of their gains.

Foreign Direct Investments (FDI) affect a great deal economic development and subsequently earning structure among population. Investments abroad are an important manner for companies given the globalisation trend to increase its competitiveness. Theoretically, there are two ways to carry out with this: price competitiveness and quality competitiveness. First one deals with a decrease of costs, which allows a

price reduction. The second one requires an increase of product quality [18]. In most cases, FDI occur mainly because a company can benefit from lower prices in host-country in comparison to the ones from home-country. This does not involve most often the activity with the highest technology, which is essential for quality competitiveness. In the home country, some people become unemployed which increases the wages disparity. In the host country, on the long term it creates a demand for more-skilled workers, leading to larger disparity in wages between lower-skilled and higher-skilled.

I.6.2. Methodological conclusions

Fermi-Dirac distribution is very robust in describing the income distribution. Thus, we applied it successfully for households and individuals for different kinds of data (mean income, upper limit on income, and median income). Also, we applied it for annual values and mean monthly values throughout more years and sometimes for long time intervals (22 years in row in the case of Finland). More remarkably, the countries analysed had different types of economy and there are on different levels of development. For example, Finland belongs to Nordic type of economy whereas France belongs to the continental type, whereas Italy belongs to Mediterranean type. Mexico has a specific economy for Latin America, while Hong Kong is one of the Asian tigers. Romania belongs to the Eastern European type of economy, a former country in transition. Finland, France, Italy, Mexico, and Hong Kong are considered to be developed economies, while Romania is a developing economy.

We can notice higher capacity of fermionic distribution to fit the data set with upper limit on income than the data with mean income distribution. This is mainly attributable to several facts. First, the upper limit on income by deciles group describes only the income of low-income tier of the population, which accounts around 90% of the whole population. Subsequently, income of this part of population evolves in a similar manner based on the fact that the earnings of this population category are composed of wages, which are affected similarly by inflation. Second, mean income could be erroneous due to the high amount of data necessary to calculate the mean. Third, considering that earnings of the

low-income tier of the population are mainly based on wages and therefore difficult to be subject for fiscal evasion, unlike the upper income tier of population (10%) for which fiscal evasion is easier to achieve. Therefore, when analysing the revenues of low-income tier of population it is advisable to use upper limit on income, which is more reliable. The best proof is the high frequency by which fermionic distribution has the coefficient of determination (R^2) equal to 1 (or 100%) when applied to upper limit income on deciles groups. In the case when high income tier of population is analysed or the entire income distribution is considered, the data set that should be considered for analyses is mean income.

The underlying reason for which Fermi-Dirac is a good distribution function for income is that an atomic model can be assimilated to an economy considered vertically. Thus, each stage in the chain of production can be assimilated to an atomic layer of electrons and the source of raw materials can be an analogue to nucleus. Another analogy is between added value at each stage of production and energy of each layer.

Thus, the first stage of production which corresponds to the first electrons layer has the lowest added value / lowest energy. An analogue for a product is an electron that jumps from one layer to another as it gets more energy. The more stages of productions a product undergoes, the more value added gets, hence more energy in an electrons layer further away from the nucleus. As industrial production is standardised, similar products undergo similar process of production. Even though technical process is mostly similar, general conditions regarding production factors determine different added values at each stage of production in each company for the same or similar products. Subsequently, people and companies whose revenues depend on the value added gotten at each production stage get different revenues according to company's productivity and individual productivity.

I.6.3. Further conclusions

This study is the first to use (to the best knowledge of the authors) upper limit on income data in order to analyse income distribution. Also, we believe that Fermi-Dirac distribution can be used to analyse the entire regime of income distribution (both for lower-income and upper-income population). Fermi Dirac distribution proved to fit very well data and can be an alternative tool to analyse inequality.

Chapter II. Study of correlation between thermodynamic variables and macroeconomic aggregates

II.1. Introduction

First serious approach of the relation between Economics on one hand and Thermodynamics and Statistical Mechanics on the other hand was made by Nicholas Georgescu Roegen, which in his magnum opus [3] pointed out the possibility of using Physics as a new paradigm in the approach of Economics.

II.2. Short Literature Review and Theoretical Background

In [11] it is dealt extensively with analogies between Thermodynamics and Macroeconomics. Thus, a macroeconomic system is assimilated with an isolated physical system such as a gas in a thermally isolated vessel. Assuming a state of a market with a certain number of trading agents (N), their assets would change over a time. It is impossible to make a detailed analysis of a market even if the initial conditions and all the forces that influence the market are known. Supposed that a huge system of interconnected equations can describe all the market forces and the solutions are found, it is very difficult (if not impossible) to use the massive amount of data in a successful manner. Instead, the alternative would be to create a statistical method based on average parameters characterising the market. This kind of average implies a vast number of microstates. Given that a market has a very large number of degrees of freedom on one hand and that many hidden and complex connections and variables may exist in the real world on the other hand, the market evolution is chaotic and unpredictable. Due to its chaotic nature, we can use in this case the ergodic hypothesis. The type of statistical ensemble used in our case is grand-canonical ensemble. Thus, total money (M) and number of trading agents (N) are not fixed, though their average is fixed for a longer for large time interval, which in our case is a year.

II.3. Data description

The data in case of France were about individual income expressed in euro for the entire period and in yearly values both for mean income and upper limit on income by decils of population. In Italy, the data were in annual aggregated figures that comprise households' income both in lire

and euro (after 2000) and both for mean income and upper limit on income by decils of households. For Finland, the data were expressed in annual aggregated figures for individuals in euro, converted to the value of euro in the final year considered (2009), both for mean income and upper limit on income by deciles of population. For Romania, the data were about annual mean income of deciles of households expressed in leu until year 2004 and afterwards in heavy leu. For Mexico, the data were about annual mean income of deciles of population (individuals), expressed in US dollars for the value in the year 2008. As for Hong Kong, the data were about mean monthly values of median income for deciles of households from three different years. The currency used was Honk Kong dollar calculated according to purchase power parity from 2001.

II.4. Methodology

After analysing the fitted data using Fermi-Dirac distribution, we obtained thermodynamic parameters specific for such a distribution. We preferred to use for the data treatment the cumulative method. In order to study the correlation between thermodynamic variables and macro-economic aggregates, we will use only temperature and chemical potential. In tables 3 and 4, we present the outcome obtained, including the degeneracy. In the following, we present the analogies that can be drawn after the analysis of the data.

Temperature is determined by the average money per person $< m > = M / N,$ where M is total amount of money in a national economy and N is total number of holders. The equivalent variable in Economics is called nominal income, which is represented by the amount of money a person or a household earns in a time interval, unadjusted by inflation and stated in the earned currency [19]. In the analysis of the correlation between temperature and nominal income, the normal trend for temperature is to have an overall growth considering that monetary mass and inflation increase in the long run and subsequently nominal income.

Chemical potential defined as $\mu = \left(\frac{\partial E}{\partial N} \right)_{S,V}$ can be assimilated with the economic variable called productivity. Thus, productivity is defined as output/input ratio or (in a different manner) as the resources/inputs necessary to yield a certain output such that for the same input to get a higher output or to get the same output with a lower input. Since chemical potential is the necessary supplementary energy to add an additional

number of particles into a system, it makes economic sense to assimilate it to the inverse of marginal increase of productivity. Subsequently, number of products obtained can be assimilated with newly introduced particles into the system (δN) and money required for production can be assimilated with energy required for introduction of new particles (δE) [20]. Another additional reason to assimilate chemical potential to marginal increase of productivity is caused by high correlation of productivity with income and its distribution.

However, in our case not total factor productivity matches the data regarding chemical potential but labour productivity. This is defined as:

labour productivity =
= measure volume of output / measure of human input use.

Human use can be measured as the amount of work per worker during a certain measure of time, or as results obtained per monetary unit allocated as wage and so forth [21]. Developed countries have high productivity and actually it is the most important factor that determines income level. Also, within the same country companies and people with high productivity have higher income. A good example is the income level difference between highly skilled, skilled, low-skilled, and unskilled personnel.

In the analysis of the correlation between chemical potential and labour productivity, the graphics obtained for the same country and time interval should be symmetric in reference to the *x*-axis, considering the definition above.

II.5. Data analysis

The next step is to get annual values for temperature and chemical potential for the entire period analysed, represent them graphically, and comment the macroeconomic implications. We chose the clearest examples for correlation between temperature and nominal income on one hand and chemical potential and labour productivity on the other hand (Finland and Mexico) and the case which allows the most insightful economic analysis (France).

II.5.1. Finland

As we can observe in figure 5, temperature/nominal income for mean income analysis has an overall increase in the time interval 1987-2007, while for 2008 and 2009 there is a sharp decrease due to the economic crisis.

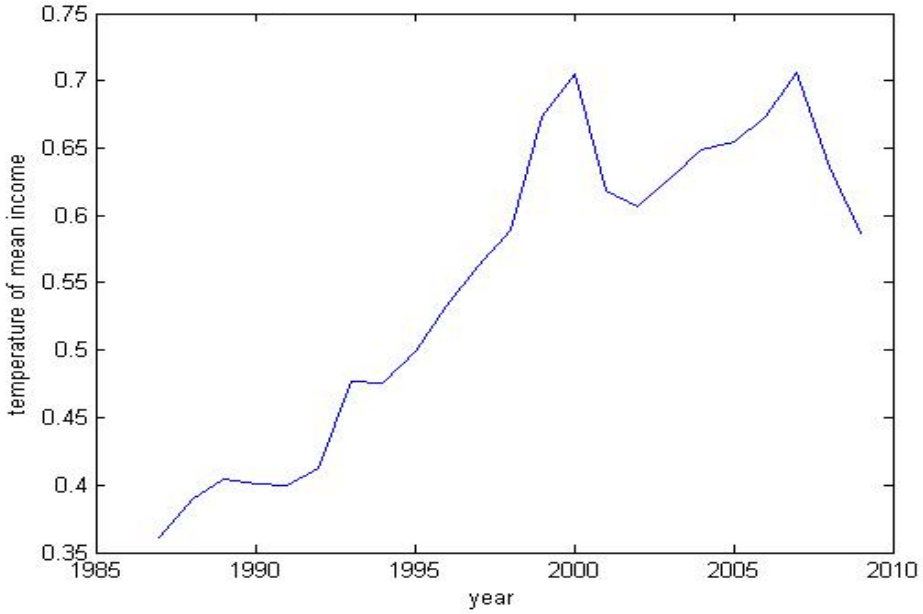

Figure 5. Temperature for mean income in Finland for time interval 1987-2009.

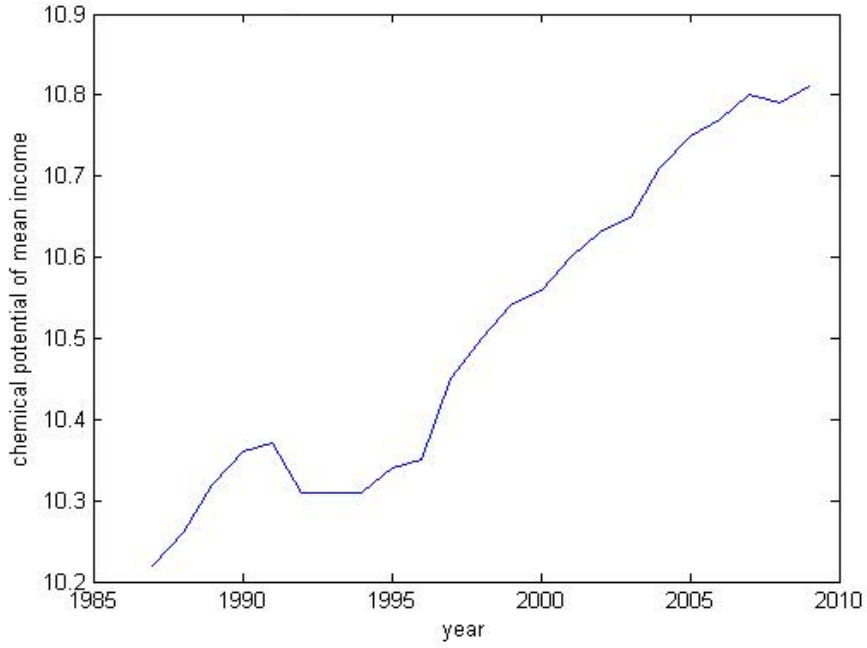

Figure 6. Chemical Potential for mean income in Finland for time interval 1987-2009.

To illustrate the evolution of chemical potential/labour productivity as presented in figure 6, in the opinion of Finish National Institute of Statistics “pace of growth in labour productivity has slowed down strongly in the whole economy since the mid-1990s, from 3.5 per cent to 0.7 per cent in 2010. Although the annual growth rates for individual years (2004, 2007 and 2010) have been around 3 per cent the trend in labour productivity has been declining since the mid-1990s” [22].

Figure 7 illustrates the increase of nominal income that occurred as a consequence of the economic recovery beginning with the year 1995. From the year 2007 on there is a sharp decrease in the nominal income due to the crisis. We can notice that its overall tendency follows the same distribution as in the case of mean income. The exception is that for the time interval 2000-2005, when the increase of temperature is not as big and accentuated as in case on the analysis performed on mean income set of data.

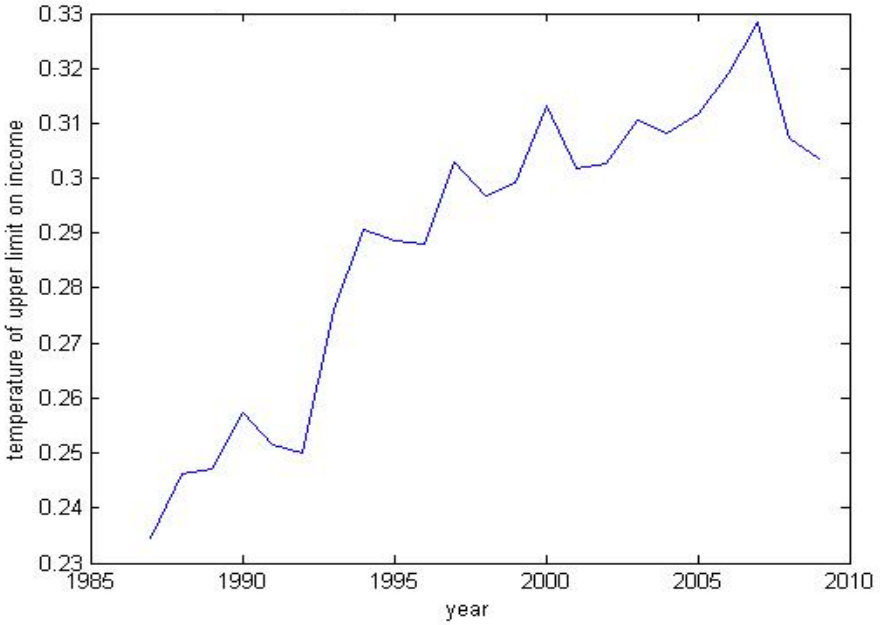

Figure 7. Temperature for upper limit on income in Finland for time interval 1987-2009.

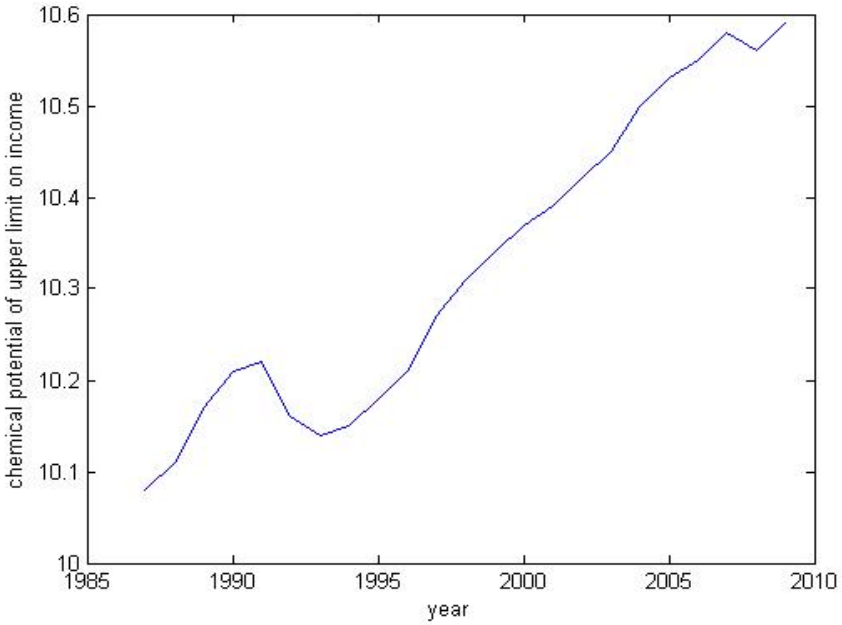

Figure 8. Chemical Potential for upper limit income in Finland for time interval 1987-2009.

From figure 8 we can notice that chemical potential in the case of upper limit income exhibits the same trends as in the case of mean income.

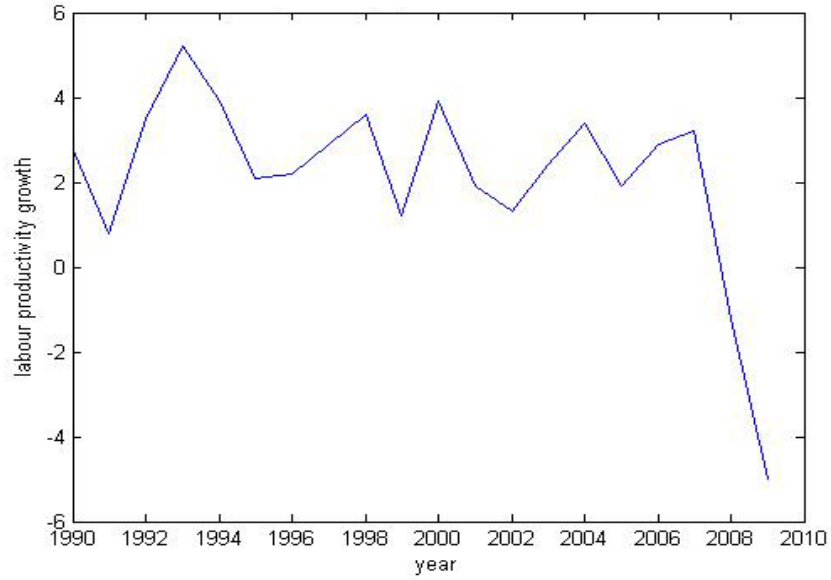

Figure 9. Labour productivity growth rate in Finland for time interval 1990-2009.

Data were provided by [23]. In figure 9 we displayed the graphical tendencies of labour productivity annual growth rate as proxy for chemical potential. Considering that chemical potential according to its definition, it is fairly symmetrical to its proxy about x axis. We can observe that main trends of labour productivity annual growth rate are captured in the evolution of the chemical potential. Subsequently, we can observe the better evolution of productivity in the middle of the 90s and slower growth in the aftermath, and the sharp decrease at the same time with the commencement of the crisis in the year 2007.

We can conclude after having a look at the overall trends of chemical potential and temperature that nominal income increased while productivity growth rate was slower. In order to have a better picture of the Finnish economy we would need the evolution of inflation, but these trends are not a good indicator for economic activity, especially for its national competitiveness.

II.5.2. France

In figure 10, temperature (which indicates the evolution of nominal income i.e. the physical amount of money that a person obtains) shows a normal behaviour except the slight decrease in the year 2004. In the 2008, when in times of deep economic crisis the nominal income increases. However, we must take into account that measures taken in order counterbalance the effects of the crisis did not affect the income in France to the same extent as was the case in other developed countries. However, we can notice that for the time interval 2003-2008 (before the economic crisis), temperature/nominal income presents an overall increase.

In figure 11, the evolution of chemical potential is in full agreement with the previous results for France. Thus, we notice the its decrease up to the “peak” of productivity during 2004, followed by an increase unaffected significantly by the crisis and from 2009 there are the first signs of a small recovery presented by an slighter increase than in the case of the previous two years. Chemical potential obtained from both sets of data regarding mean income and upper limit on net income on one hand and mean income before redistribution on the other hand show remarkable similarities.

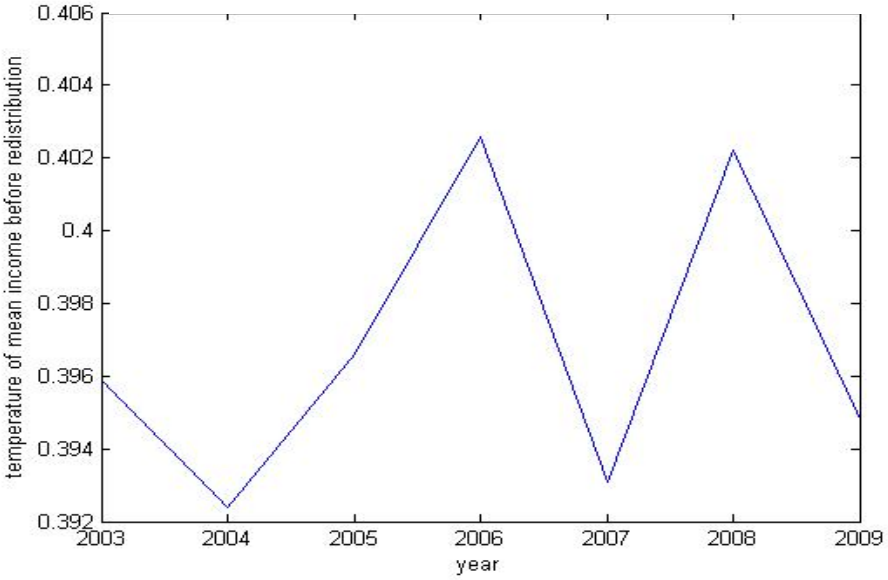

Figure 10. Temperature for France income before redistribution for time interval 2003-2009.

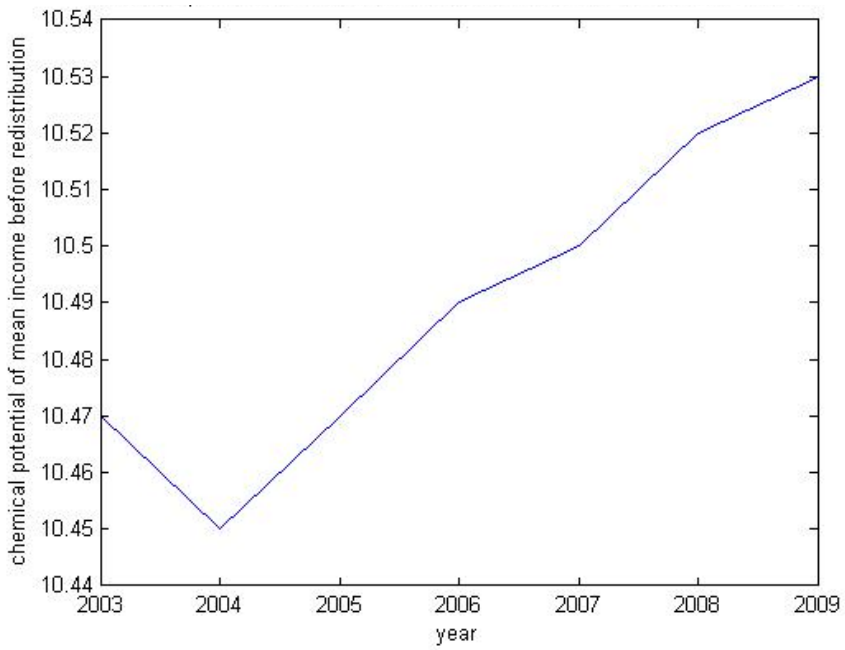

Figure 11. Chemical Potential for France income before distribution for time interval 2003-2009.

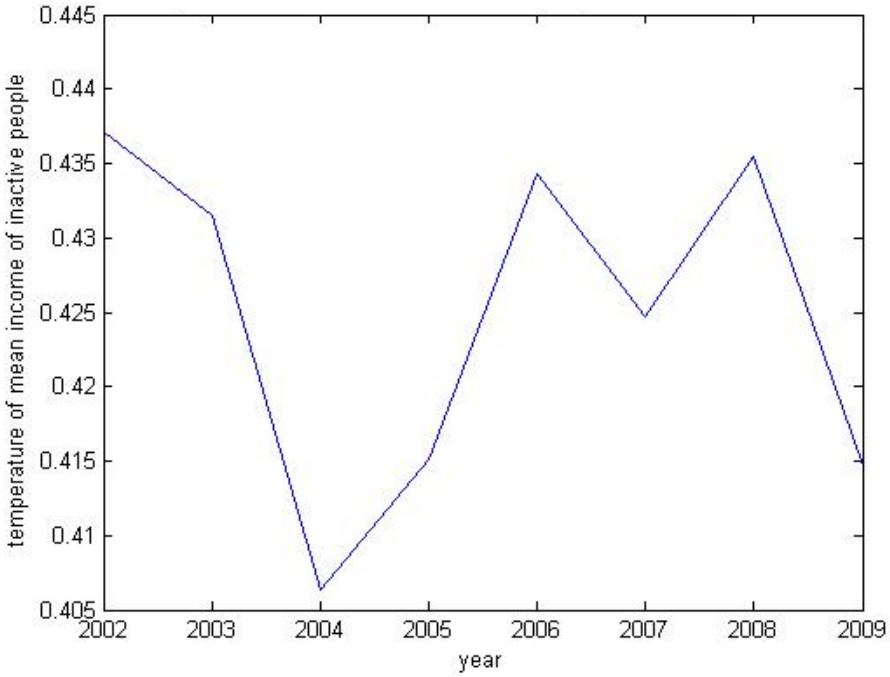

Figure 12. Temperature for France mean income of inactive people for time interval 2002-2009.

In figure 12, temperature follows the same trends as the temperature extracted from data about mean income before distribution. This implies that is a remarkable good similarity between the evolution income before distribution and the income for inactive people, which consists mainly of pensions and social benefits. The evolution in the year 2007 for temperature both for income before redistribution and inactive people's income highlights once again the tight correlation between gross income and various social benefits not only as general trend but for specific time intervals as well.

In figure 13, the evolution of chemical potential of mean income of inactive people is in full accordance with the ones from mean income, upper limit on income, and mean income before redistribution. The evolution of chemical potential shows the above mentioned trend even more than in the case of evolution of temperature.

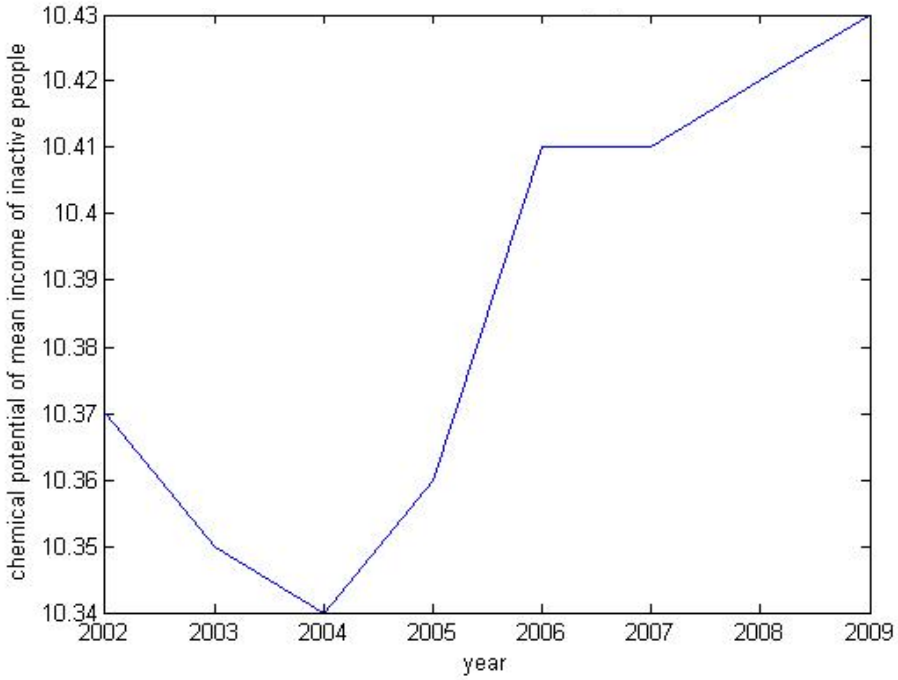

Figure 13. Chemical Potential for mean income of inactive people for the time interval 2002-2009

II.5.3. Mexico

In figure 14, Temperature indicates a normal increase of nominal income for years 2005 and 2006 followed afterwards by a decrease caused by the crisis. However, there is an abnormality regarding the decrease of temperature (nominal income) in the years 2002 and 2004, while for the next years the general level stays under the level from the year 2000. A possible explanation is that during the time interval 2000-2002 the labour productivity had small increments or negative increments/drops, when it is known that productivity is one of economic variables that determines to a very large extent the income level.

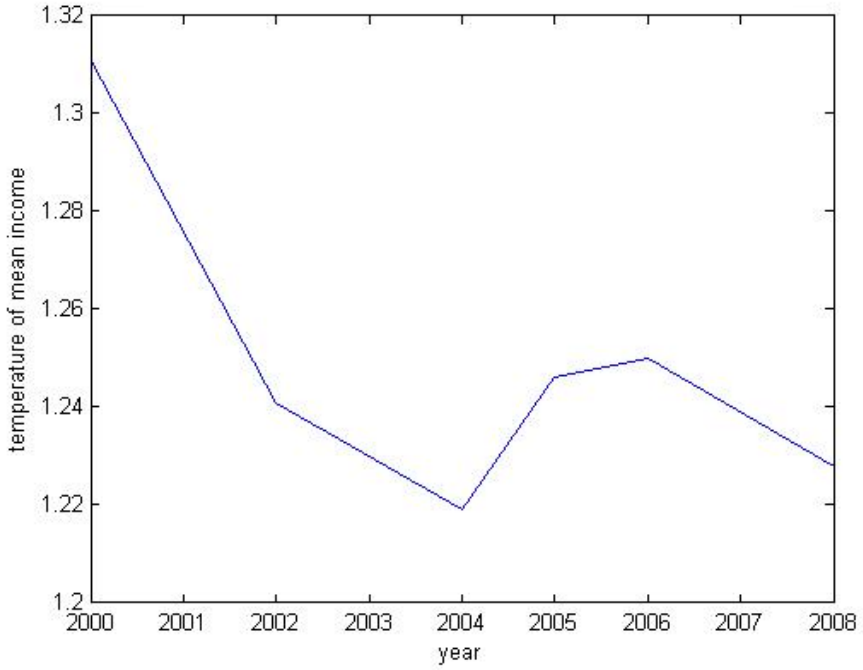

Figure 14. Temperature for mean income in Mexico for time interval 2000-2008.

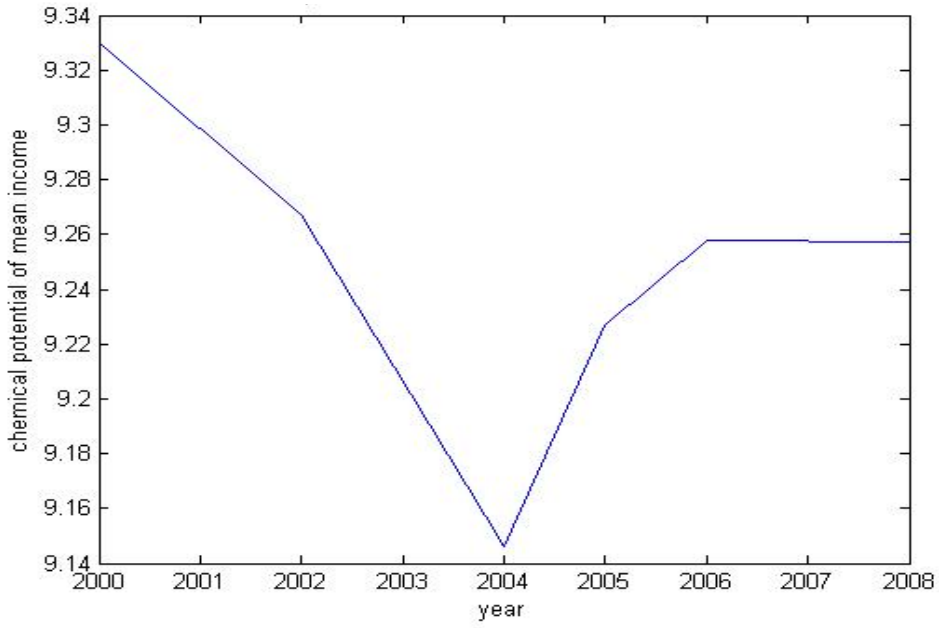

Figure 15. Chemical Potential for mean income in Mexico
for the time interval 2000-2008.

In figure 15, The evolution of chemical potential indicates a “peak” of labour productivity in the year 2004, followed by slower growth of productivity until the year 2006. Afterwards, during the crisis, productivity growth succeeded to stay relatively normal. A possible explanation for this is that Mexican companies succeeded to cut personnel costs.

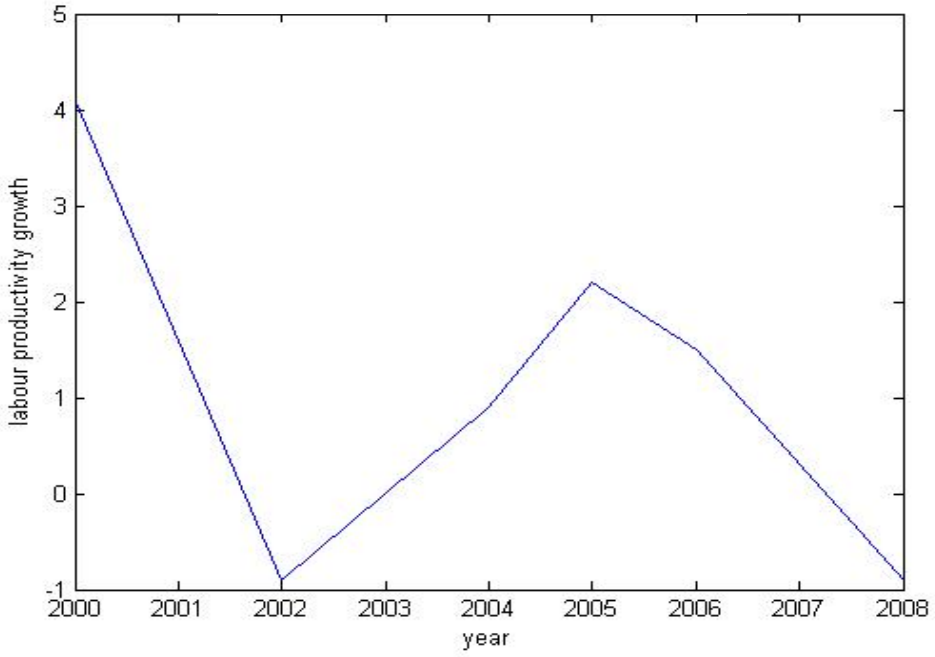

Figure 16. Labour productivity annual growth rate in Mexico for the time interval 2000-2008.

Data were provided by [23]. In figure 16, we displayed the graphical tendencies of labour productivity annual growth rate in Mexico as proxy for chemical potential. Considering that chemical potential according to its definition is fairly symmetrical to its proxy about x axis, one can observe that main trends of labour productivity annual growth rate are captured in the evolution of the chemical potential. Subsequently, the peak of the evolution of labour productivity growth in the year 2004 and its decrease starting from the year 2006 on are highlighted. However, the increase from the year 2005 of labour productivity is not captured in the evolution of the chemical potential.

Annual parameters of Fermionic distribution applied to income distribution by deciles of population/households (cumulative method) (Table 3).

Table 3

Country	Year	Upper limit on income			Mean income		
Finland		*T*	*C*	μ	*T*	*C*	μ
	1987	0.2344	4.588	10.08	0.361	4.827	10.22
	1988	0.2461	4.609	10.11	0.3893	4.874	10.26
	1989	0.2472	4.602	10.17	0.4048	4.899	10.32
	1990	0.2573	4.633	10.21	0.4007	4.9	10.36
	1991	0.2516	4.632	10.22	0.3993	4.902	10.37
	1992	0.2501	4.645	10.16	0.413	4.955	10.31
	1993	0.276	4.692	10.14	0.477	5.065	10.31
	1994	0.2906	4.725	10.15	0.4762	5.064	10.31
	1995	0.2886	4.702	10.18	0.4989	5.09	10.34
	1996	0.2881	4.671	10.21	0.5332	5.205	10.35
	1997	0.3029	4.674	10.27	0.5624	5.14	10.45
	1998	0.2967	4.636	10.31	0.5893	5.147	10.5
	1999	0.2992	4.64	10.34	0.6739	5.314	10.54
	2000	0.3133	4.65	10.37	0.7052	5.349	10.56
	2001	0.3018	4.63	10.39	0.6181	5.159	10.6
	2002	0.3028	4.633	10.42	0.6066	5.135	10.63
	2003	0.3106	4.643	10.45	0.6282	5.175	10.65
	2004	0.3083	4.625	10.5	0.6489	5.187	10.71
	2005	0.3117	4.631	10.53	0.6543	5.196	10.75
	2006	0.3191	4.633	10.55	0.6734	5.212	10.77
	2007	0.3283	4.642	10.58	0.7062	5.247	10.8
	2008	0.3074	4.621	10.56	0.6354	5.135	10.79
	2009	0.3036	4.618	10.59	0.5873	5.066	10.81
France	2002	0.3946	4.734	10.4	-	-	-
	2003	0.3835	4.721	10.39	0.6644	5.134	10.59
	2004	0.3745	4.711	10.38	0.6793	5.17	10.58
	2005	0.3778	4.712	10.39	0.673	5.121	10.62
	2006	0.3906	4.73	10.42	0.7019	5.165	10.64
	2007	0.3824	4.713	10.44	0.6904	5.144	10.66
	2008	0.3901	4.746	10.45	0.7074	5.185	10.67
	2009	0.387	4.716	10.46	0.6796	5.112	10.69
Italy	2000	0.4358	4.566	10.77	0.6885	4.821	11.04
	2002	0.4421	4.573	10.84	0.6966	4.839	11.1
	2004	0.4607	4.623	10.88	0.7323	4.924	11.13
	2006	0.4254	4.59	10.93	0.7266	4.938	11.19
	2008	0.4616	4.616	10.98	0.7111	4.886	11.23
Romania	2005	-	-	-	0.7977	5.722	7.581
	2006	-	-	-	0.7926	5.547	7.787
	2007	-	-	-	0.7419	5.461	7.991
	2008	-	-	-	0.6739	5.355	8.228
	2009	-	-	-	0.6382	5.385	8.274
	2010	-	-	-	0.6245	5.468	8.227
Mexico	2000	-	-	-	1.311	5.102	9.33
	2002	-	-	-	1.241	5.088	9.267
	2004	-	-	-	1.219	5.076	9.146
	2005	-	-	-	1.246	5.094	9.227
	2006	-	-	-	1.25	5.141	9.258
	2008	-	-	-	1.228	5.086	9.257

Annual/monthly parameters of Fermionic distribution applied to income distribution by deciles of population/households (cumulative method) (Table 4).

Table 4

Year	France annual income before redistribution			France annual income of inactive peoples			Hong Kong monthly median income		
	T	*C*	μ	*T*	*C*	μ	*T*	*C*	μ
1991	-	-	-	-	-	-	0.6161	4.654	10.22
1996	-	-	-	-	-	-	0.615	4.638	10.79
2001	-	-	-	-	-	-	0.6188	4.587	10.92
2002	-	-	-	0.4372	4.871	10.37	-	-	-
2003	0.3959	4.577	10.47	0.4315	4.88	10.35	-	-	-
2004	0.3924	4.582	10.45	0.4064	4.839	10.34	-	-	-
2005	0.3966	4.585	10.47	0.4151	4.842	10.36	-	-	-
2006	0.4026	4.592	10.49	0.4343	4.854	10.41	-	-	-
2007	0.3931	4.578	10.5	0.4247	4.846	10.41	-	-	-
2008	0.4022	4.599	10.52	0.4355	4.88	10.42	-	-	-
2009	0.3948	4.578	10.53	0.4146	4.824	10.43	-	-	-

II.6. Conclusions

II.6.1. Conclusions regarding the data analysis

Temperature exhibited a relative overall trend of increase as the amount of money normally increases. For most of these countries, the year 2007 marked the beginning of crisis and therefore temperature/nominal income decreased. Exception was for Mexico in year 2006 and Romania in 2008.

Chemical potential was supported by data regarding labour productivity in its overall trends. For Mexico, the chemical potential representation captures the peak of labour productivity growth in 2004 and afterwards the downfall corresponding to the crisis from 2006. Finland was characterised by a bigger growth of labour productivity in the 90s followed by a dramatic decrease in years 2000.

France showed a remarkable similarity regarding temperature and chemical potential between across all three sets of data (gross income, net income, and inactive people income) which indicates also a very good reliability of data.

II.6.2 Methodological conclusions

First methodological consequence is that study of income distribution is useful to analyse social system and taxation system. In the case of France

was very useful to compare the performed analysis on income before redistribution, net income, and social benefits. We can notice that results in the case of income before redistribution and net income are very similar. This indicates that taxation has a high degree of fairness, as no decile of population's income is overtaxed. Also, if we examine the shape of income distribution between net income and inactive people, we observe that they are very similar. As a consequence, we can say that this shows that social welfare system is very well linked to the general trends of income and productivity. We can state also that social benefits and pensions are awarded considering the economic efficiency and no electoral gifts were noticed during electoral years. Thus, there is a genuine concern that social benefits to be awarded such that they do not harm the macroeconomic equilibrium.

In the analysis of temperature, some graphics exhibit (the most illustrative case is Mexico) an abnormal evolution of temperature for few years, when there is a drop. Thus, nominal income should not decrease except times of deep recession, as was the case from 2007 for most countries analysed. This situation could be explained by several phenomena such as an increased level of taxation (in case of net income), capital withdrawal, restrictions regarding credits imposed by National Bank, reduction of money quantity by National Bank. Another explanation for the decrease of temperature/nominal income is represented by an increase of number of unemployed. Thus, this part of population has no wage or (only) social benefits (which are traditionally low) and as a result the amount of money per capita drops. However, there is necessary a more in depth analysis, especially an econometric study. A possible solution is to consider temperature as an analogue to an index which would contain other economic variables such as GDP.

Chemical potential was found to be a good overall proxy for labour productivity. Analyses for on countries which we not included in this study support this conclusion as well. For instance, the evolution of labour productivity in the USA in the year 2002 is in conformity with the evolution of the chemical potential [11].

More in depth analysis of the chemical potential should be performed, especially by using econometric methods.

II.6.3. Further conclusions

Further analysis could be done in order to fully explain the underlying phenomena regarding chemical potential. Next step would be to consider the activity coefficient which is related to both chemical potential and temperature and we believe it to describe overall profitability.

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THE SIMPLE CHAOTIC GENERAL ECONOMIC EQUILIBRIUM GROWTH MODEL

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Abstract. *The basic aim of this paper is to construct a relatively simple chaotic general economic equilibrium growth model that is capable of generating stable equilibriums, cycles, or chaos.*
A key hypothesis of this work is based on the idea that the coefficient $\pi = \frac{\mathrm{d}b\, m_{RT}}{(\alpha - 1)\, m_{RS}}$ *plays a crucial role in explaining local stability of the general economic equilibrium output, where, b – the coefficient of the demand function, d - the coefficient of the marginal cost function,* m_{RS} *– the marginal rate of substitution ,* m_{RT} *– marginal rate of transformation,* α *- the coefficient of marginal cost growth.*

Keywords: *General equilibrium, Output, Chaos, logistic equation..*

1. Introduction

Chaos theory reveals structure in unpredictable dynamic systems. It is important to construct deterministic, nonlinear general economic equilibrium growth model that elucidate irregular, unpredictable general economic equilibrium behaviour.

Chaos theory can explain effectively unpredictable economic long time behaviour arising in a deterministic dynamical system because of sensitivity to initial conditions. A deterministic dynamical system is perfectly predictable given perfect knowledge of the initial condition, and is in practice always predictable in the short term. The key to long-term unpredictability is a property known as sensitivity to (or sensitive dependence on) initial conditions.

Chaos theory started with Lorenz's (1963) discovery of complex dynamics arising from three nonlinear differential equations leading to turbulence in the weather system. Li and Yorke (1975) discovered that the

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simple logistic curves can exhibit very complex behaviour. Further, May (1976) described chaos in population biology. Chaos theory has been applied in economics by Benhabib and Day (1981, 1982), Day (1982, 1983, 1997), Gandolfo (2009), Grandmont (1985), Goodwin (1990), Medio (1993, 1996), Lorenz (1993), Jablanovic (2010, 2011a, 2011b, 2011c, 2012), among many others.

The basic aim of this paper is to provide a relatively simple chaotic general economic equilibrium output growth model that is capable of generating stable equilibriums, cycles, or chaos.

2. General economic equilibrium

Marginal rate of substitution, m_{RS}, is the amount of a good A that a consumer is willing to give up in order to obtain one additional unit of good B. When output markets are perfectly competitive, all consumers allocate their budgets so their marginal rates of substitution between two goods are equal to the price ratio. For our two goods, A, and B:

$$m_{RS} = P_A / P_B \tag{1}$$

where m_{RS} – marginal rate of substitution, P_A – the price of good A, P_B – the price of good B.

Each profit-maximizing firm will produce its output up to the point at which price is equal to marginal cost. For goods A and B:

$$P_A = MC_A \text{ and } P_B = MC_B. \tag{2}$$

Marginal rate of transformation is an amount of good A that must be given up to produce one additional unit of a good B. The marginal rate of transformation is the ratio of the marginal cost of producing good A, MC_A, to the marginal cost of producing good B, MC_B, or:

$$m_{RT} = MC_A / MC_B \tag{3}$$

where m_{RT} – marginal rate of transformation, MC_A – the marginal cost of poducing good A, MC_B – the marginal cost of producing good B.

An economy produces output efficiently only if, for each consumer:

$$m_{RS} = m_{RT} \tag{4}$$

where m_{RS} – the marginal rate of substitution, m_{RT} – marginal rate of transformation.

The efficient combination of outputs is produced when the marginal rate of transformation between the two goods (which measures the cost of producing one good relative to the other) is equal to the consumer's marginal rate of substitution (which measures the marginal benefit of consuming one good relative to the other).

Because the marginal rate of transformation is equal to the ratio of the marginal costs of production, then:

$$m_{RT} = MC_A / MC_B = P_A / P_B = m_{RS} \quad (5)$$

when output and input markets are competitive, production will be efficient in that the m_{RT} is equal to the m_{RS}.

In a competitive output market, consumers consume to the point where their marginal rate of substitution is equal to the price ratio. Producers choose outputs so that the marginal rate of transformation is equal to the price ratio. Because the m_{RS} equals the m_{RT}, the competitive output market is efficient. Any other price ratio will lead to an excess demand for good *A* and an excess supply of the good *B*.

Suppose the demand function is:

$$Q_t = a - bP_t \quad (6)$$

where *P* – the price; *Q* – the demanded quantity; *a, b* – the coefficients of the demand function.

Further, suppose the quadratic marginal-cost functions (MC_A and MC_B) have the identical form:

$$MC_t = c + dQ_t + eQ_t^2 \quad (7)$$

where *MC* – marginal cost; *Q* – output; *c, d*, and *e* – coefficients of the quadratic marginal-cost function.

Further, it is supposed that:

$$MC_{A,\,t+1} = MC_{A,\,t} + \alpha\, MC_{A,\,t+1} \quad (8)$$

or:

$$(1 - \alpha)MC_{A,\,t+1} = MC_{A,t} \quad (9)$$

Substitution (2) and (5) in (9) gives:

$$(1 - \alpha)m_{RS}P_{B,\,t+1} = m_{RT}\, MC_{B,t}. \quad (10)$$

Firstly, it is supposed that $a = 0$ and $c = 0$. Further, by substitution (6) and (7) in (10) one derives:

$$Q_{B,t+1} = \frac{dbm_{RT}}{(\alpha - 1)\, m_{RS}} Q_{B,t} - \frac{ebm_{RT}}{(1-\alpha)\, m_{RS}} Q_{B,t}^2. \quad (11)$$

Further, it is assumed that the equilibrium output, $Q_{B,t}$, is restricted by its maximal value in its time series. This premise requires a modification of the growth law. Now, the equilibrium output growth rate depends on the current size of the equilibrium output, $Q_{B,t}$, relative to its maximal size in its time series $Q^m_{B\,t}$. We introduce $q_{B\,t}$ as $q_{B,\,t} = Q_{B,\,t}/Q^m_{B\,t}$. Thus $q_{B,t}$ range is between 0 and 1. Again we index $q_{B,t}$ by t, i.e., write $q_{B,t}$ to refer to the size at time steps t = 0,1,2,3,... Now, growth rate of the equilibrium output is measured as:

$$q_{B,t+1} = \frac{db\, m_{RT}}{(\alpha - 1)\, m_{RS}} q_{B,t} - \frac{ebm_{RT}}{(1-\alpha)\, m_{RS}} q_{B,t}^{\,2}. \qquad (12)$$

This model given by equation (12) is called the logistic model. For most choices of *b, d, e,* m_{RS}, m_{RT}, and α there is no explicit solution for (12). Namely, knowing *b, d, e,* m_{RS}, m_{RT}, and α and measuring $q_{B,0}$ would not suffice to predict $q_{B,t}$ for any point in time, as was previously possible. This is at the heart of the presence of chaos in deterministic feedback processes. Lorenz (1963) discovered this effect – the lack of predictability in deterministic systems. Sensitive dependence on initial conditions is one of the central ingredients of what is called deterministic chaos.

This kind of difference equation (12) can lead to very interesting dynamic behaviour, such as cycles that repeat themselves every two or more periods, and even chaos, in which there is no apparent regularity in the behaviour of $q_{B,t}$. This difference equation (12) will possess a chaotic region. Two properties of the chaotic solution are important: firstly, given a starting point $q_{B,0}$ the solution is highly sensitive to variations of the parameters *b, d, e,* m_{RS}, m_{RT}, and α; secondly, given the parameters *b, d, e,* m_{RS}, m_{RT}, and α the solution is highly sensitive to variations of the initial point $q_{B,0}$. In both cases the two solutions are for the first few periods rather close to each other, but later on they behave in a chaotic manner.

3. Logistic Equation and general equilibrium output

The logistic map is often cited as an example of how complex, *chaotic* behaviour can arise from very simple *non-linear* dynamical equations. The logistic model was originally introduced as a *demographic model* by *Pierre François Verhulst*. It is possible to show that iteration process for the logistic equation:

$$z_{t+1} = \pi z_t(1 - z_t),\ \pi \in [0,4],\ z_t \in [0,1] \qquad (13)$$

is equivalent to the iteration of growth model (12) when we use the following identification:

$$z_t = \frac{e(\alpha - 1)}{d(1-\alpha)} q_{B,t} \text{ and } \pi = \frac{dbm_{RT}}{(\alpha - 1)m_{RS}}. \tag{14}$$

Using (12) and (14) we obtain:

$$z_{t+1} = \left[\frac{e\,(\alpha - 1)}{d\,(1-\alpha)}\right] q_{BA,\,t+1} =$$

$$= \left[\frac{e(\alpha - 1)}{d(1-\alpha)}\right] \left\{ \left[\frac{dbm_{RT}}{(\alpha - 1)\,m_{RS}}\right] q_{B,t} - \left[\frac{ebm_{RT}}{(1-\alpha)\,m_{RS}}\right] q_{B,t}^{\,2} \right\} =$$

$$= \left[\frac{ebm_{RT}}{(1-\alpha)m_{RS}}\right] q_{B,t} - \left[\frac{e^2 b\,(\alpha - 1)m_{RT}}{d(1-\alpha)^2\, m_{RS}}\right] q_{B,t}^{\,2}.$$

On the other hand, using (13), and (14) we obtain:

$$z_{t+1} = \pi\, z_t\,(1 - z_t) = \left[\frac{bdm_{RT}}{(\alpha - 1)m_{RS}}\right] \left[\frac{e\,(\alpha - 1)}{d(1-\alpha)}\right] q_{B,t} \left\{ 1 - \left[\frac{e(\alpha - 1)}{d(1-\alpha)}\right] q_{B,t} \right\} =$$

$$= \left[\frac{ebm_{RT}}{(1-\alpha)m_{RS}}\right] q_{B,t} - \left[\frac{e^2 b\,(\alpha - 1)\,m_{RT}}{d(1-\alpha)^2\; m_{RS}}\right] q_{B,t}^2.$$

Thus we have that iterating $q_{B,\,t+1} = \frac{db_{RT}}{(\alpha - 1)m_{RS}} q_{B,t} - \frac{ebm_{RT}}{(1-\alpha)m_{RS}} q_{B,\,t}^2$ is really the same as iterating $z_{t+1} = \pi z_t(1 - z_t)$ using $z_t = \frac{e\,(\alpha - 1)}{d\,(1-\alpha)} q_{B,t}$ and:

$$\pi = \frac{dbm_{RT}}{(\alpha - 1)\,m_{RS}}.$$

It is important because the dynamic properties of the logistic equation (13) have been widely analyzed (Li and Yorke (1975), May (1976)).

It is obtained that:

(i) For parameter values $0 < \pi < 1$ all solutions will converge to $z = 0$;

(ii) For $1 < \pi < 3{,}57$ there exist fixed points the number of which depends on π;

(iii) For $1 < \pi < 2$ all solutions monotonically increase to $z = (\pi - 1)/\pi$;

(iv) For $2 < \pi < 3$ fluctuations will converge to $z = (\pi - 1)/\pi$;

(v) For $3 < \pi < 4$ all solutions will continuously fluctuate;

(vi) For $3{,}57 < \pi < 4$ the solution become "chaotic" which means that there exist totally a periodic solution or periodic solutions with a very large, complicated period. This means that the path of z_t fluctuates in an apparently random fashion over time, not settling down into any regular pattern whatsoever.

4. Conclusion

This paper suggests conclusion for the use of the simple chaotic general equilibrium growth model in predicting the fluctuations of the equilibrium output. The model (12) has to rely on specified parameters b, d, e, m_{RS}, m_{RT}, and α and initial value of the equilibrium output, q_{B0}. But even slight deviations from the values of parameters b, d, e, m_{RS}, m_{RT}, and α and initial value of the equilibrium output show the difficulty of predicting a long-term behaviour of the general equilibrium output.

A key hypothesis of this work is based on the idea that the coefficient $\pi = \dfrac{db\, m_{RT}}{(\alpha - 1)\, m_{RS}}$ plays a crucial role in explaining local stability of the general equilibrium output, where, b – the coefficient of the demand function d – the coefficient of the marginal cost function, m_{RS} – the marginal rate of substitution, m_{RT} – marginal rate of transformation, α – the coefficient of marginal cost growth.

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MULTIFRACTAL STRUCTURE IN INDIAN STOCK MARKET INDICES

Faiz MOHAMMAD* and Valeed A. ANSARI*

Abstract. *In this paper we perform a detailed multifractal analysis on NSE Nifty and BSE Sensex indices over a period of eight years using the partition function approach. US S&P 500 index series is also analyzed for the purpose of comparison. In all the three cases the partition function $\chi_q(\varepsilon)$ is found to have a power law dependence on the size of partition ε. ln $\chi_q(\varepsilon)$ vs ln ε graphs for all the three index series are plotted for q= –10 to q = +10, stepped by 1. Values of the mass exponent $\tau(q)$ for different values of q are obtained by the linear fits to the ln $\chi_q(\varepsilon)$ vs ln ε graphs. We have also plotted $\tau(q)$ vs q graphs and the mass exponent $\tau(q)$ is found to have a non-linear dependence on q for all the three index series. All the three graphs are concave downwards, again signaling the presence of multifractality in the three index series. Finally, we plot the singularity spectra $f(\alpha)$ for the three index series. The widths of the spectra for Nifty and Sensex are smaller than that for S&P 500, indicating that Indian markets are inefficient compared to the US market.*

Keywords: *Multifractality, stock market, partition function, singularity spectrum, market inefficiency.*

1. Introduction

Time series generated by the financial systems e.g. stock markets, *fx* markets, commodity markets, etc carry useful information about the underlying mechanisms that govern these complex systems. But the traditional analysis techniques of Econometrics fail to extract the useful information from the time series. Consequently, analysis techniques from other fields, especially physical sciences, are being used to obtain a better description of financial markets. Multifractal analysis, which was initially introduced to investigate the intermittent nature of turbulence, has been extensively employed to study the multifractal properties of financial time series [1-3]. Different methods have been developed for the multifractal

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analysis of the time series. Some of these methods are: (a) partition function method [4], (b) rescaled range analysis [5], (c) wavelet transform method [6] (d) detrended fluctuation ayalysis (DFA) method [7] and (e) multifractal detrended fluctuation ayalysis (MDFA) method [8,9].

In this paper we use the partition function method to study the multi-fractality in Indian stock market indices Nifty and Sensex. We also study the multifractality in the US market index S&P 500 for the purpose of comparison. The paper is organized as follows: In section 2, we give a brief description of the partition function method. Section 3 gives details of the data analyzed in the paper. Empirical results and their discussion are presented in section 4 and finally we conclude in section 5.

2. Methodology

The multifractal structure of financial time series can be investigated using the partition function method. The method is described briefly as follows.

Let $\{x(t): t = 1,2,3\ldots\ldots\ldots\ldots..T\}$ be the closing value of index series of a stock market. T is the total length of the series. The series is divided into N parts of equal length $\varepsilon = T/N$. The mass probability of the ith part of the series ($i = 1, 2, 3\ldots\ldots\ldots N$) is defined as:

$$P_i(\varepsilon) = \frac{I_i(\varepsilon)}{\sum_{i=1}^{N} I_i(\varepsilon)}, \tag{1}$$

where $I_i(s)$ is the sum of indices in ith part of the series. The partition function can be calculated as:

$$\chi_q(\varepsilon) = \sum_{i=1}^{N} P_i^q(\varepsilon). \tag{2}$$

In the presence of fractality the partition function scales as:

$$\chi_{q(s)} \alpha s^{\tau(q)}, \tag{3}$$

where τq is called the mass exponent. If τ_q is found to depend non-linearly on q, the series under analysis is said to be multifractal. The singularity exponent $\alpha(q)$ and its singularity spectrum $f(\alpha)$ are related to $\tau(\alpha)$ through the following relations:

$$\alpha = \frac{d\tau(q)}{dq} \tag{4}$$

$$f(\alpha) = \alpha\, q - \tau(q). \tag{5}$$

Generally two types of multifractality are present in the financial series:

(a) – multifractality due to a broad fat-tailed probability density distribution of the financial series. This type of multifractality cannot be removed by shuffling the series and

(b) – multifractality due to long range correlations of small and large fluctuations which can be removed by shuffling the financial series.

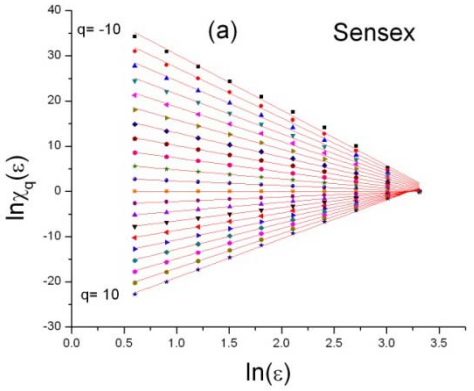
So if both types of multifractality are present in the financial series, shuffling of the series will remove multifractality due to long range correlations and as a result the shuffled series will exhibit a weaker multifractality as compared to the original one.

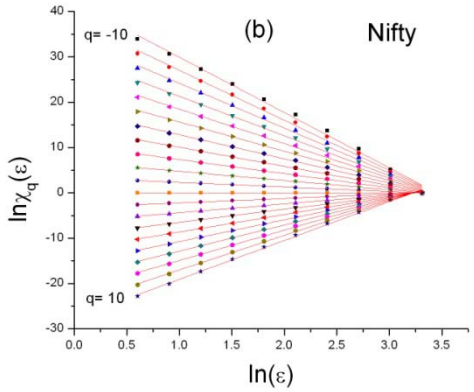
3. Data

To study multifractality in the indices of Indian markets, we used daily closing values of Nifty and Sensex. As US market is a widely studied developed market, we also studied multifractality in its index (S&P 500 index) for the purpose of comparison. The data period of each index series is until 30/31 December, 2010 and the starting date is chosen such that the total length of each series is 2048 trading days.

4. Empirical results

Values of the partition function $\chi_q(\varepsilon)$ for different values of ε were calculated using Eq. 3. Figure 1 shows ln $\chi_q(\varepsilon)$ vs. lnε plots for $q = -10$ to $q = 10$, stepped by 1 for the three series. Slopes $\tau(q)$ of these plots for different values of q were determined by linear fits to these plots. Figure 2 displays $\tau(q)$ vs. q plots for all the three series. A mono-fractal series is characterized by a linear dependence of $\tau(q)$ on q, while a multifractal series exhibits a non-linear dependence of $\tau(q)$ on q. All these plots, shown in figure 2, are concave downwards, implying presence of multifractality in all these series. The highest non-linearity or the strongest multifractality is observed in case of Sensex series, while the smallest non-linearity or weakest multifractality is observed in case of S&P series.





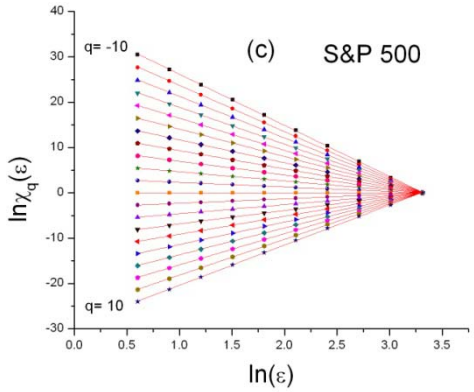
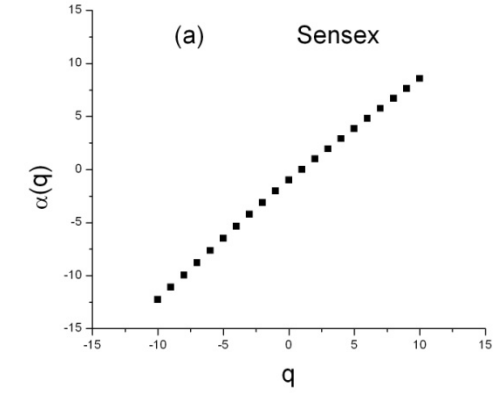
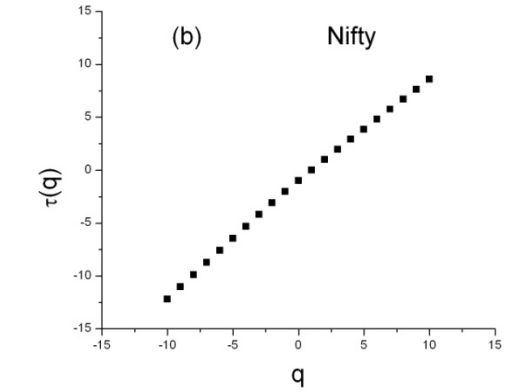


Figure 1. $\ln\chi_q(\varepsilon)$ vs $\ln(\varepsilon)$ plots





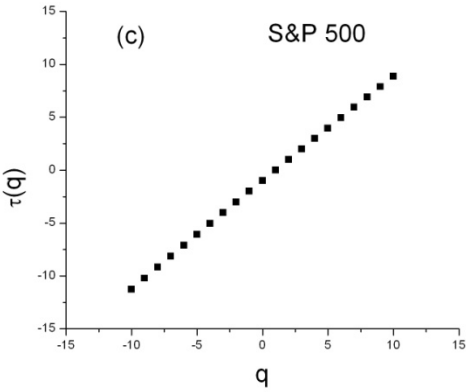


Figure 2. $\tau(q)$ vs q plots

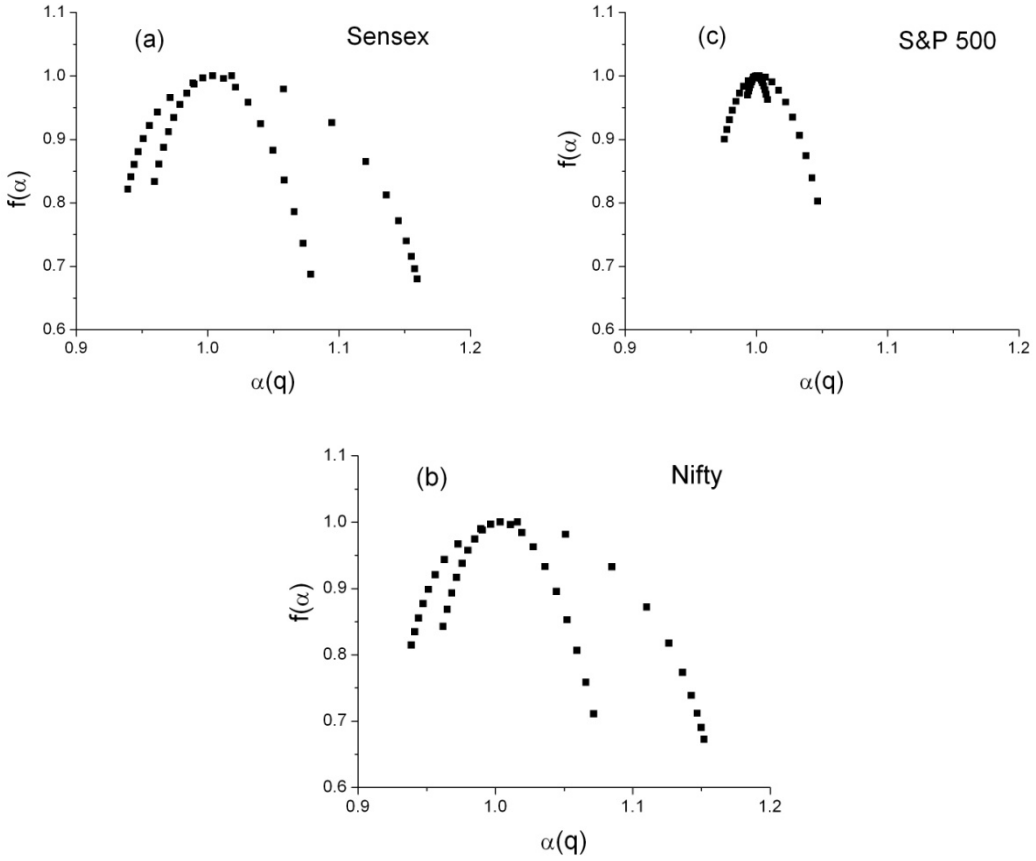


Figure 3. Singularity spectra for the three series.

A better way to visualize the multifractal nature of the time series is to plot the singularity spectrum $f(\alpha)$. It is a more effective method because here one can easily assess the strength of multifractality in different series as the width of the singularity spectrum is proportional to the strength of multifractality. Figure 3 displays singularity spectra for all the three series under study. The inverse parabolic shapes of the singularity spectra $f(\alpha)$ confirm the presence of multifractality in all cases. As can be seen from figure 3, the size and shape of the singularity spectra are different for different series and it appears that the singularity spectra may contain some useful statistical information about price movements and the degree of development of markets [10, 11]. As observed earlier, the strongest multifractality or the largest width of the spectrum ($\Delta\alpha = 0.220$) is observed in case of Sensex series, while weakest multifractality or the smallest width ($\Delta\alpha = 0.071$) is observed in case of S&P series. For Nifty

($\Delta\alpha$ = 0.213). Smaller values of $\Delta\alpha$ for Sensex and Nifty suggests that Indian markets are less efficient compared to US market.

As mentioned earlier, there are two main sources of multifractality in the financial series: (a) Long range correlations and (b) fat-tailed probability distribution. Long range correlations can be removed by shuffling the series. So in order to assess the contribution of long range correlations to the observed multifractality in different series, we shuffled all the three series 100 times. Figure 3 also displays the singularity spectra for the shuffled series. It can be seen from figure 3 that the width of $f(\alpha)$ for the shuffled series is less than that of the original series in all cases, implying the presence of both types of multifractality in all the three series.

5. Conclusions

We investigated the multifractality in the Indian stock market indices Nifty and Sensex using the partition function method. Our results show that the partition function $\chi_q(\varepsilon)$ for all three series scales as a power law with box size ε for each order q, implying that all series have multifractal structure. By comparing the singularity spectrum $f(\alpha)$ of the original series with that of the shuffled series, we also found that the multifractality observed in all time series is due to the presence of long range correlations of small and large fluctuations and also due to broad fat-tailed probability distribution. Finally a comparison of the singularity spectrum $f(\alpha)$ of S&P 500 series with those of Nifty and Sensex series showed that the width of the spectra for the developed US market is less than those for the Indian market. This result suggests that the Indian market is less efficient than the US market.

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ECONOMIC ANALYSIS THROUGH DATABASES

Raul ŞERBAN*

Abstract. *The paper will present the possibility to develop information systems based on dynamic web language with interconnected databases. In this paper we want to attempt the way of shifting the information systems that runs on identical platforms to information systems that run from any platforms and from all over the world, creating this way a universal platform that can use theoretically any database. Also in this paper will try to present a model of interconnecting databases based on fractal theory.*

Keywords: *information system, database, dynamic language, fractal, information fluxes*

1. Introduction

Not many years ago, processing information was perform manual and transmission was done on paper The appearance of mechanographic ways for processing information, led to a different manner of approaching information systems.

The invention of electronic computers has led to the idea that a modern information system can only be fully mechanized and automated. This idea was quickly abandoned because not all the management and execution can be standardized, thus remains a series of activities that cannot be driven solely by computer. In this component of the system people are operating information according to their meaning. Such processed information appears on the entry and exit, where people are identified them. The primary objective of an information system is provided with maximum information necessary to the management. We can appreciate that, the computerization of information systems is in fact a process of increasing their efficiency and therefore the notice of decision.

The level of computerization of the information system depends strictly on the level of complexity for decision aggregation and potential

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financing in commercial enterprise. Therefore, in order to achieve a permanent system, to be compatible with all platforms on the market but with a reduced share of the level of funding – Web 2.0 technology has allowed the appearance of such systems that run in web browsers on secure systems, allowing a total compatibility between existing platforms at the moment.

This paper will try to present the model of an information system that can be compatible with all platforms on the market and also can work with more than one database at a time. Also we want to introduce a new model of interconnecting databases using fractals.

The model of interconnecting databases that we introduce is based on Benoit Mandelbrot fractal theory that can be used much more efficiently.

Benoit Mandelbrot came up with a method of creating fractals that fit the above description. He based in on simple generator iteration and created base-motif fractals that could model the market. In the February 1999 issue of Scientific American, he published some of his fractal "forgeries" next to real market lines, showing how remarkably similar they were.

The concept of fractals has been spread over all fields of sciences and represents "a rough or fragmented geometric shape that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole, a property called self-similarity".

2. Information systems

Today, more than ever, conducting any business, financial or banking, cannot be imagined without a strong support to ensure competitive advantage to other competitors in the market.

For most enterprises and companies an essential aspect is the investment in to a performing information system. The investment should be as small as possible to offers in the same time a reliable and strong system. This has lately led to the emergence of migration to the Internet for the information systems. For this reason more organization and management systems are using Internet technology.

By using the internet and PHP language, which is a dynamic programming language with many possibilities, it can create low-cost reliable and powerful systems for any company.

Such a system, adaptable to any area of business processes and internal organizations can be considered a universally adaptable system of

management and organization. This can create a system called generic AUMPS – Adaptive Management and Production System. AUMPS seeks combining segments of production, marketing, commercial, row materials administration, human resource management and financial accounting in companies. This AUMPS process is based on creation and use informational fluxes adapting new feeds to existing ones.

AUMPS is a centralized information system based on Web 2.0 technology that combines PHP language with MySQL databases to create a system that doesn't require application of client-server type for data introduction and management. Thus it is enough that users to have computers connected to the Internet and to make appeal to the server address using an Internet browser.

Thanks to the platform he needs to run and also to the universal system needed to access the data, AUMPS reduce the cost of investment in the companies' information system because it uses only a single server with a backup system, only a single license for all terminals connected to it and can also be possible to use the existent computers without making a new investments in new ones.

Another advantage is quick access to all company data from any part of the world without a specialized program type.

We identify the following advantages of the AUMPS system:

1. System requires a single server to run.

2. The operating system on this server can be Unix, Linux or Windows, the system can run on any of the three operating systems without the need for rewriting the code, thus achieving a rapid portability system when the company wants to move from one platform to another.

3. It is not necessary to have any type of specialized software client-server to access the data because access is made directly from your Internet browser.

4. Does not require changing the infrastructure of the company system, the system can run on older course that have a connection to the network or the internet

5. Can run on any mobile device with access to the Internet just using an Internet browser.

6. Management in the system uses the electronic signature.

7. The entire company management can be done directly from the program, without needing writing paper.

8. The system has the option of saving any type of file created in other applications.

9. The system can be changed by a specialist IT who knows PHP language, thus allowing to the end a greater control and the deployment of new features based on modules of a specific area of their own.

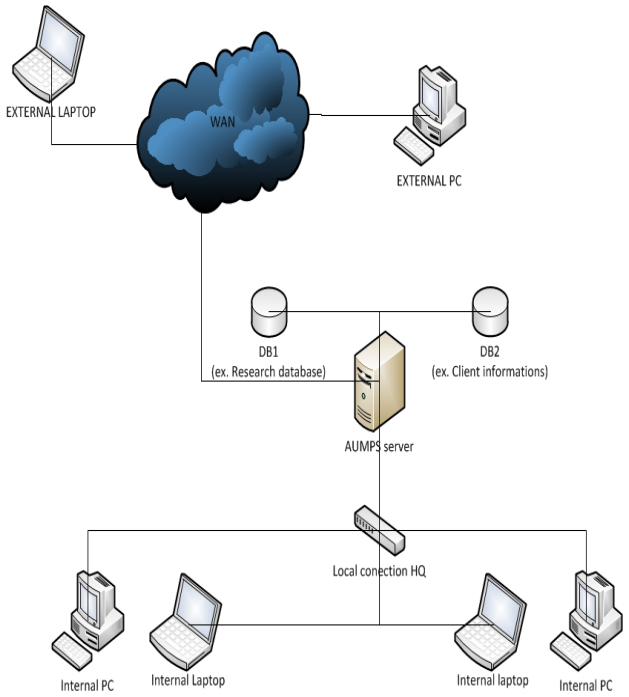

Figure 1. Interconnections with the AUMPS system.

3. Designing databases

As show in the Figure 1 the AUMPS system can use two databases that are interconnected with the Open Systems Interconnection (OSI).

The open system interconnection model is a product of the open system interconnection effort at the international organization for standardization. It is a way of sub-dividing a communications system into smaller parts called layers. A layer is a collection of conceptually similar functions that provide services to the layer above it and receives services from the layer below it. On each layer an instance provides services to the instances at the layer above and requests service from the layer below (see Fig. 2).

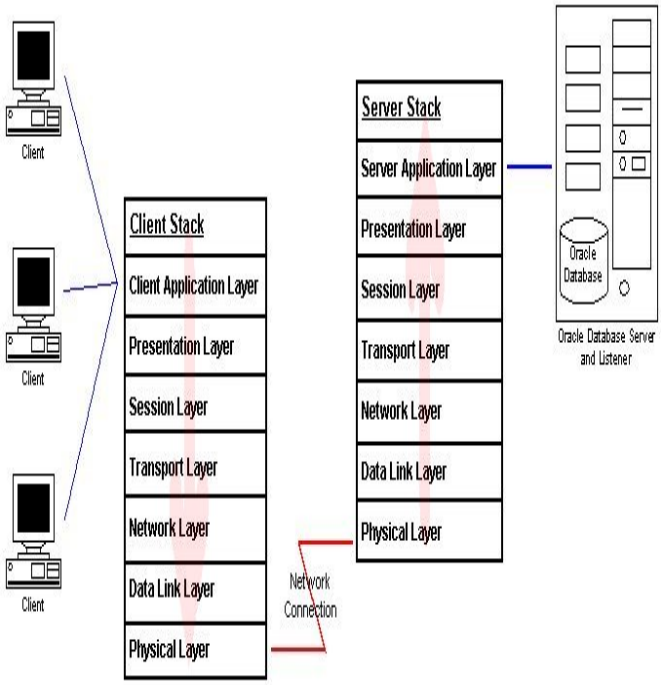

Figure 2. The Open Systems Interconnection (OSI) Model.

–Application Layer: The application layer is a first and host layer of the open system interconnection model. The application layer is provision to applications with network access and user service. Two type of application layer, client application layer and server application layer. Both application layers are connected with network connection.

–Presentation Layer: The presentation layer is the second and host layer of the open system interconnection model. The presentation layer formatting between application layer above and session layer below of the open system interconnection. The presentation layer like two task character and data-type conversion and SQL, PL/SQL by processing by OCI on the client node or OCP on the server.

–Session Layer: The session layer is the thread and host layer of the open system interconnection model. The session layer is a communication between database software on client and server nodes.

–Transport Layer: The transport layer is the fourth layer of the open system interconnection model. The transport layer like the reliability and routing.

– Network Layer: The network layer is the fifth and media layer of the open system interconnection model. The network layer is addressing and routing information provision between or within networks.

– Data-Link Layer: The data link layer is the six and media layer of the open system interconnection model. The data link layer creates network session packaging data into frames, synchronization, error checking and data flow control.

– Physical Layer: The physical layer is the last and media layer of the open system interconnection model. The physical layer is the hardware definition, physical, electrical and mechanical link between nodes.

In order to better understanding the implementation model we will use a price fluctuations analysis.

The important point is that demand is essentially a stochastic variable because human action can never be predicted perfectly; hence the balance of demand and supply should also be viewed in a probabilistic way. If demand and supply are balanced on average the probability of finding an arbitrarily chosen commodity on the shelves of a store should be 1/2, namely about half of the shelves should be empty. Contrary to this theoretical estimation shelves in any department store or supermarket is nearly always full of commodities. This clearly demonstrates that supply is much in excess in such stores. Excess supply generally holds for most of commodities especially foods in economically advanced countries.

In order to design a correct database for a price fluctuations analytic system we must identified the numerical market model. The model consists of speculative dealers who transact with others simply following the basic rule "buy at a lower price and sell at a higher price". These two threshold prices are determined at each time step by each dealer taking into account the information of past market price changes. It is shown that even a smallest limit case of three dealers can show chaotic behaviours, implying that the transaction's nonlinear effect is very strong [1]. If we organize this data into a database structures like a table, as below (see Table 1):

Table 1.

Id_price	Buying price	Selling price

We can obtain in time information that can be manipulating for creating analysis. The model of the table presented can be extended in order to create an analysis based on the formula:

$$C(T) = \frac{< \Delta r(T_0 + T)\Delta r(T_0) > - < \Delta r(T_0) >^2}{< \Delta r(T_0)^2 > - < \Delta r(T_0) >^2} \quad (1)$$

In the paper *Fractal Properties in Economics* written by Hideki Takayasu, Misako Takayasu, Mitsuhiro P. Okazaki, Kouhei Marumo,

Tokiko Shimizu is presented a typical example of yen-dollar rate changes in three different time scales (see Fig. 3). Intuitively this figure demonstrates a fractal property of exchange rates in the time axis measured by ticks, namely, Mandelbrot's classical finding also holds for this contemporary market price fluctuation. The statistics of this fluctuation is very close to random walk; actually it is easy to confirm that the power spectrum of this fluctuation clearly follows an inverse square law that is almost identical to a Brownian motion. The corresponding auto-correlation function for rate fluctuation per tick defined by the equation decay very quickly.

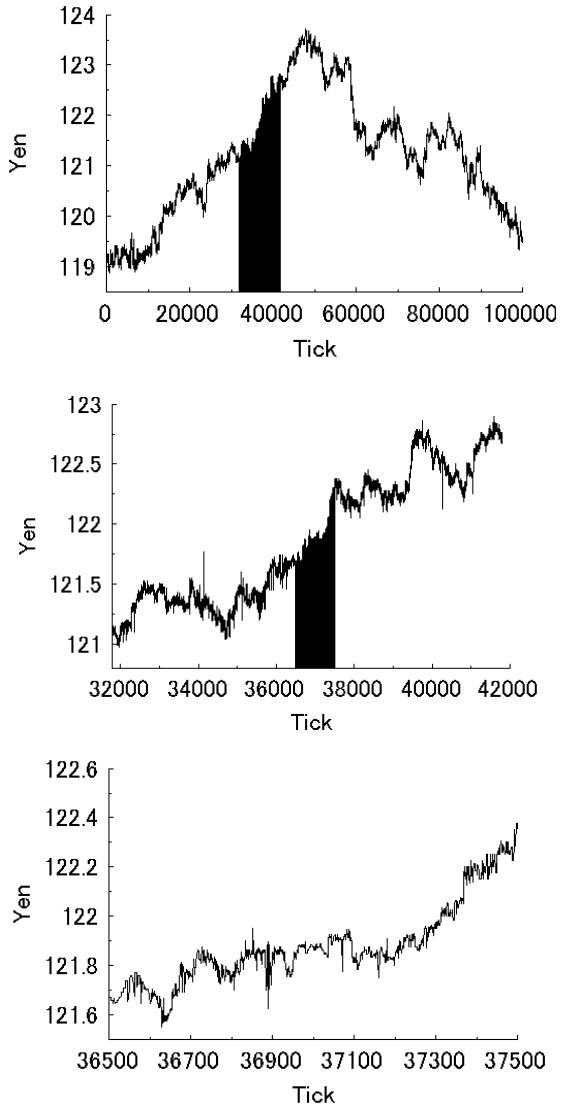

Figure 3. Fractal properties in foreign currency exchange rate fluctuations. The dark part of (a) is magnified 10 times in (b), and the dark part in (b) is magnified in (c) [1].

If we extend the table 1 in order to accumulate the information for analysis we obtain Table 2:

Table 2.

Id_price	Buying price	Selling price	Transaction Time

Also we can use the cash-flow model to build the structure of database and for a better analysis (see Fig. 4).

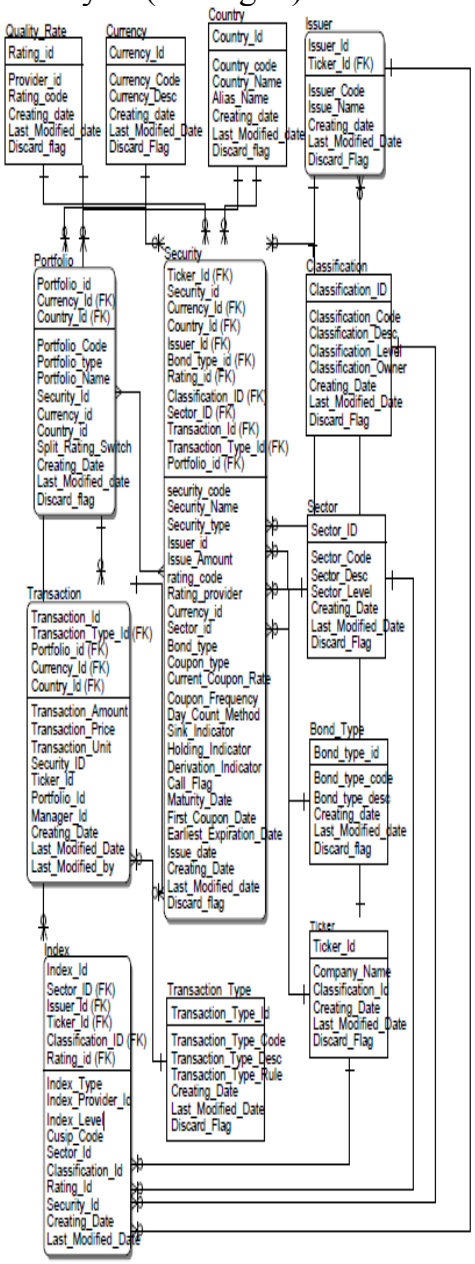

Figure 4. Cash-flow model for database design [2].

4. Modular presentation of aumps

Each module of the main system contained different options. An example is the module Financial/accounting – this function perform financial transactions accounts specific to each company; entries are from all the departments and the output of this module is materialized in the documents specific accounting department (accounting notes, log sales, log purchases, monthly balance, balance sheets etc.). The module is composed of:

a) Customer Accounts – allows the definition of accounts for each client and also generate customers with reports on goods delivered per customer in certain periods of time specified by the user.

b) Accounts suppliers – allows the definition of accounts for each registered supplier arc introduction of payment records with reports on goods and services purchased per supplier in certain periods of time specified by the user.

c) General accounts – under this option the soft generates the following documents: Plan accounts, accounting, financial reports and exchange rates.

d) Budgets – this option allows the user forecast and the budget allocation for the department: subsidiaries. With this feature the manager can follow the dynamics and values recorded each year to highlight the share of spending in each department part in the total expenditure of the company. Through graphs generated by the program, the client company managers will easily identify the amounts required for the function subsystems in subordination.

e) Centre of the income-generating option allows reports for the economic outcome.

f) Cost analysis – this option allows the user forecast short and medium term costs of the cost of the investment to be made, and generate reports on the analysis of the earlier situation.

g) Fixed Assets – accounting for all existing fixed assets or to be purchased. This option also these values by calculating the amortization in each stage of business enterprise and at the same lime reason these costs depending on various factors characteristics of each area of activity.

h) Exchange Rates – carried out the revaluation of assets based on exchange rates.

5. Conclusions

The primary objective of this paper work has been highlighting the importance of the dynamic PHP language and MySQL databases in designing and building a universal model for information systems that can be use in any enterprise. As we mentioned in this paper, information, specifically the power of information, is the main competitive advantage of companies on the market.

For years the information system has undergone spectacular transformation. Not long ago, all data and information were transmitted in physical form on paper and all the processes were mentally or at best with Pocket PC. In that period, employee productivity of administrative departments was very low, the required number of employees to cope with a huge volume of work. In that time, information requires a very large storage space and the risk of loss or damaging them was very high.

The information system summarized in this article, not only manages to combine into a universal and easy way the two concepts: that the dynamic web language and databases interconnection, but it manages to bring a new concept – the software can be adapted to any economical activity and can use any multiple database.

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NEW ECONOMY Section

THE SYSTEMS OF SYSTEMS (SoS) MODEL FOR THE MULTIDIMENSIONAL COMPLEXITY ANALYSIS OF THE MODERN ENTERPRISES

Ioana ARMAŞ*

Abstract. *The present evolutions highlights that globalization represents a phenomenon that takes place at all levels of economic, social, technical, information, etc. levels. In this context are developed complex and heterogeneous enterprises that must integrate different types of systems and individuals, and that must perform a global function as an expression of their requested behaviour in attaining the goals of competitiveness and survival on the markets. From this point of view, the paper proposes a model based on the systems of systems (SoS) concept for the multidimensional complexity analysis of the enterprises.*

The multidimensional complexity analysis of the modern enterprises in the context of the SoS-based model represents an important approach for the development of new competitive enterprises, and also for the growth of the existing ones in complex structures, with complex goals in a globalizing context.

Keywords: *systems of systems (SoS), multidimensional complexity, process map of SoS, competitiveness, SoS integration, SoS architectures.*

1. Introduction

The present enterprises became complex systems due to their needed responses relative to the external requests and constraints. Thus, their heterogeneity is a defining characteristic that determined the growth of their complexity at different levels as: communication with their external environment, internal processes, information processing and the internal information life-cycle, products and services development and implementation, research, management and control etc.

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Additional to this, a structural and functional growth of the modern enterprise takes place, such that they integrate different types of systems, that may be distinct enterprises, and individuals, that modify the old strong and weak points in a manner that should be known and controlled.

In these conditions, the management and development of the modern enterprises need models on which fundaments of their decisions will be built and analyzed. One of these models is based on the systems of systems (SoS) concept with the goal of representing the multidimensional complexity of the enterprise, and to offer a solution for the heterogeneous and complex enterprise's architecture as a SoS architecture.

2. The multidimensional complexity

Considering that every enterprise is characterized by its reality level as the internal environment governed by its specific set of laws, and that according to the functional and processes heterogeneity, corresponding reality under-levels can be determined based on their specific laws, results that the multidimensional complexity of an organization is defined as:

Definition 1. Let be an organization *Og* having the following specific reality under-levels: $L_1, L_2, ..., L_n$ that form the reality level *R*, and considering the complexity of each reality under-levels as $C_1, C_2, ..., C_n$ (Fig. 1), then the complexity *C* of the reality level *R* is determined by a relation of the type: $C = Int[C_1, C_2, ..., C_n]$, where *Int* is an integration operator, and represents the ***multidimensional complexity of the organization***, *MC*(*Og*).

The integration operator (see Fig. 1) can be of different types regarding the rules of interconnection in realizing the enterprise's level of reality as following:

a) the *Int* operator corresponds to the "maximum", such that:

$$C = Int[C_1, C_2, ..., C_n] = \max[C_1, C_2, ..., C_n], \quad (1)$$

b) the *Int* operator is determined by the weight of each complexity, such that:

$$C = Int[C_1, C_2, ..., C_n] = \mu_1 \cdot C_1 + \mu_2 \cdot C_2 + ... + \mu_n \cdot C_n, \quad (2)$$

where $\mu_i \in [0,1]$, $i = \overline{1,n}$, $\sum_{i=1}^{n} \mu_i = 1$.

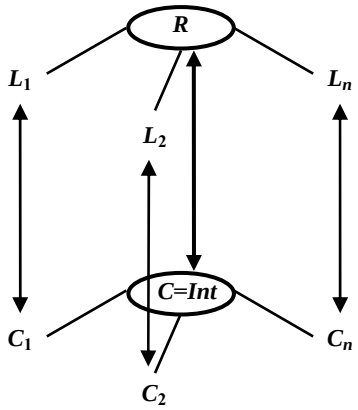


Figure 1. The *Int*operator in the multidimensional complexity analysis.

The reality under-levels of any enterprise are determined mainly by the following aspects of activity:

a) The life cycle structure of its products and services;

b) The competitiveness components;

c) The environmental and financial framework, all these related to the enterprise's objectives, polices, and strategies that consider the external environment.

For example, the reality under-levels for an enterprise are determined as in Table 1.

Table 1.

Types of reality under-levels in an enterprise

L_i	Reality under-level	Specific laws
L_1	Research and design	Laws of creativity, technical areas, standards, quality, reliability etc.
L_2	Production	Technological laws, productivity, specific standards etc.
L_3	Sales and distribution	Market and competition laws, clients behaviour etc.
L_4	Enterprise's quality	Laws of quality, quality management, leadership etc.
L_5	External relations with suppliers	Laws of collaboration, trust, agreements, etc.
L_6	Financial support	Financial laws of the external environment and the internal polices and strategies.
L_7	Economical support	Laws of economic efficiency, profit maximization, costs minimization etc.

Table 1 continued

L_i	Reality under-level	Specific laws
L_8	Internal human factor	Behavioural laws, common and individual interests in the organization and outside it, fuzzy appurtenance to different contexts etc.
L_9	Natural external environment	Natural laws, evolution etc.
L_{10}	Social external environment	Social behavioural and evolution laws.
L_{11}	External financial context	Specific financial laws of the countries, regions, and their financial policies.
L_{12}	Cultural and educational context	Understanding capacities, resistance to changes, beliefs, quality requests etc.

Each reality under-level in table 1 is characterized by its complexity, such that the reality level of the considered enterprise / organization will be characterized by a multidimensional complexity according to definition 1.

3. The SoS-based model for the multidimensional complexity

Considering the organizational dimensions of the enterprise's development and implementation, results that the reality under-levels are structurally represented by the corresponding systems disciplinary oriented on specific technical, economical, financial, market, laws and settlements aspects. Thus, the reality level of the enterprise is implemented through the integration of these systems in a global organization. In this context, for every reality under-level can be specified the corresponding system according to the relation:

$$L_i \leftrightarrow S_i \,,\; i = \overline{1,n}, \tag{3}$$

where L_i is a reality under-level of the enterprise, and S_i is the corresponding system.

If a reality under-level has more than one specific system, the relation (3) becomes:

$$L_i \leftrightarrow S_i = \{S_{1i}, S_{2i}, ..., S_{p,i}\},\; i = \overline{1,n}, \tag{4}$$

where $S_i = \{S_{1i}, S_{2i}, ..., S_{p,i}\}$ is the set of systems governed by the same assemble of laws, that implement L_i.

Let $L_1, L_2, ..., L_n$ be the reality under-levels of an enterprise, and $S_1, S_2, ..., S_n$ the corresponding systems or set of systems, such that

relation (3) holds, then the reality level R results to be represented by the set $S = \{S_1, S_2, ..., S_n\}$, according to the relation:

$$R \leftrightarrow S = \{S_1, S_2, ..., S_n\}. \quad (5)$$

According to the fact that in constructing reality level, inter-connections between the corresponding reality under-levels are established, results that between the implementation systems of relation (5) are established also interconnecting relations, such that S becomes a system of systems (SoS) according to the following definition [1]:

Definition 2. A system of systems (SoS) is a set of systems that are following individual goals and functions in performing a global accepted goal.

According to definition 2 and relations (3) ÷ (5) results that the reality under-levels considered for an enterprise correspond to different goals (e.g., economical, financial, technical, social, etc.), and the resulted reality level must correspond to the global accepted goal of the enterprise.

In these conditions, let E be an enterprise, then its structure can be represented as a network of systems performing its global goal through specific functional dimensions viewed as reality under-levels, such that the enterprise E is a SoS according to the relation:

$$E = \left[S = \{S_1, S_2, ..., S_n\}, ICon, P\right], \quad (6)$$

where: $S = \{S_1, S_2, ..., S_n\}$ represents the set of systems; *Icon* – the interconnection relation; P – the protocol of interconnection, as the assemble of rules according to which the systems of S will relate to each other in attaining the global goal.

Considering, in this context, the multidimensional complexity of the enterprise as an organization, according to definition 1, results that the corresponding measures are determined by the following relation:

$$C = Int\left[C_1, C_2, ..., C_n\right] = C(E) = C\left(\left[S, ICon, P\right]\right). \quad (7)$$

Relation (7) represents the SoS-based model for the multidimensional complexity of the enterprise.

The SoS-based model of the enterprise and of its multidimensional complexity is applied for different types of structures:

a) *the individual enterprise*, where S is formed by the structural and organizational dimensions (e.g., departments, process oriented teams etc.);

b) *the extended enterprise*, where *S* is formed by a central enterprise and other ones specialized in different services and manufacturing areas;

c) *the virtual enterprise*, where *S* is formed temporarily by different individuals and/or independent enterprises that collaborate in attaining a goal through which are satisfied their individual goals;

d) *multidimensional complex enterprise*, where *S* is formed by a multitude of different organizations, enterprises, end even institutions, that collaborate to resolve complex and heterogeneous problems critical for a large area of interest, that can be extended at a global level.

The *Icon* relation can be of various types, determining corresponding network topologies of the enterprise, and the interconnection protocol, *P*, has different levels of integration capabilities, as is shown in Table 2.

Table 2.

The integration capabilities of the interconnection protocols.

Level of integration	Capabilities of the interconnection protocol
Interfacing	• The communication between the elements of *S* is established only at the level of data and information exchange, regarding the global goals. • The components of *S* preserve their functional, structural and disciplinary individuality specific to their homogeneity, quasi-homogeneity or heterogeneity. • An importance order of the elements can be established and accepted at the global level of the enterprise, *E*.
Interoperability	• Implements the communication between the systems of *S* that are considered as having the same weight / importance in the enterprise *E*. The information exchange is performed such that a cooperation context is formed at the level of the functional capabilities. • The *Icon* relation is implemented in a way that supports the interconnection relation of functional capabilities for the components of *S*. • The systems of *S* are functionally and disciplinary related and correlated. • The components of *S* preserve their individuality, but in a way that satisfies the cooperation conditions.

Interworking	• Implements the communication between the functions and tasks of the elements of *S*, and their coordination. Thus, the global goal is attained through cooperation, collaboration, and co-working, such that a level of performance is attained by the global structure, *E*. • The communication is performed both at the levels of information and functional states, such that the components of *S*, functionally converge in attaining the global goals. • The components of *S* are interconnected in a manner that creates, at the level of their global goals, an unifying bond. • Structurally, the components of *S* preserve their individuality, but the functional bonds in the context of *E* are much stronger and impose many constraints to each component.
Total integration	• The communication becomes an open context of information and states exchange through multi-dimensional channels, such that the *Icon* relation unifies, at the structural level, the components of *S*. • The components of *S* are 'regrouped' considering process-oriented or functional criteria, and thus their individuality is only functional, being not preserved at the organizational level. • The structure of the enterprise, *E*, becomes a new integrated global system, and appertains no more to the SoS class.

In these conditions, according to relation (7), the multidimensional complexity of an enterprise as SoS is determined by:

$$C = \left[C(S), C(ICon), C(P)\right], \tag{8}$$

where: $C(S)$ represents the complexity of the set of systems *S*; $C(ICon)$ – the complexity of the interconnections *ICon*; $C(P)$ – the complexity of the protocol *P*.

Thus, according to relation (8), results that the main metrics of the multidimensional complexity, *C*, correspond to the metrics of its main components (see Table 3).

Table 3.

Metrics of the multidimensional complexity of the enterprise.

1. **Metrics for the complexity of the set of systems $C(S)$**

1.1. The dimension of S as the cardinality of the set of systems, card(S), respectively the number of the component systems.

1.2. The goal heterogeneity of S (GHS) representing the goals of each systems structured in a corresponding table or database of the following form:

S_i/G_i	G_1	G_2	…	G_j	…	G_q	…	G_w
S_1	X		…		…	X	…	
S_2	X	X	…		…		…	X
…	…	…	…	…	…	…	…	…
S_k		X	…	X	…		…	
…	…	…	…	…	…	…	…	…
S_n	X		…	X	…	X	…	

1.3. The compatibility of the individual goals of the component enterprises with the global goal aspects of the structure E, viewed as points of: contradiction (●), non-contradiction (■), full compatibility (▲), or not related, in an compatibility table as:

$G_i/A_j(G)$	A_1	A_2	…	A_q	…	A_l	…	A_p
G_1	■	▲	…	●	…	▲	…	▲
G_2	▲	▲	…	■	…	■	…	▲
…	…	…	…	…	…	…	…	…
G_i	▲	●	…	▲	…	■	…	▲
…	…	…	…	…	…	…	…	…
G_n	●	■	…	▲	…	▲	…	●

2. **Metrics for the complexity of the interconnections $C(ICon)$**

If an interconnection is viewed as an edge between two nodes that represent two connected enterprises, then the structure E as a SoS is represented by a graph, and all the metrics of graphs are applied as metrics for $C(ICon)$ as: number of nodes, number of edges, flows in graphs, edges capacities etc.

3. **Metrics for the complexity of the protocol $C(P)$**

Considering the role of the protocol, the following types of metrics can be used:

- the number of rules and/or procedures;
- the levels of activity considered by the protocol's rules and procedures;
- the depth at which the protocol's rules and/or procedures influence the behaviour of each component enterprise;
- the degree of autonomy left to the individual enterprises etc.

4. The SoS architectures in building modern enterprises

The main problem in designing and implementing an enterprise as a SoS is to establish its architecture according to the constructive relation (6).

As any architecture, the SoS architecture considers functional blocks, but these will represent, in fact, the individual enterprises that form *E* through *S*, *ICon*, and *P*. Thus, taking into account that any SoS is a network of systems, results that the network topologies (e.g., hierarchical, star, ring, etc.) represent architectures that can be considered.

Also, another type of architectures can be developed, that are based on the interconnection of the component enterprises / systems, as in table 4[2, 3]. These interconnected – oriented architectures correspond to the following relation $\forall p = \overline{1,n}$, at least two indices $u, v \in \{1,...,n\}$ exist, such that:

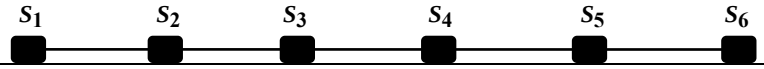
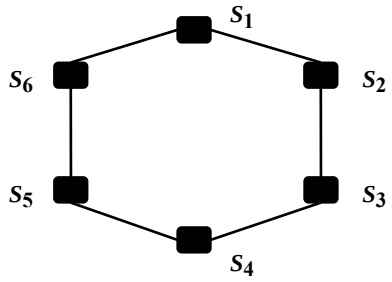
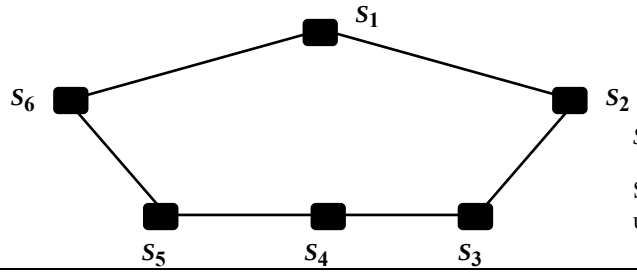
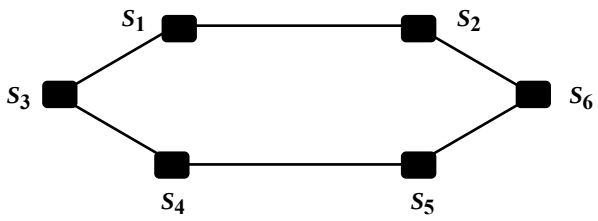
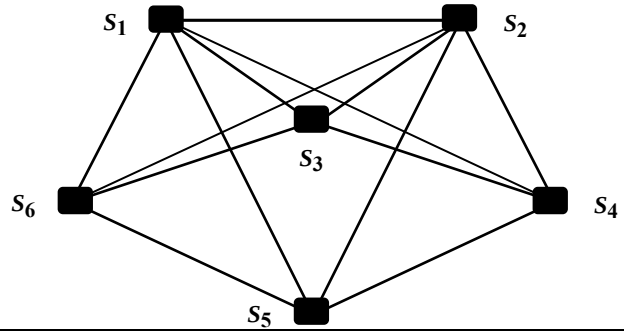
$$\begin{aligned} &[e_{pu} \in ICon \text{ and } e_{pv} \in ICon] \text{ or} \\ &[e_{up} \in ICon \text{ and } e_{vp} \in ICon] \text{ or} \\ &[e_{up} \in ICon \text{ and } e_{pv} \in ICon] \text{ or} \\ &[e_{pu} \in ICon \text{ and } e_{vp} \in ICon] , \end{aligned} \tag{9}$$

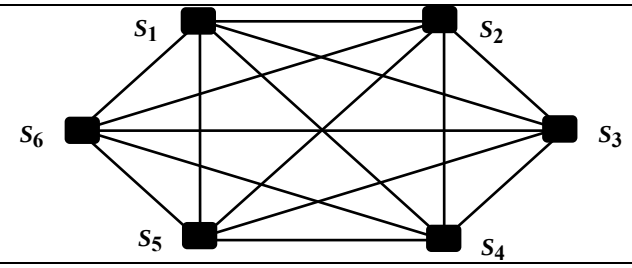
where $e_{\alpha\beta}$, $\alpha,\beta = p,u,v$ are oriented or not oriented edges that connect the nodes $S_1, S_2, ..., S_n$ representing the component enterprises.

Considering the architectures presented in table 4, other types can be derived.

The interconnection – oriented architectures are recommended due to their capabilities to support all the characteristics of the interconnection protocols, from interfacing to total integration, being also a support for the synergistic integration of the SoS when all the edges represent the information set (see [2, 3]) of the SoS, respectively of the enterprise *S* as a SoS.

Table 4.
Interconnection – oriented architectures of the enterprises as SoS (for $n = 6$).

1.	**Serial SoS architecture**
	
2.	**Closed serial SoS architecture**
	
3.	**1 – Centred SoS with open serial interconnection**
	 S_1 – central system; $S_2 \div S_6$ – open serial under-connection.
4.	**2 – Centred SoS with open serial under-connection**
	 S_1, S_2 – central system; $S_3 \div S_6$ – open serial under-connection.
5.	**2 – Centred SoS with closed serial under-connection**
	 S_1, S_2 – central system; $S_3 \div S_6$ – closed serial under-connection.

6.	Total connected SoS or complete SoS
	

5. The process map of the enterprise developed as SoS

In order to develop or re-engineer an enterprise as a SoS, the main dominant processes are should be considered as following:

P1 – communication;
P2 – collaboration, co-working;
P3 – SoS control;
P4 – configuration and reconfiguration;
P5 – analysis and identification;
P6 – decision and planning;
P7 – production / service delivery;
P8 – learning and experience accumulation.

The corresponding process map of the enterprise developed as a SoS is represented in figure 2.

The above processes must support the global function of the enterprise in the conditions of:

- individual missions of the component systems / enterprises;
- specific internal structures and organizations;
- individual resources and capabilities;
- individual management of the component systems / enterprises.

Accordingly, the design of each process is critical for the development of the enterprise as a SoS in the context of multidimensional complexity.

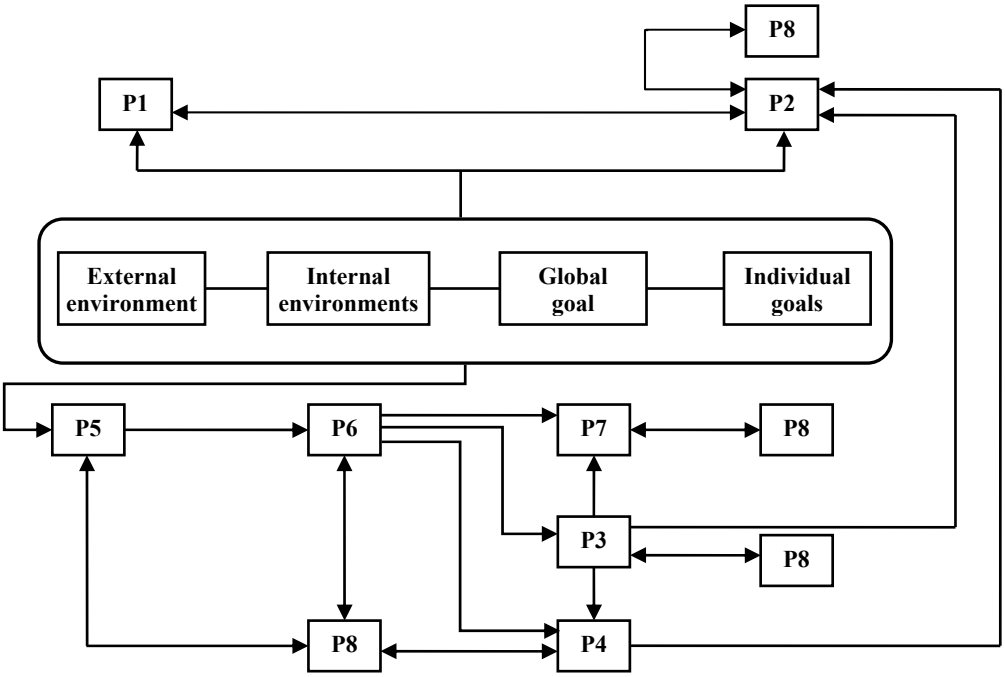


Figure 2. The process map of the enterprise as a SoS.

6. Conclusions

The present economical, technological, and business environment is characterized by heterogeneity and complexity that determine specific dynamics in the enterprises' behaviour.

Thus, regarding the complexity of the modern individual enterprises, and the modern business structures, result two main aspects of the problem: the multidimensional complexity of the enterprises, and the development of the enterprises towards complex structures as systems of systems (SoS).

The present paper considers both aspects in defining the multi-dimensional complexity concept and its SoS corresponding aspects. In this context are developed the SoS-based model of the multidimensional complexity of the enterprise, the SoS architectures of the enterprises built as SoS, and the process map for the enterprises with SoS structures.

The resulted framework represents an approach both for the analysis and the development of the modern enterprises in the context of the SoS concept and multidimensional complexity.

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FOREIGN DIRECT INVESTMENT FLOWS – GROWTH STIMULANT IN ROMANIA

Radu-Marcel JOIA[*], Cătălin-Emilian HUIDUMAC-PETRESCU[**]

Abstract. *The foreign direct investment flows (FDI) expansion over the last 20 years has not been a spontaneous one, but it was stimulated over time by important reforms, such as the opening of the world's economies to attract capital flows, changes in economic policies, but also the implementation of the companies' privatization process. Also, the agreement to provide national treatment to foreign direct investment, approved by member countries of World Trade Organization, has helped this expansion process.*
The economic benefits of foreign direct investment flows are quite common and knew: technological innovation, competitiveness increase, efficiency improvement and intangible resource transfer as new forms of organization, administration and marketing.

Keywords: *FDI inflows and outflows, economic growth, GDP per capita, investment incentives, foreign investors.*

1. Introduction

In the following lines of our paper we will present the FDI flows situation in Romania related to the FDI stock based on the same econometrical model made in the case of China, not in the idea of comparing the two emerging economies, but to highlight two different economies model.

According to a 2011 UNCTAD report, the transition economies of South – Eastern Europe have reached in 2010 the value of $70 billion concerning the FDI flows, after a decline of over 40% comparing with the last year. FDI flows have continued to decline by over 31% mainly due to very poor investment from the European Union, the main investor in this geographical area[1]. In terms of the countries which are in this geographical

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[1] *Global Investment Trends Monitor*, No. 5, 17 January 2011, page 5.

area, UNCTAD makes statistics on the Black Sea Economic Cooperation Organization, internationally known as BSEC (Black Sea Economic Cooperation), International Organization on which Romania takes part (see Table 1).

Table 1.
FDI flows, FDI stock and GDP[2] – values from 1990 to 2010 in Romania

Year	FDI flows	FDI stock	GDP	Year	FDI flows	FDI stock	GDP
1990	0,01	0,01	38.510,55	**2001**	1.157,93	8.339,19	40.585,89
1991	40,00	44,00	29.054,33	**2002**	1.140,65	7.846,37	45.988,51
1992	77,00	122,00	19.715,60	**2003**	2.196,30	12.202,47	59.466,02
1993	94,00	215,00	26.546,04	**2004**	6.435,59	20.486,00	75.794,73
1994	341,00	402,00	30.283,94	**2005**	6.482,86	25.816,44	99.172,61
1995	419,00	821,00	35.726,50	**2006**	11.366,87	45.452,07	122.695,85
1996	263,00	1.097,20	35.563,02	**2007**	9.921,47	62.961,25	170.616,96
1997	1.215,00	2.416,64	35.533,25	**2008**	**13.909,99**	**67.911,09**	**204.338,61**
1998	2.031,00	4.527,25	42.115,35	**2009**	4.846,89	72.006,97	161.109,00
1999	1.027,03	5.673,98	35.995,56	**2010**	3.573,30	70.011,67	159.337,64[3]
2000	1.056,75	6.953,00	37.305,10	**2011**	–	–	–

Measure: US Dollars at current prices and current exchange rates in millions.

Source: The data has been extracted from UNCTAD statistics (http://unctadstat.unctad.-org/ReportFolders/reportFolders.aspx)

This International Organization was born in 1992 and was composed of eleven countries: Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Moldova, Romania, Russia, Turkey and Ukraine. Currently meets twelve countries, Serbia adhering to it in 2004. Its main objective is to foster cooperation between countries and also to develop economic relations.

[2] According to UNCTAD statistics, the GDP is nominal and real, total and per capita in annual values.

[3] The values for 2010 are estimated.

Romania, country which held the presidency of this organization, believes that relations with neighbouring countries based on mutual trust, dialogue and cooperation between states are the main features of such an organization. Black Sea region has a huge human and economic potential that can be used effectively also to help countries overcome the negative effects of international economic context.

For a better illustration of this organization objective, we summarize the main objectives through the activities promoted by this organization, namely:

- to act in a spirit of friendship and good neighbourliness and mutual respect and enhance dialogue, trust and cooperation between Member States;
- to develop and diversify bilateral and multilateral cooperation based on principles and norms of international law;
- to take action to improve the business environment and to promote individual initiative and collective enterprises and companies directly involved in economic cooperation;
- to develop economic cooperation in a way that does not violate inter-national obligations of Member States, including those arising from their membership to other organizations or institutions;
- to be aware of the specific economic conditions and of the Member States interests;
- to further encourage participation in the BSEC economic cooperation and other interested states, international economic and financial institutions and enterprises and companies[4].

2. FDI and Stock Flows Analysis in Romania

The analysis that we performed on FDI flows, stock of FDI and economic growth of China in the article *China's Geostrategic Position – FDI Flows and Stock Analysis* [2] will be done on the case of Romania too, of course comparison between the two economies not being able to make but the idea was to illustrate the differences in autocorrelation between the

[4] The principles are extracted from Black Sea Economic Cooperation Charter; Charter came into force on May 1, 1999.

explained variables. Thus based on Table 1, we conducted an econometric analysis of the variables presented.

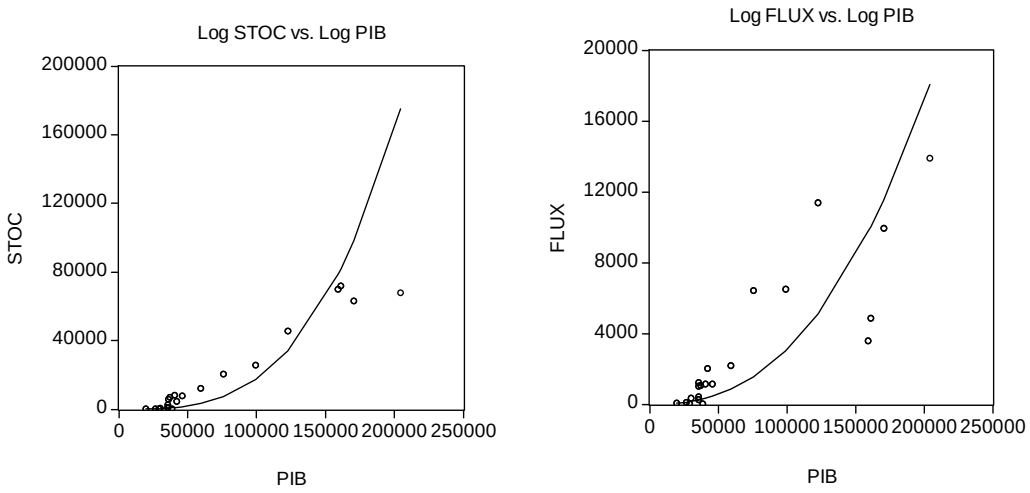

Figure 1. Economic growth correlated with FDI and stock flows in Romania from 1990 to 2010.

Source: Table 1 – FDI flows, FDI stock and GDP – values from 1990 to 2010 in Romania (Flux = Flows, Stoc = Stock, PIB = GDP)

Looking at Table 1 and Figure 1 (the data were logarithmic for better analysis), we can see that at the beginning of the period, until about 2000, in Romania, between FDI flows and GDP is a very close correlation, the same being true also for the stock of foreign direct investments. This means that any new investor in Romania have a contribution to economic growth.

While, due to economic activities diversification, technological progress, to all the economic facilities, all created by the Romanian Government, and also to the economic globalization in one word, in Romania, investment flows have entered in an upward trend (see Table 1), their contribution to GDP growth being really a significant one. It is well highlighted the upward trend in FDI inflows during 2000-2004, the year of 2003 being a border year, FDI flows actually exploding from $ 2.196 million in 2003 to $ 6.436 million in 2004, the same thing happening with the FDI stock, which grew at 68% over the previous year.

It was only the first step towards an increase in these flows. In 2005, flows remained stable, and then the same as the 2004 explosion occurs. In 2006, FDI flows reached a maximum for this period, registering a growth of 75% and higher than in reference year, 2004, of 77%. In Figure 2 we

showed these peaks particularly important for investments and the stock of FDI flows, representative of the first half of 2000 years.

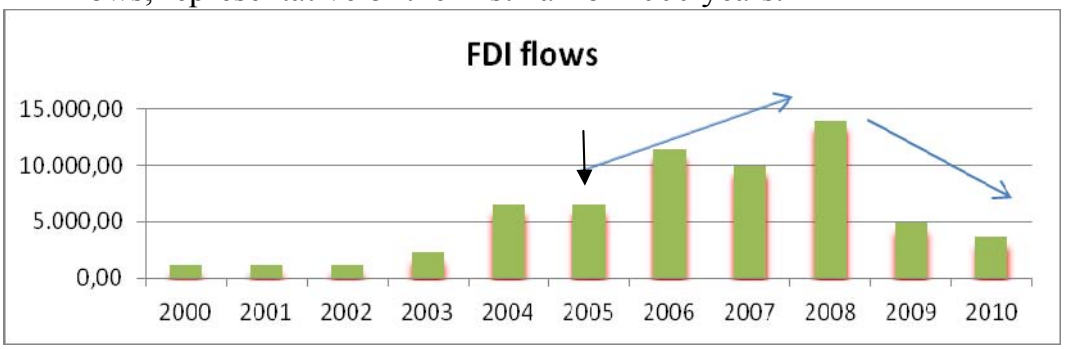

Figure 2. FDI flows between 2000 and 2010.

Source: Table 1 – FDI flows, FDI stock and GDP – values from 1990 to 2010 in Romania.

2007 brings a reduction of the capital flows to about 13%, decline that was recovered sharply in 2008, when flows have increased over the previous year by 40% and 22% from base year to date, and namely 2006.

From Figure 2 and Table 1 we can and we must analyze the FDI flows and stock situation or of all macroeconomic indicators in two periods, namely from 2000 to 2004 and from 2004 to 2008. The most representative period is as we see from the statistics 2004-2008, representing the expansion of FDI flows in Romania. The factors which determined this important expansion for our country are many and will be mentioned them below.

If the Romanian Government until 2004 adopted only protectionist measures, quite protectionist, in 2004, the new government introduced new regulations for growth. The government change from 2004 brought also a change of mentality, because it brought a perspective of opening the Romanian market to the foreign investors. The idea that ruled that period of time was that foreign direct investment flows are particularly important for an economy as they bring an essential contribution to economic growth by creating jobs, by optimizing resource allocation, allowing the transfer of technology from developed country to our own and finally by stimulating the international trade. With this new concept there has been adopted incentives for economic growth, leading to a heating of the economy, increasing the resentment of entry if the economic crisis, appeared to us in Romania, until the end of 2008.

2004-2008 comes with economic liberalization and with a friendly fiscality for the entrepreneurs, including foreign ones. The most important

desire for the political environment was to stimulate the investments, being a considerable source of economic growth. The government tried to create a deregulated business environment, coordinated by a beneficial tax measures and incentive for all investors, a favourable economic environment through the promotion of favourable conditions for foreign investors, such as fair treatment, fair and non-discriminatory protection from illegal expropriation, appeal directly to international arbitration and transform Romania in a fiscally attractive country[5]. These measures were based on international experience has shown that improving the investment climate was the main condition for attracting foreign investors in a global economy where competition to attract foreign direct investment is fierce.

For the economic development and the modernization of a country, foreign direct investments have an important role because it helps countries in transition or in developing to integrate globally, but to move to a competitive market economy. FDI flows lead to a technology diversification worldwide, making it easily accessible. Thus, for a national economy, especially for those in developing or in transition, foreign investment helps its modernization by implementing advanced technology, new quality standards, new knowledge etc…., which determines the economy to move to a higher level of growth.

The international context shows us that these foreign direct investment flows or foreign capital flows, undoubtedly represents the foundation of the economy progress or the base of economic growth. Clear examples are China, South Korea, Singapore and Malaysia. China's example we analyzed it briefly, and we could see through an econometric analysis that we performed that indeed these flows determines growth and there are the foundation of economic growth to some extent, because while diversifying technology, knowledge and know-how developed this Asian economy in an extraordinary proportion.

We know that in also in the geographical area of former Soviet states, their transition to a market economy has developed, especially due to the development of these flows of capital investments in the area. We give examples of countries in transition that have succeeded in attracting foreign direct investments, which led to the development and modernization of their countries. Thus, countries like Poland, Czech Republic and Hungary started to use new technologies, technologies that have helped to

[5] Chamber of Tax Consultants, Tax Consultant Magazine, Editorial no. 13, *Foreign direct investment – key to sustainable economic growth in Romania*

more quickly and efficiently manage the affairs of the local environment. These examples points out that foreign investment led recovery differences between Western Europe and them, reducing substantially this "disability".

Romania, since 2004, wanted to reduce the gap between itself and the developed countries of Europe, in one way also to prepare for EU accession in 2007, through investment incentives in innovative sectors in conjunction with measures of fiscal relaxation. In addition, Romania started projects through which it tried to convince the foreign investors to develop a profitable business in Romania, and not in their country of residence.

As shown by UNCTAD (Table 1) and the National Bank of Romania, from 2005 to 2008, Romania had a lot to gain from the introduction of flat tax, flat tax that was seen as a measure of stimulus for the foreign direct investments. In Figure 3 and Table 1 we can see that from 1990 to 2004, the growth of foreign direct investment flows was an insignificant in volume, during which the tax system was progressive.

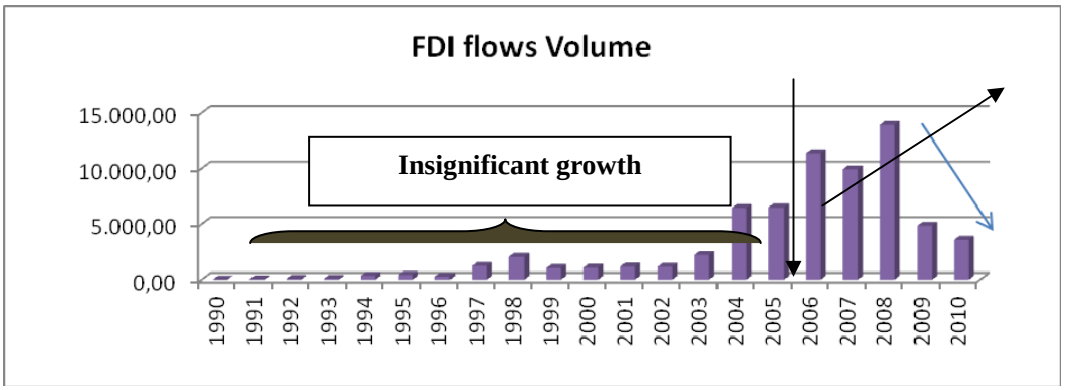

Figure 3. FDI Volume from 1990 to 2010.

Source: Table 1 – FDI flows, FDI stock and GDP – values from 1990 to 2010 in Romania.

Since 2005, the tax system was changed; it has become a unique one, allowing the volume of foreign direct investments to grow and to go on an upward trend, recording important figures for our economy. This governmental measure has led to a very beneficial situation, such as major investors made their appearance in Romania, investors such as Nokia, Ford, Erste Group, these adopted measures, in the first place, apart from a positive effect, increased the confidence in the national economy.

There are many local voices that believe that this flat rate is not beneficial, and on the contrary it would be better that Romania returns to

the progressive tax rate, without taking into account the evolution of the key macroeconomic indicators during the 2000-2004 period and then 2004 to 2008. Although, perhaps it has not generated exclusively positive effects in terms of foreign direct investment flows, but from the rate introduction, the effects were beneficial for our country. Flat protesters should take into account several elements, namely: flat rate resulted in better compliance with law and terms of payment of taxes on income, solutions on tax avoidance payment effective disappeared. In addition, fiscal regulations were removed from the approximately 150,000 jobs and that facilitated the tax administration system, which however was quite cumbersome.

We can say that those who really enjoyed the flat tax were the investors, because this measure has attracted and still attracts many investors, especially foreigners. This, when it is combined with incentives to stimulate the foreign investments, in the future, will attract citizens of other European countries to establish tax residency in Romania and pay taxes on their global income in Romania to benefit from a favorable tax regime. Romania's goal is to keep the attracted investors as much as possible, so in other words, FDI stock to be a rising or steady one, but not decreasing. In these conditions, if it returns to the progressive tax rate, the investors that are already in the country might look burdened, reason that could determine their departure from the country. A flat rate helps the country to combat also the underground economy, a primary goal for each state, while the progressive rate may provide loopholes and there can be found solutions to avoid paying the taxes.

According to Central Bank statistics, the end of 2005-2008, the period of maximum expansion of these flows, the balance of tangible and intangible assets of foreign investors accounted 45% of total FDI, which stresses the durability of these foreign direct investments. This is evidenced also by the evolution of FDI stock during the second half of 2000 years.

Another important indicator of the FDI contribution to national GDP is the contribution they have to the trade balance. During 2005-2008 the FDI contribution to exports was 73% and to imports 62.6%, according to Central Bank statistics for this period.

Globally, in terms of FDI, we are witnesses of the development of a new type of investments or investment flows, based on technology and innovation. Thus, future share of foreign direct investments and their size will be dictated by how investors will create and implement new technologies, patented technological solutions, proprietary products, new brands, however being an intrinsic force of the new foreign investments in Romania.

Table 3.
Econometric model – case of Romania

Dependent Variable: PIB
Method: Least Squares
Sample: 1990 2010
Included observations: 21

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
Flows	3.206178	0.693035	4.626288	0.0002
Stock	1.718046	0.107859	15.92864	0.0000
C	27391.31	2220.835	12.33379	0.0000
R-squared	**0.982976**	Mean dependent var		71688.34
Adjusted R-squared	**0.981084**	S.D. dependent var		56930.06
S.E. of regression	7829.874	Akaike info criterion		20.90084
Sum squared resid	1.10E+09	Schwarz criterion		21.05006
Log likelihood	–216.4589	*F*-statistic		519.6567
Durbin-Watson stat	**2.263620**	Prob (*F*-statistic)		0.000000

Source: Table 1 – FDI flows, FDI stock and GDP – values from 1990 to 2010 in Romania.

Regression slope values are 3.20 and 1.71, statistically greater than one, the econometric data is correct; the values are correct, positive, which highlights significant parameters. As an explanation, if the trend of FDI flows is increasing, it will lead to an increase of the stock of foreign investments on the Romanian territory. So, over the period analyzed, always an increase in capital flows undoubtedly caused an increase in stock investments.

In addition, if we analyze the equation in Table 3 we see that *R*-squared has a value of 0.982976, which means a dependence of 98.29% (almost perfect) between the amount of investment flows, stock and Romania's economic growth. This dependence is also one of economic logic, because always capital investments contribute to economic growth of a state, the dependence being direct proportional.

Comparing with China case study when the Durbin-Watson statistic value was very low, namely 0.202703, which would translate that investment capital flows affect growth moderate, in Romania's case study things change, the difference is indeed observed and significant, namely Durbin-Watson statistic is 2.263620, which shows that in our economy these variables are extremely correlated, FDI flows are directly correlated to the economic growth, having a significant influence on GDP value. The Durbin-Watson statistic value is closer to 1.5, respectively 2, the correlation and dependence between the analyzed variables is higher.

3. Conclusions

The most representative period for our country is 2004 to 2008. Already since 2004 the share of investment flows is an important, effectively tripling their value from the previous year. This cycle of four years of expansion of FDI flows has led to a growth illustrated in the gross domestic product value, one of the main economic indicators. Peak was in 2006 and 2008 when flows reached impressive values in Eastern Europe and South – Eastern Europe, the most important figures being in Russia, Turkey, Romania and Ukraine.

Peak in terms of attractiveness of FDI was registered in 2006 and 2008 when flows reached the spectacular value. Now, in regard to Romania, we can say that through the Romanian Center for Foreign Trade and Investment Promotion, our country is trying to promote opportunities for attracting foreign investors, but also to answer the question "Why to invest in Romania?"

As a conclusion we can say that Romania is one of the countries with great potential to attract foreign investors. We are witnessing a political experience that stimulates the growth of foreign direct investment flows, especially after 2004, being encouraged by beneficial government measures. According to our econometric analysis we identify that for our country, the investments, inflows and outflows, or stock of FDI, are extremely important to stimulate national economic growth. In other words, every investment that we managed to attract contributes to a certain extent of the economic growth.

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ROLE OF STAKEHOLDER ORIENTATION IN MANAGEMENT OF ORGANIZATION SUSTAINABILITY

Wioletta WEREDA*

Abstract. *The changing nature of each organization, far-reaching re-evaluation in the structure of its sources, the liquidity of its borders, the need for flexibility and the need for integration of economic and social approaches have not been without influence on the structure of power and decision-making processes in companies, local government units and other organizations.*

Confronting each organization, especially enterprises, there have been more and more new challenges which top managers must deal with. If the organization is to respond effectively to these challenges, such as the progressive globalization of capital markets and labour markets, the imperatives of continuous innovativeness and creativity, extending boundaries of the company or increasing social and ecological sensitivity of the environment, there is no doubt that in the present improvement of corporate governance systems an approach based on the integration of the orientation of the ownership and the orientation of stakeholders is necessary. Treating the organization as a social institution implies that apart from economic objectives, it should accomplish particular social goals as well.

Keywords: *stakeholder orientation, organization sustainability, sustainable development, CSR.*

JEL Classification: M21 – Business Economics

1. Introduction

Competitiveness of enterprises is a primary element of the organization's operations. The concept of sustainable development in numerous organizations indicates competitiveness being a crucial driver behind their expansion, notably enterprises. Competition is a phenomenon occurring in economy which is characterized by striving to achieve the best possible position on the market. Enterprises may "wage a struggle" on the market at various levels, though great importance is attached to the image

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created of the organization as well as value to be provided to stakeholders. Therefore, it is essential to keep an appropriate balance within and outside the organization which is increasingly labelled as sustainable development.

The idea of sustainable development is a response to environmental changes. Principally this concept represents a shift in perceiving the world. Sustainable development enables to reach a compromise in varied aspects of development through maintaining environmental balance and integrating social, political and economic efforts. This study illustrates the concept of sustainable development as well as drivers and behaviours determining an integral approach to management of the enterprise through relations with stakeholders. Moreover, the idea of sustainable development will be compared to the concept of CSR which is a resultant of stakeholder orientation and creation of value for them.

Corporate social responsibility and sustainable growth in Poland have been relatively new trends, though due to their importance and enormous business sense it becomes an issue of strategic significance. Modern and responsible business seeks out synergy among economic, environmental and social aspects of operations, building a comprehensive strategy for company development on the basis of CSR guidelines. Not only do these activities originate from moral needs, they are principally connected to the awareness that CSR is a driving force for innovation, a factor of competitive advantage and quality measurement for the management system[1].

The objective of this article is to identify determinants for functioning and implementing sustainable development of organizations, in particular enterprises, as well as to reveal the impact exercised by stakeholder orientation on management towards sustainable development, as well as to provide answers to the following questions:

1) What is stakeholder orientation about?
2) What are the determinants behind functioning and implementing sustainable development for enterprises?
3) Which factors most affect sustainable development of enterprises?

Deliberations have been based on the research conducted by MillwardBrown SMG/KRC[2] and PwC[3] commissioned by the Polish

[1] B. Domanska-Szaruga, *Performance of activities related to implementation of corporate social responsibility standards to the practice of Polish enterprises,* [in] ŠtefanMajtan (ed.) Aktuálne problem podnikovej sféry, Vydavateľstvo Ekonóm – Ekonomická univerzita v Bratislave, Bratislava 2012, p. 67.

[2] A leading global research company, the largest research centre in Poland as well as throughout Central and Eastern Europe, www.smgkrc.pl

Agency for Enterprise Development (PARP)[4]. They concern the state of implementing social responsibility standards in Polish enterprises.

2. Corporate social responsibility and sustainable development concepts

Economic growth should provide society with prosperous life, mitigate poverty and serve other social purposes. Despite a gradual increase in national income, the differences in wealth and unemployment heighten, and democracy is eroded. At present economic growth leads to the loss of cultural identity, or abuse of natural resources. Accomplishment of the overarching objective, that is development of the man and mankind as a whole prompts strengthened efficiency of the means for realization of economic growth. Thus, a closed-ended structure is formed. At the beginning of the 21st century the phase of the third industrial revolution began. New technologies based on microelectronics, robotics, biotechnologies, phone communications and computers contribute to quicker economic growth of the contemporary world. The former century strove to identify social and ecological aspects of economic growth. For these reasons, scientists and practitioners seek out new concepts which definitely include the concepts of CSR and sustainable development.

The concept of social responsibility has been evolving over many years and receiving attention among both practitioners as well as business theoreticians. The reference literature offers a broad array of CSR definitions; however the authors do not share the same approach to their definitions. Corporate Social Responsibility is largely defined as "voluntary" business operations moving beyond ordinary operations focused on realization of their own interest and observance of law[5] as well as activities

[3] PwC is a leading global organization providing professional consultancy services in 158 countries, www.pwc.pl

[4] Polish Agency for Enterprise Development (PARP) is a government agency committed to, among others, creating favourable conditions for sustainable growth of Polish economy through underpinning innovativeness and international active presence, and promoting environmentally friendly production and consumption forms.

[5] M. Blowfield, A. Murray, *Corporate Responsibility: A Critical Introduction*. New York: Oxford University Press 2008; P. Kotler, N. Lee, *Corporate Social responsibility: Doing the Most Good for Your Company and Your Cause*. New York: John Wiley & Sons 2004; J. Margolis, J. Walsh, *People and profits? The search for a link Between a company's social and financial performance*. Mahwah, NJ: Erlbaum 2001; M. Willmott,. *Citizen Brands: Putting Society at the Heart of Your Business*. Chichester: John Wiley&Sons Ltd. 2001.

in line with goals and preferences of key stakeholders leading to organizational competitive advantage and increasing the value of the enterprise[6].

Advancement of the concept of corporate social responsibility, the variety of definitions and varied comprehension of CSR, produced a necessity for standardizing this issue, particularly in the context of its implementation in the organization. As a consequence there emerged a great many guidelines, norms and standards governing social responsibility (Figure 1). Attempts for specifying CSR standards are made by both international and sector organizations as well as by enterprises alone which formulate their own ethic codes and CSR policy.

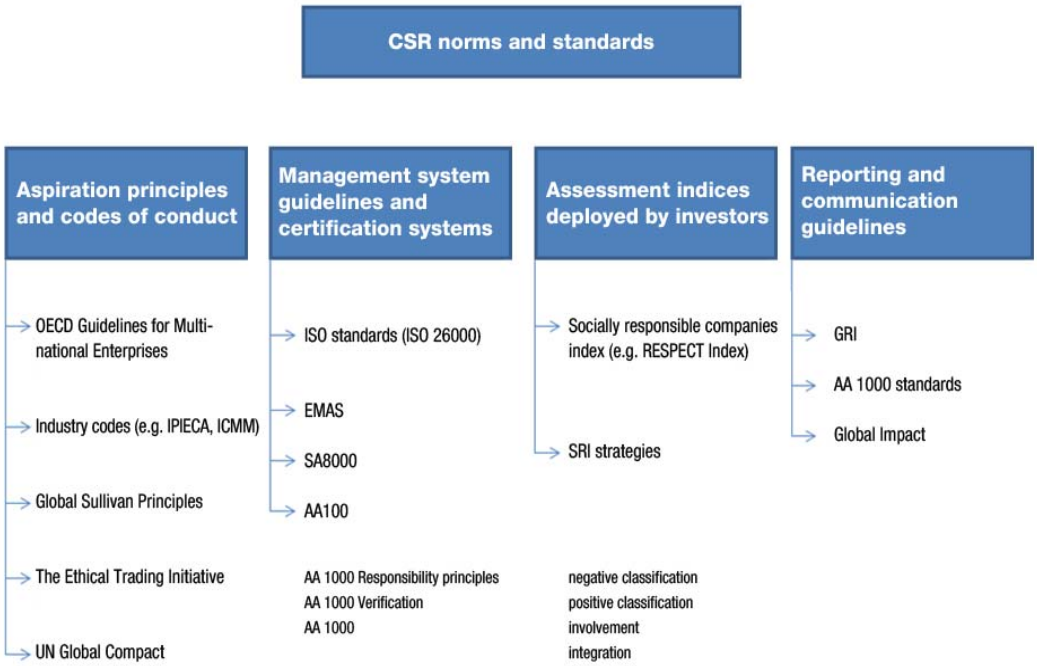

Figure 1. CSR norms and standards.

Source: Own study on the basis of Ł. Makuch, *Normyistandardyspołecznejodpowiedzialnościbiznesu (CSR,) [Norms and standards for corporate social responsibility (CSR)]*, http://spolecznieodpowiedzialni.pl/files/file/vs6y70yawb8g8tthdif-wzajn4jlxof.pdf.

[6] M. C. Branco, L. L. Rodrigues, *Factors Influencing Social Responsibility Disclosure by Portuguese Companies*. J. Bus. Ethics 83 (4), 2008, pp. 685-701; O. Falck, S. Heblich, *Corporate social responsibility: Doing well by doing good*. Business Horizons (2007) 50, pp. 247-254; M. E. Porter, M. R. Kramer, *Strategy and society: The link between competitive advantage and corporate social responsibility*. Harvard Business Review, Dec. 2006, pp. 1-16.

As it can be seen clearly, CSR norms and standards frequently act as practical tools for implementation of CSR, being a set of procedures, processes illustrated step by step, or specifications in relation to both management and decision making process as well as for operational activities and relationships with organizational environment

However, the objective of sustainable development is to run business operations, to develop and harness the environmental potentials and community organizations in such a manner as to ensure a dynamic evolution of new-quality production processes, sustainable use of natural resources as well as enhanced or maintained high standards of life for generations ahead[7].

This implies pursuit to integrate:

- social development ecologically determined at a local, regional and global level,
- effective management,
- socially just development[8].

Integral development should be correlated among varied areas of life so that implementation of this concept will deliver measurable benefits for both people as well as enterprises.

Targets of sustainable development need to be harmonized between a variety of social dimensions (local, national, international) and between present and future generations[9]. This is outlined in Figure 2.

Sustainable development is underpinned by the following:

- ecological determinants:
  – atmospheric balance,
  – long-term safeguarding of nature,
  – reduction of pollution affecting nature,
  – availability of natural resources over long-term;

[7] M. Czyż, *Strategia wdrażania rozwoju zrównoważonego [A strategy for implementing sustainable development]*, [in:] „Ekonomia i Środowisko" 2000, No. **1**(16), p. 47.

[8] M. Urbaniec, *Kooperatywne działania na rzecz rozwoju zrównoważonego [Cooperative operations in favour of sustainable development]*, [in:] F. Piontek (ed.), *Ekonomia a rozwó jzrównoważony. Wdrażanie [Economy and sustainable development. Implementation]*, Ekonomia i Środowisko, Białystok 2001, p. 69.

[9] *Ibid*.

- economic determinants:
  – „preventative" environmental protection is cheaper than „reparational",
  – boost of competitiveness of enterprises through economical exploitation of natural resources,
  – technological innovations;
- social determinants:
  – safeguarding new jobs,
  – guarantying appropriate standard of living,
  – social and political stability.

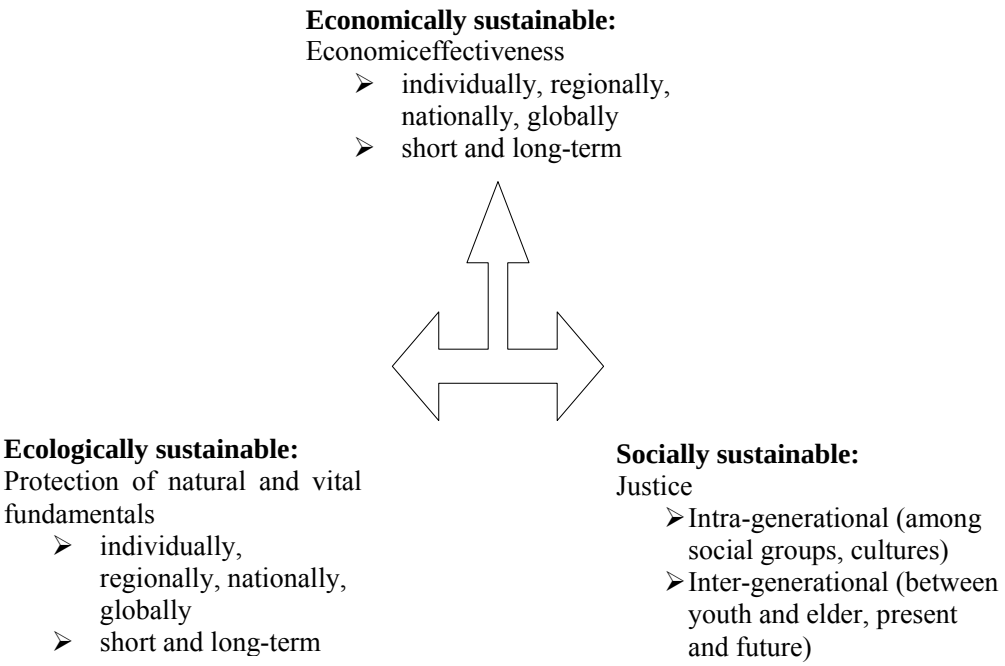

Figure 2. Goals of sustainable development.

Source: Own study based on: M. Urbaniec, *Cooperative operations in favour of sustainnable development*, [in:] F. Piontek (ed.), *Economy and sustainable development. Implementation*, Białystok 2001, p. 69.

Sustainable development is formulated in a variety of disparate definitions, yet each proves correct. Sustainable growth should be understood as a conscious process which requires changes, both institutional as well as in defining technical progress, as well as shifts in patterns of

consumption and behaviour. To secure an existence for generations ahead it is primarily necessary to find solutions to the following woes:

- dynamic increase in population worldwide,
- constrained occurrence of natural resources,
- curbed capacities of polluting ecosystems,
- insufficient catering of a large portion of population worldwide, and social and economic deficits[10].

The goals concerned with pro-ecological advancement should increasingly be specified for individual states, enterprises as well as products.

The quest for sustainable growth is frequently considered not only as a scientific and ecological problem but also as technical and economic, which presents a particular challenge for industry widely understood, and specifically for enterprises[11]. The idea of sustainable development of enterprises is associated with responsible management of all resources within an enterprise.

The switch of the concept of sustainable development to the level of operations performed by an enterprise suggests bringing economic, social and ecological targets into balance with strategic decisions of the enterprise. In the English-language literature such transformation is termed as *sustainable business*. Efforts in favour of sustainable development need to be actions having strategic character (long-term and material) as they exercise a decisive impact on the prospects of the enterprise[12]. A central assumption underlying the concept of sustainable development is not financial growth but sustainable development whose ultimate outcome is three-dimensional, creating an economic, social and ecological value[13]. The foregoing is illustrated in Figure 3.

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[10] *Ibid*, s. 69-70.

[11] *Ibid.*

[12] J. Adamczyk, *Koncepcja zrównoważonego rozwoju w zarządzaniu przedsiębiorstwem [A concept of sustainable development in management of the enterprise]*, Kraków 2001, p. 32.

[13] A. Paliwoda-Matiolańska, *Odpowiedzialność społeczna w procesie zarządzania przedsiębiorstwem[Social responsibility in the process of management of the enterprise]*, C. H. Beck, Warsaw 2009, p. 240.

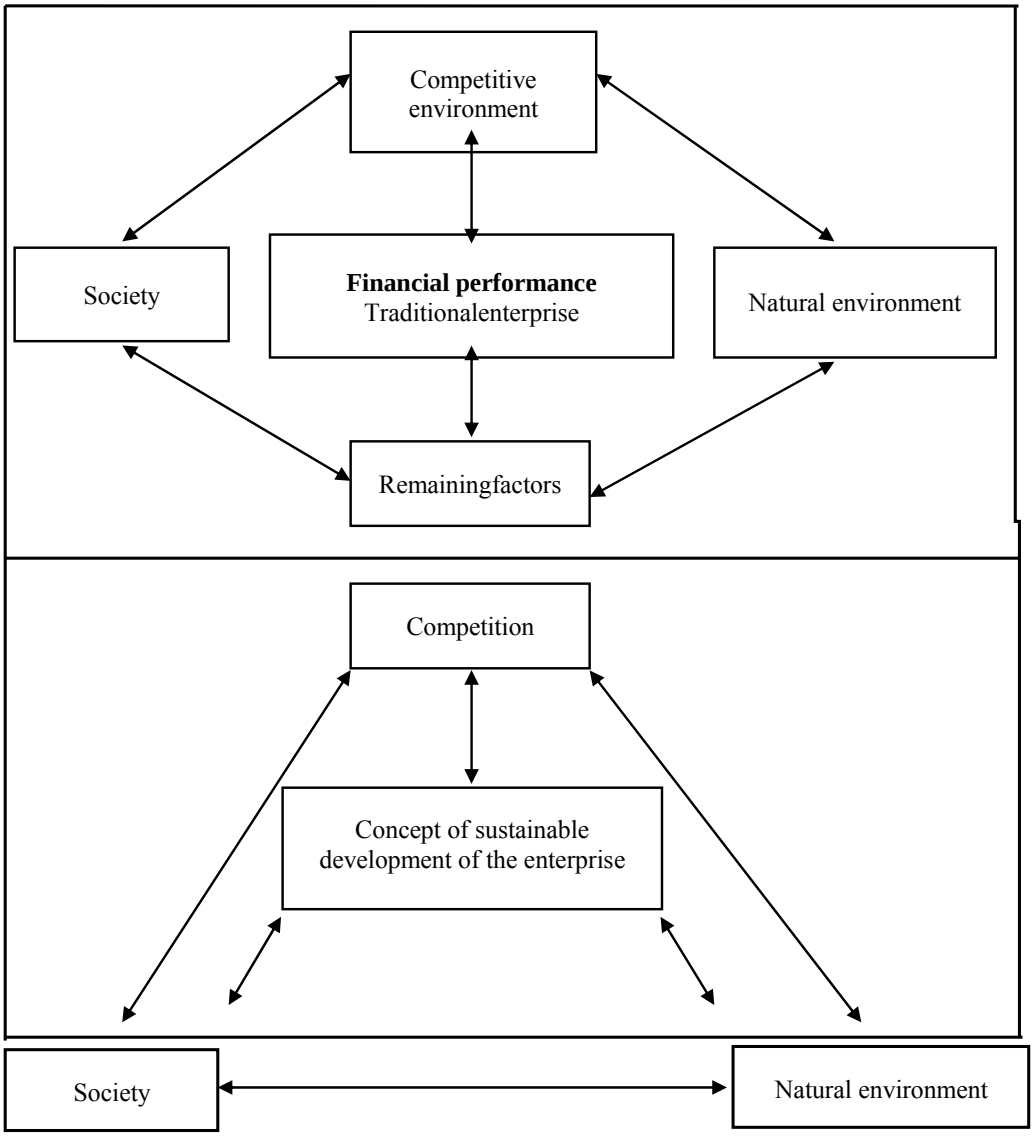

Figure 3. A traditional enterprise and a concept of sustainable development of the company.

Source: Own study based on: A. Paliwoda-Matiolańska, *Social responsibility in the process of management of the enterprise*, C. H. Beck, Warsaw 2009, p. 241.

3. Stakeholder orientation – a short overview

The idea of *stakeholders* has its origins in the 19th century concept evolved by German lawyers which sees an enterprise not only as a separate economic and legal entity but also a social entity. Crucially, recognition of

the corporation as a social institution implies that in addition to economic aims it should pursue specific social targets. Embracing of such an assumption entails a distinct concept of management and ownership supervision over an enterprise, and ensuring a distinct model of economic and social system[14].

Stakeholder orientation enjoys popularity chiefly in Germany and Japan. It is due to the fact that these states have a strong and long-standing tradition in terms of social prosperity and stable industrial relations[15].

An idea of the corporations rooted in the 19th century also had numerous proponents in the first half of the 20th century. However, clear sanctioning of social targets in the structure of company's objectives was completed in the study by the Stanford Research Institute (California) dating from 1963. This study asserted for the first time ever that there also are other interest groups (despite shareholders group) towards which a corporations has specific obligations and "without their support it would be practically unlikely to exist". All these groups were defined as *stakeholders*[16].

An above mentioned definition of the notion of *stakeholders* (in a broader sense) was repeated next year by Freeman in his work *Strategic Management. A Stakeholder Approach*[17]and shortly afterwards it became a global definition standard with regard to the perspective of *stakeholders*[18].

More significant differences between a narrower and broader definition lie in the fact that a narrower description is grounded on pragmatism in the approach to *stakeholders*, compelled by limitations in resources and time likely to be available to a company and its managers. Hence, a general suggestion put forward by proponents of the narrower approach to define individual interest groups from the perspective of their implications for a fundamental economic interest of the firm that is its survival[19]. Overall, such definitions of the concept of *stakeholders* are provided by e.g. M. Clarkson, T. Donaldson and L. E. Preston.

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[14] *Ibidem,* pp. 34-35.

[15] *Ibidem.*

[16] R. E. Freeman, D. L. Reed, *Stockholders and Stakeholders: A New Perspective on Corporate Governance*, [in] „California Management Review" 1983, No. 3 (Spring), p. 89.

[17] R. E. Freeman, *Strategic Management: A Stakeholders Approach*, Pitman, Boston 1984, p. 46.

[18] J. Jeżak, *Orientacja stakeholders jako podstawa zrównoważonego rozwoju dużego przedsiębiorstwa [Stakeholders orientation as a fundamental for sustainable development of the large enterprise]* [in] M. Cisek, B. Domańska-Szaruga, *Zrównoważony rozwój przedsiębiorstw [Sustainable enterprise development]*, Studio Emka, Warsaw 2010, p. 37.

[19] *Ibidem.*

Meanwhile, an interesting remark is formulated by Clarkson who in his analysis of what actually constitutes stakeholders comes to the conclusion that the status of the stakeholder should be solely bestowed to the persons or groups of persons who voluntarily or out of necessity assume part of the risk related to the functioning of the firm: capital, staff, financial or trade risk. The element of risk and jeopardy in losing any value is central to legitimization of the stakeholder, even if a given interest group has an opportunity to influence the firm or it is related with it in any manner[20]. Such an assertion is also shared by other advocates of the narrower approach to the category of *stakeholders*.

For example T. Kochani S. Rubenstein defines as stakeholders merely the interest groups that provide resources and values critical for the firm, delivered under circumstances of risk[21].

In a similar vein *stakeholders* are defined by J. E. Post, L. E. Preston and S. Sachs who argue that they include the groups of persons who voluntarily or out of necessity contribute to wealth creation within the company, and thus its potential beneficiaries or risk takers[22].

The definitions cited above show that proponents of the narrower approach which may be labelled as an economic approach, attempt to identify normative fundamentals for legitimizing *stakeholders* so that managers have no doubt as to which interest groups enjoy actual legitimization to affect the decisions made by the company[23].

A broad view on the category of *stakeholders* is premised on the assumption that a company is under the influence of a diverse array of interest groups which may have, but do not need to have legitimization for submitting their requests. Yet, they may affect the operations of the company in a specific manner or they themselves are affected[24].

To sum up, *stakeholders* (also described as e.g. strategic supporters, risk carriers) may be defined as groups or persons indirectly or directly interested in the organization's operations in its pursuit of delivering

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[20] M. Clarkson, *A risk based model of stakeholder theory*, Proceedings of the Second Toronto Conference on Stakeholder Theory, Centre for Corporate Social Performance & Ethics, University of Toronto, Toronto 1994, p. 4.

[21] T. Kochan, S. Rubenstein, *Toward Stakeholder Theory of the Firm: The Saturn Partnership*, [in] „Organizational Science" 2000, No. **11**/4, pp. 367-386,

[22] J. E. Post, L. E. Preston, S. Sachs, Managing the Extended Enterprise: The New Stakeholder View, [w:] „California Management Review", Fall 2002, vol. **45,** No. 1, p. 8.

[23] J. Jeżak, *Orientacja…*, *op.cit*., [in:] M. Cisek, B. Domańska-Szaruga, *Zrównoważony…*, *op.cit*., p. 37.

[24] *Ibidem,* p. 38.

targets[25]. They are both inside as well as outside an enterprise, they submit to organization specific postulates, counting on their accomplishment. Disregarding these expectations over a long-term induces losses to the company. Shaping appropriate relations with stakeholders by the firm gives the enterprise a chance for expansion and viability. Therefore, there is an urgency to launch initiatives by the enterprise striving to determine basic stakeholders groups, and to deliver on their postulates. A dialogue between enterprises and interest groups is central for both parties to become acquainted and better understand each other. A dialogue with stakeholders is an attempt to build an image of the company, creating an image of the company as a socially responsible company which attains its objectives in line with social expectations.

4. Role of stakeholders orientation in implementation of social responsibility standards in Polish enterprises – research results

Implementation of social responsibility in Polish enterprises is embedded in strategic documents on the economic growth of Poland, among others, in postulates of the National Development Strategy 2007-2015, National Strategic Reference Framework 2007-2013 (being a reflection of objectives of the Lisbon Strategy) and in Europe 2020. In connection with activities undertaken and projected by public administration with respect to promoting and reinforcing practices in the field of sustainable development and responsible governance, there emerges an urgency to carry out research to assess the current situation through exploring the awareness of the ideas of social responsibility and to analyze the state of CSR standards implementation. To date, studies in the area of CSR have centred on large companies or their knowledge of the issue alone, ignoring small and medium-sized enterprises[26].

"Assessment of implementing corporate social responsibility standards alongside the study on SR indices set in micro, small, middle-sized and large enterprises"[27], commissioned by the Polish Agency for

[25] J. A. F. Stoner, R.E. Freeman, D. R. Golbert, *Kierowanie*, PWE, Warsaw 1999, p. 80.

[26] Polish Agency for Enterprise Development, http://www.parp.gov.pl

[27] Assessment of implementing CSR standards alongside the study on SR indices set in micro, small, medium-sized and large enterprises, report on the survey; SMG/KRC MillwardBrown and PwC for PARP, Warsaw, 9 December 2001, http://badania.-parp.gov.pl/files/74/75/77/13079.pdf

Enterprise Development (PARP) is the largest and the most comprehensive survey conducted in Poland so far investigating CSR implementation. A crucial element of the research is encompassing micro, small as well middle-sized and large firms in the sample. The research was conducted on a nationwide sample of enterprises (850 companies) drawn from among the EFEKT database containing 2m records, being run by the Polish Marketing Centre.

By analysing detailed answers that demonstrate knowledge of specific standards (Figure 4), it appears that these declarations are overdone and fail to reflect actual circumstances. Also it should be noticed that 51% indications to ISO 14001 standard most likely results from the fact that many companies in Poland hold a certificate of conformity with ISO 14001 standard, whereas 30% of indications to ISO 26000 standard rather stems from the overall application of ISO standards group and not from the genuine knowledge of that standard; which was published in 2010 and its Polish version is still not available. On the other hand, it should be assumed that CSR-related activities may be performed by companies that fail to declare its understanding. Therefore, results presented may prove to be understated at a national level[28].

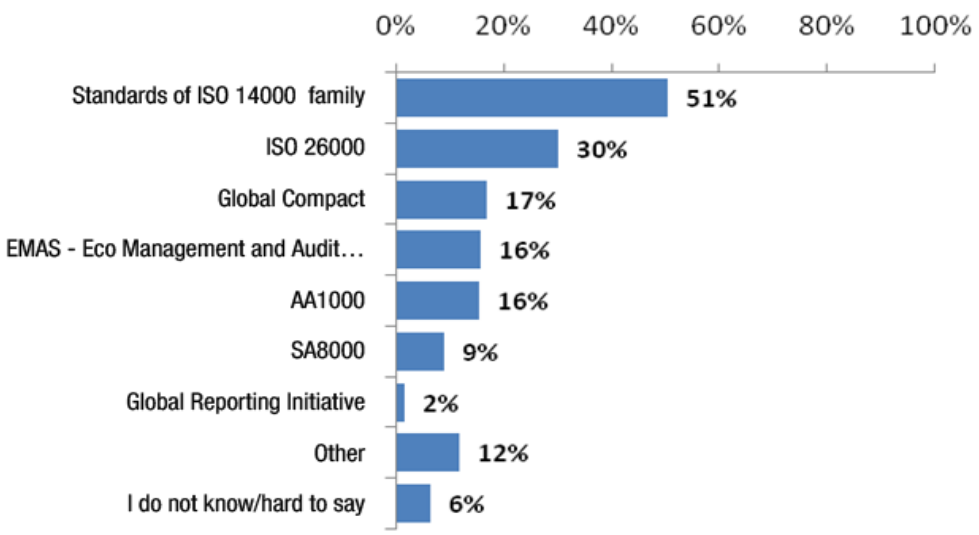

Figure 4. Knowledge of specific standards for implementing CSR.

Source: Assessment of implementing CSR standards alongside the study on SR indices set in micro, small, medium-sized and large enterprises, report on the survey; SMG/KRC MillwardBrown and PwC for PARP, Warsaw, 9 December 2001.

[28] B. Domanska-Szaruga, *Performance of activities related…, op.cit.*

37% of representatives of the companies that are acquainted with the notion of CSR and declare their company's involvement in socially responsible initiatives claim that these activities are executed in accordance with specific standards and guidelines. The respondents chiefly point to performance of activities on the basis of ISO standards (Figure 4).

When we come to the stakeholder orientation the majority, specifically 86% representatives of businesses from the whole-Poland group declare that there are subjects in the company`s closest environment that affect it and that the company affects. Among the OP IE[29] beneficiaries, this proportion equals 94%. 15% companies from the whole-Poland sample and 6% from the OP IE beneficiaries group declare that they have no stakeholders in their closest surroundings. Neither the company size, nor the type of industry, nor scope of activity nor the number of years in the market affect the ability to identify stakeholders in the company`s surroundings. Stakeholders are first of all the company`s clients – 70% mentions in the whole-Poland sample and 75% in the group of OP IE beneficiaries. Furthermore, employees are also considered stakeholders – 54% and 58% mentions respectively, apart from that also suppliers – 48% and 49% mentions. Furthermore, OP IE beneficiaries include public administration in the group of stakeholders much more often than other companies, with 45% mentions. Nearly all representatives of companies declare that their companies communicate with clients[30].

The groups that companies cooperate with most often when carrying out socially responsible activities are clients (31% mentions in the whole-Poland group, 48% – OP IE beneficiaries), suppliers (27% and 40%) and other companies from the industry (10% and 22%). The choice of the group for cooperating with is not very strongly linked to the size of the company, the industry in which it operates or how long it has functioned in the market. In the group of whole-Polish companies, large companies enter into cooperation with clients most often (44% mentions), and less often micro companies (30%). Service-providing companies cooperate with clients more willingly (38%) and construction companies do so less

[29] Operational Programme of Innovative Economy.

[30] Assessment of implementing CSR standards alongside the study on SR indices set in micro, small, medium-sized and large enterprises, report on the survey; SMG/KRC MillwardBrown and PwC for PARP, Warsaw, 9 December 2001, http://badania.parp.-gov.pl/files/74/75/77/13079.pdf, p. 15.

willingly (29%). Large enterprises cooperate with suppliers more willingly (35%), just like trade or production companies (34% and 33% respectively). Micro companies clearly cooperate with other companies from the industry least often – 7% mentions, also trade companies (11%) and companies operating less than 15 years (11%)[31].

5. Conclusions

The concept of sustainable enterprise development has been unsatisfactorily examined in the literature, and it is held as a new approach in management sciences in Poland. *Sustainable development* entails a substantial shift in perceiving and understanding business and its role in the society. Importantly, it places an emphasis on developing innovative strategies to effect effectiveness and efficiency in management while taking into consideration three aspects: economic, ecological and social. Even less explored concepts include responsible investment and management of issues concerned with environmental protection, society and corporate governance within an enterprise.

Another problem is that knowledge of CSR standards among entrepreneurs in Poland is marginal which then also translates into their implementation. The analysis of survey results presented shows that for companies to further their CSR initiatives and recognize the urgency for these activities it is central to enhance awareness among entrepreneurs in this respect, with a particular emphasis placed on CSR standards. Increasing the number of companies implementing responsibility principles in line with the same standards would allow for arranging and systemizing CSR not only at a conceptual level but also practical level[32].

The foregoing deliberations merely signal a problem of sustainable development in the process of management with recognition of the impact exerted by stakeholders at the same time. Sustainable development is a reasonably new under the circumstances of the Polish economy, but the hope should be cherished that not only large companies, but also companies from the sectors of small and medium-sized enterprises seeking for external financing will turn their focus on management in the area of non-financial factors behind value creation of the enterprise.

[31] *Ibidem*, pp. 15-16.
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YOUNG LABOR MARKET IN THE GLOBAL CRISIS

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Abstract. *New strategy regarding economic growth and employment in the EU, "Europe 2020 – A strategy for smart, sustainable and inclusive growth", adopted by the European Council in March 2010, offers an overview of the development of Europe in the decade two XXI century, aimed to drive out of the current financial and economic crisis, but also to transform the EU into a smart, sustainable and inclusive growth, with high levels of labour employment, productivity and social cohesion.*

This paper presents a brief characterization of young labour market at global, European Union and national level during the current financial and economic crisis.

Of the many problems facing young labour market, in this paper is analyzed the evolution of unemployment population aged 15-24 years.

In this paper are presented a series of the best practices from European Union countries to minimize the rate of youth unemployment, and their employment on the labour market. Also, are presented some of the advantages of using young labour in achieving the objectives of "Europe 2020" strategies.

Keywords: *youth, unemployment, crisis, high technology, best practices, sustainable development*

JEL Classification: E24, J21, J23, J24

1. Introduction

Economic crisis of the end of the first decade of XXI century produced a significant decrease of economic activities, accompanied by loss of millions of jobs.

In the European Union, young (15-30 years large group) is, according to Eurostat statistics, one-fifth of the total population. Although currently, modern Europe offers unprecedented opportunities for young people, however, young people face challenges (aggravated by the economic crisis) related to educational and training systems and labour market access.

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Youth unemployment is very high, ranging from 21.8% in 2010 and to 21.9% in 2011. In this context, target of labour employment, 75% for the population aged 20-64 years in “Europe 2020” Strategy, requires improvement measures / ways of transition of youth to the labour market.

With a population of 21431298 inhabitants on 1 July 2010, Romania faces about two decades of decline, population growth is negative (in 2010 there was a birth rate of 10.0 per thousand live births, equal to mortality rate per thousand inhabitants).

Age structure of population reflects a process of aging by declining of the share of young (0-14 years) from 18.3% in 2000 to 15.1% in 2010 and increasing proportion of older (65 years and over) of from 13.3% to 14.9% (2010).

Problems faced by young people in the labour market have a significant impact on their living standard, their families and the national and international communities whose members are.

This paper presents a brief characterization of young labour market at global, European Union and national level during the current financial and economic crisis.

Of the many problems facing young labour market, in this paper is analyzed the evolution of unemployment population aged 15-24 years.

In this paper are presented a series of the best practices from European Union countries to minimize the rate of youth unemployment, and their employment on the labour market. Also, are presented some of the advantages of using young labour in achieving the objectives of "Europe 2020” Strategy.

2. General characteristics of the labour market during the crisis

The crisis had a high social cost in Europe, with a strong increase in unemployment. Eurostat Statistics, estimated in November 2011, about 23,674 million unemployed in EU-27, an increase of 55,000 in the EU-27 and 45,000 in the euro area. Over the same month of 2010, unemployment increased by 723,000 in the EU-27 and over 587,000 in the euro area.

Employment rate of population aged 15-64 years decreased in 2010 in the EU-27 by 0.4 percentage points from 2009. Values higher employment rate of people aged 15-64 years at the EU-27 (64.1%) were recorded in twelve Member States: the Netherlands (74.7%), Denmark (73, 4%), Sweden (72.7%), Austria (71.7%) and Germany (71.1%), thus exceeding the target set for 2010 Lisbon Strategy (70%). Four countries

recorded an employment rate in the same category of employed population between 60-70% (Fig. 1), and the rest of the employment rate between 55-60%. The lowest employment rate was recorded in Hungary (55.4%).

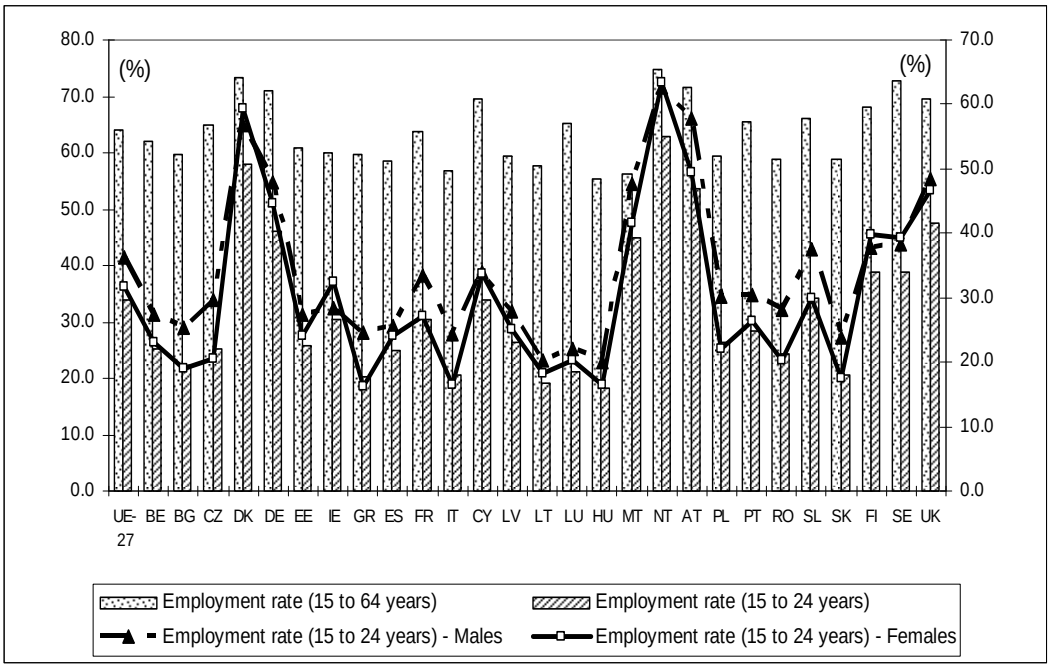

Figure 1. Employment rate, by age in 2010.

Data source: Eurostat Statistics (online data code: lfsi_emp_a).

Compared with 2008 and 2009 for most Member States, in 2010 was a deceleration in employment. In eighteen Member States reduce employment rates ranged between 0.2 and 2.9 percentage points (reduction registered by Bulgaria). In Luxembourg, Poland and Hungary in 2010 the employment rate remained the same value as in 2009 (Figure 3), and others have recorded slight increases in employment rates: Malta (+1.0 pp), Sweden (+0.5 pp), Belgium (+0.4 pp), Romania, Germany (+0.2 pp) and Austria (+0.1 pp).

In the context of the "Europe 2020" Strategy, the employment rate for age group, smaller, from 20 to 64 years, should reach 75%.

However, in 2010, following the financial crisis, this indicator decreased by 0.4 pp to 2009 and by 1.7 percentage points compared to 2008. For this age group, also, in 2010 the employment rate was higher among men (75.1 pp) compared to women (62.1 pp), although its decrease compared to 2008 was more pronounced (2.8 percentage points for men, versus 0.7 percentage points for women).

Youth unemployment is an issue that occurs more frequently in analyzes global, European or national level because, in parallel with serious worsening of the main indicators reflecting the situation of young people on global labour market, young people share in the total population is continues to decrease, thus determining the increased aging of the population.

International statistics indicate that the most serious problems of aging are found in developed countries and the European Union. But this, in contradiction with the fact that, these countries can provide the highest level of education and decent living for young people. Most young people are concentrated in poor areas with limited access to education, and an unsatisfactory level of living.

For employment young, global participation rates fell from 53.8% in 2000 to 50.9% in 2010, which means that currently, only every second young person is active on worldwide labour markets.

Among the causes that determine the number of inactive young in the labour market in the world, is not only the economic turmoil, but also more active recruitment of young people in the educational process. Thus, more and more students continue their studies up to 23 to 25 years, are not employed in the meantime, but, not being considered as unemployed. However, the increase of education level, not contributes to reduce the problems facing youth in the labour market, their employment rate continued to decline in 2009.

Population aged 15-24 years represented in the EU-27, from 1 January 2010, 12.1% of the total population. In Romania, young people represent 13.9% of country population. The higher percentage of the population aged 15-24 is found in Lithuania (15.3%), Latvia (14.5%) and Slovakia (14.5%).

The problems faced by young people in the labour market have a significant impact on their living standard, their families and the national and international communities whose members are. The most important effects of inactivity youth are at risk of poverty, inability to play an active role in society.

At the end of 2010, the number of young unemployed was estimated around 5.33 million people.

The highest values of unemployment in 2010 were registered in Spain (41.6%), Lithuania (35.1%), Latvia (34.5%), Estonia (32.9%) and Slovakia (33, 6%). Romania had a youth unemployment rate of 22.1%.

The analysis of Eurostat data indicates that in most Member States, the unemployment rate for young women in 2010 was higher than that of

men (Figure 2). Unemployment among young women was lower than men in Poland (3%), Italy (2.6%), France (1.5%) and Cyprus (1.2%) and Portugal (0.6%).

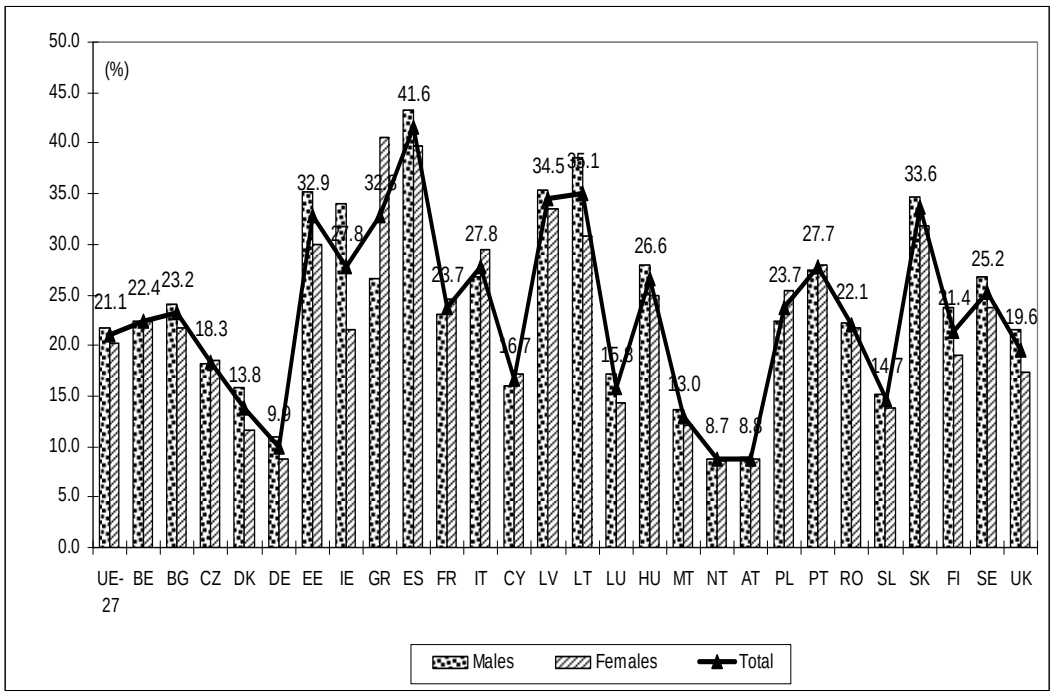

Figure 2. Youth unemployment rate in the EU-27 in 2010

Data source: Eurostat Statistics (online data code: [une_rt_a])

Youth unemployment rate is dependent on their level of training. So, the analysis of fourth quarter 2009 and 2010 data, show that in 2009 unemployment was higher among educated young pre-school, primary and secondary (levels 0-2). Exceptions were made only Greece, where youth unemployment rate to secondary education, post-secondary and foremen (levels 3 and 4) was 5.6 percentage points higher than the registered unemployment rate in young pre-school education, primary and secondary education (levels 0-2). In Romania and Cyprus the differences between youth unemployment rate with higher education and those with 0-2 or 3-4 level studies are significant.

Comparative analysis of youth unemployment rates with different levels of study reveals that both in the 2009 and in 2011 in the large majority of Member States unemployment rate was even lower as the level of training was higher. Only in Greece, Romania, Cyprus and Portugal, the unemployment rate of young graduates was higher than the others.

3. Youth unemployment in Romania

According to data from the National Institute of Statistics of Romania, the unemployment rate in Romania, for people aged 15 to 19 years and 20 to 24 years in 2010, reached the level at 27%, respectively 21.2%. The evolution of main macroeconomic indicators reflecting labour market situation of young people in Romania during the transition, not evidence the positive evolutions for people aged between 15 to 24 years. However, the few existing jobs in the country were fully exploited, which cannot be said of many European Union countries.

Data provided by the National Agency for Employment (NAE) indicates that the structure unemployment by age group at the end of 2011 was as follows: 81,911 unemployed were under 25 years, 35,494 unemployed aged between 25 and 29 years, 108,536 unemployed were between 30 and 39 years, 119,909 unemployed were between 40 and 49 years, 58,564 unemployed were between 50 and 55 years, 56,599 unemployed people aged over 55 years.

Statistics analysis of the evolution of unemployment, indicate that the structure of registered unemployed by age and kept development in the period 2008-2011, with regular amplitudes, the crisis did not affect this structure.

Most unemployed (276,900 people) came from rural areas. At territorial level, the number of unemployed decreased in 8 counties recorded decreases in Dolj (with 1011 people), Iasi (375 people), Maramures (with 348 persons), Neamt (201 people). In Bucharest the number of unemployed decreased by 32 persons.

Increases of the unemployed were registered in the counties: Galati (822 people), Alba (773 people), Suceava (666 people), Covasna (491 people), Valcea (466 people), Bistrita-Nasaud (360 people) and Cluj (326 persons).

The counties with the largest share of the unemployed not total unemployed were in 2011: Virginia (77.20%), Buzau (74.72%), Dolj (74.13%), Galati (73.24), Braila (72.69%) and Covasna (72.24%).

One of the causes, that contributing to the increase of youth unemployment in Romania is inconsistency between education and labour market requirements. In other words, the educational system in Romania, first, does not prepare professionals to work in specialties required by market, and second, has an overabundance of students in specialties for which does not require labour market.

The Romanian state has allocated over 61 million in 2010 to reduce unemployment in the country. Businesses to hire unemployed individuals can receive financial support amounting to 50% of new employee wages for a period up to 12 months.

4. Elements of good practice in youth labour market in the European Union

Current economic recession has imposed and requires governments to intervene strong on labour market, especially in youth employment.

In short term, the main objective is to ensure that newcomers, as those who have already experienced difficulties in finding a job to maintain contact with the labour market.

In many Member States have adopted some measures to reduce youth unemployment rate and to employment the young people on the labour market.

Most of good practices in EU countries (involving direct or indirect financial costs of the state) have an important role in minimizing youth unemployment rate, in the appropriate planning conditions, and more detailed and can change their situation.

Among good practice in the youth labour market in the European Union, can be mentioned:

- in Ireland, in 2011was launched a program that envisaged the creation of 2000 new jobs for young graduates of universities of this country, and all expenses related to salary to be paid integral by the State, the duration of the grant is still undetermined;
- Polish companies who employ young people benefit from state subsidies, depending on conditions in the program (e.g. number of young people, duration of employment etc.).
- at EU level of, in early 2010, it was decided to support the business sector and falling unemployment, similar to the Polish experience: every company who employ a person registered as unemployed for more than six months, may request payment in one instalment: 2500 Euros (one pay-off). In parallel employers are exempted from paying social security contributions for 24 months, or can choose the exemption from social security contributions for 36 months;

- in Poland was initiated to create a vocational training school in specialties required by the labour market and work directly with businesses. The courses are on a relatively short period (several months), and aim to optimize the economic agents requirements. After graduation graduates the young people are directly engaged in the partner companies of this schools;
- in Poland, courses were organized for a period of 12 months strictly specialized in certain fields, and have been organized for people who require advanced knowledge, practical skills and have already studies in this field;
- pronounced subsidies of the Polish academic specialties who enjoy by a high demand for specialists in the labour market, respectively, moderate subsidize or zero for the specialties with the highest number of unemployed;
- the end of 2010 the European Commission finalized microcredit program for young people. The program budget amounts to 100 million Euros and is addressed to young unemployed people who have difficulty in the contracting a loan from commercial banks;
- in Estonia is organized unemployed youth clubs, in order to intensify the process of finding a job through collective effort and exchange of experience in the search process;
- increasing the number of employees working part-time regime in Germany, so a job is divided between two employees working with reduced time and therefore, they have the possibility to continue searching for a job and still get a salary;
- organize by the Greek government organizations of professional orientation courses to reduce youth unemployment;
- in 2010, in Netherlands, have invested over 16 million for increase basic school enrolment rate for youth and lengthening the duration of studies;
- diminution of social security contributions for employees aged up to 26 years in Sweden;
- employers of young people aged up to 29 years and of women are partially exempt by the social contributions for a period of five years in Turkey;

The current economic crisis can be the opportunity to solve some problems faced by many young people during the transition from school to employment, who are at the beginning of their professional journey. Especially, governments should prevent young people to abandon school early, without qualifications and to remedy some of the labour market

asymmetries that exist in many European countries and who disadvantage the young. In many of European countries, among the most frequent obstacles to integration in employment of young people are: high cost of labour, large imbalances in the legal provisions regarding the permanent and temporary employment contracts, measures for protection of young people from disadvantaged backgrounds, discriminatory practices.

4. Conclusions

The analysis of indicators that reveals the situation of young people in the labour market in the EU, leads to several conclusions, of which:

- Average duration of a job search in 2008-2010 increased significantly, contributing further to discourage young people in seeking a job;
- The discrepancies between employment opportunities of an educated young, and one with no education are also increasing. The duration to search a job for a young professional is lower than a youth with no education, and the rate unemployment knows a considerable difference;
- EU is the region where unemployment is dependent on the education level of young and the employment opportunities decrease proportionally with the decrease years of study;
- During 2010 there was register a greater number of young people who want to continue their studies after a period of rest, being discouraged by seeking unnecessary job, but encouraged to obtain a diploma that, later increase the chances to obtain a job.
- Achievement the overall objectives of "Europe 2020" Strategy, depends on how young people are involved in the actions that are taken for this purpose. Today's youth are expectancy and the potential for future. Young people should be more mobile, more multicultural and technologically skilled, than before.

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THE ANTHROPIC ECOSYSTEM OF LEADING

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Abstract. *In order to analyze the perspectives of management today, we need to answer the questions: what are the challenges in our society (as they admit)? How to manifest the consequences of their economic, social and psychological?*

Current economic and social complexity requires the leading of an integrated approach, holistic. Psycho-socio-economic perspective of contemporary leading is updated by the need to take into account the cultural and anthropological trends, ecological and ethical. It takes a psycho-socio-economic approach to generate complex social changes with positive impact; changes which can be achieved by increasing the entrepreneurial initiatives.

Integrating ecological perspective on the psycho-socio-economic and cultural perspective, ecosystem of leading appears formed of the entire individual variables (psychological), social, economic and cultural, and of all their interactions in an environment which is in a continuous and accelerated changing.

The universe of the leading ecosystem requires to the leaders to supervise the processes of management, leadership and entrepreneurship in a sustainable and an ethical perspective. The roles of manager, leader and entrepreneur acquire new meanings corresponding to the processes of ecomanagement, ecoleadership and ecoentrepreneurship.

These three ecosystems manifests in closely related dependence, interacts and integrates in a complex ecosystem, which seeks to respond to both current needs and future development of the individual, business and society: ecosystem of leading.

Keywords*: Sustainability, management, leader, entrepreneur, eco-manager, entrepreneurial, thinking.*

JEL Classification: *Q56, M56; M54, L26*

1. Introduction

Current economic and social complexity requires the leadership an integrated, holistic approach. The psycho-socio-economic perspective of contemporary leadership is updated by the need to take into account

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the cultural and anthropological trends, ecological and ethical. It takes a psycho-socio-economic approach to generate complex social changes with positive impact changes that can be achieved by increasing entrepreneurial initiatives.

Today it takes more and more entrepreneurial, to complete and to bring added value for roles of manager and leader. The manager maximizes results. The leader is centred on man and team and is focused on motivation and satisfaction to the people, their development, and emotional alignment. Entrepreneurs seek innovation, they takes risks and is heavily oriented towards change.

For this reason, we believe that today is very important to resume and update the great role of the entrepreneur in progress both economically and socially.

Currently, management has to find solutions to new challenges arising from natural resource depletion, global warming, population growth and aging and associated social changes. Also, the current leadership will have to find solutions to create significant competitive advantages. Thus, one of the main concerns of future leadership is developing the man-business-community ecosystem, which involves business development in a sustainable and ethical perspective, predictable on long-term.

Generating social changes with a positive impact in the community and society through massive innovation and creating added value and the harmonious development, integrated employee-team-organization is the fundamental aims of the new leadership.

Thus, the classical dimensions of leading: management, leadership and entrepreneurship are now completed by an environmental and an ethical perspective, causing significant changes and updates in leadership thinking and behaviour.

The new leadership, as a complex process, conducted in an environment oriented towards sustainable development must take into account the present needs in view of obtaining eco-results allowing future generations to ensure their own needs. The question is to what extent the three forms of leading – scientific management, leadership and entrepreneurship – are the response for the challenge? We dare to give a hypothetical answer, which integrates environmental and ethical perspective in thinking and behaviour leadership – ecosystem of leadership which consists in eco-subsystems: eco-management, eco-leadership and eco-entrepreneurship. These three subsystems define new roles, hypostases of leadership: eco-manager, eco-leader and eco-entrepreneur.

2. Ecology and ethics in the new philosophy of leading[1]

In order to analyze the perspectives leadership today, you need to answer the questions: what are the challenges in our society (how we recognize it)? How are manifesting and which are the consequences on the economic, social and psychological plan?

Trying to prioritize the current concerns, we believe that the main challenges in the economic and environmental impact in the field refers to at least two aspects: **1.** The perspective of natural resource depletion, damage to cultural resources, population growth and scarcity and food price increases; **2.** Protection of natural environment affected by pollution, global warming due to the process of accelerating industrialization and economic growth based on polluting energy resources.

At *the social level*, the main challenges relate to the needs of a growing global population (especially in poorly developed economically and socially zone). Also, see today's restrictive effects in the functioning of the welfare state. These new problems involve finding sustainable solutions for: raising the retirement age and hence the length of productive life of man; reducing state support and creating alternative sources of income by participating in private pension insurance schemes , life, health, etc.. Perhaps in the near future we will see gradually to replace the welfare state to a state that provides for the optimal use of human potential for life (and allowing intergenerational exchanges), integration of environmental and ethical thinking at all levels of society.

At *the individual level* we can note the following two major trends. Earlier this century we see an exacerbation of the self-centred man on its interests and on present, in an environment increasingly polluted both physical (biological) and psychological and social (characterized by lack of integrity, fairness, lack of principles and values). We see boost intra-personal conflicts, stress intensification factors due to economic and social pressures.

In these circumstances, the problem of responsibility to future, to the future generations is acute and requires a change in the pattern of thought and behaviour which brought us into this situation.

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[1] Our option is to use the notion leading rather than management, since we want to differentiate its main roles of manager, leader and entrepreneur. Manager uses the principles and methods of management and economic that theory offers; leader uses psycho-sociological and anthropological skills and techniques arising from science leadership and management theories by the growth, and entrepreneur use skills to differentiate from classical manager by: innovation and creativity, risk taking etc..

Birnbacher D. (1988) considers that "responsibility for future generations ... is, to the increased dimensions of human development possibilities in the future life of mankind and beings endowed with consciousness, an unavoidable duty. It's not necessary a new ethic to its foundation, but an update of general moral principles that are already recognized in most of today"[2].

Starting from Birnbacher's statements, we can say that the government's role over time was and is, by expressing our metaphorically, to fight evil and win. In this way, current debt leadership is to identify and manage actual evil. Current leadership must find solutions for the environment which is in a constantly changing, to meet the socio-economic and environmental challenges (climate) worldwide.

Gunter Pauli gives us many examples of how ecosystems can teach us to work better to fight the current social evil: poverty, lack of jobs and income etc... According to the author, "evolution involves a consistent trend towards greater efficiency and greater diversity. This could apply economy, shaped by entrepreneurs at all levels in business, science, culture and education"[3].

Pauli's solution for a *blue economy* is entrepreneurship development at all levels (economic, cultural, social, environmental etc...), Generating massive innovation and introduction of products on the market.

Change our attitude towards the environment and to the future, building on its sustainable development is fundamental priority of current leadership.

Adopting Pauli's solution, we can imagine the future by developing ecosystem: man-business-community. And leading through the three phases – manager, leader and entrepreneur – is challenged to rethink the principles, to update their behaviour, to effectively manage the ecosystem.

3. Integration of environmental trends in leadership behaviour and ethical

The current environmental trends shaping the leadership of organizations (the roles of manager, leader and entrepreneur) start from the classical role of manager, namely insufficient resources to manage and control waste and losses. So, with this approach we notice three levels:

[2] Maria Furst and Jurgen Trinks, *Philosophy Manual,* Humanitas Publishing, Bucharest, 1997, p. 266

[3] Gunter Pauli, *Blue Economy,* Paideia Publishing, Bucharest, 2010, p. 78

insufficient resources, waste and loss. Without proposes a utopian ideal, we believe that we need a new innovation in leadership thinking, based on renewable resources, human development along the (employee), business and community.

Analyzing theories of leadership (management, leadership and entrepreneurship) of the last century, we can point out some signals, especially after 80 years, indicating modern leadership paradigm shift (maximum efficiency, short-term thinking, rather imitated perspective on people and the world).

The evolution of management, identify at least four critical milestones that marked the last decades of the 20th century and early 21st century:

1. Development of culture focused on performance and behaviour performance, including results and with other dimensions such as innovation, organizational citizenship behaviour (mutual aid), loyalty etc..;
2. Integration of objectives and personal values in the organizational and development together people and organizations;
3. Integration of emotional part tendency, intuitive in scientific, rigorous management;
4. Strongly felt the need to innovate deep structural managerial thinking.

The last two trends indicate a paradigm shift of modern management. Although often criticized, intuitive management perspective can highlight emotional, intuitive, and so necessary in building long-term future, in the form of vision and strategic objectives across organizational boundaries.

If we consider the theory of leadership, we can say the development of charismatic approach to focus on principles and not least, transformational theory that considers unique human being and its development in a holistic emotional and intellectual and cultural.

Entrepreneurial thinking (based on risk-taking, initiative and innovation) can be compressed into three episodes: **1.** strong focus on inventions and innovations (new products, new markets), but also organizational change for purposes of strategic differentiation and gain a competitive advantage, **2.** the tendency to associate in the entrepreneurial behaviour, in classic role of manager in a company – intra-preneurial and **3.** integration trend of social change in the structure of the core of entrepreneurial thinking, coupling economic objectives (profit) with the social (involvement in community development) and ecological (environmental care).

In Table 1 we present an overview of development theories on horizontal management: leadership, business manager and vertically, the gradual integration of environmental and ethical perspective in thinking and behaviour of the new leader who assumes future construction.

Table 1.

The evolution of leadership: Specific synthesis of thought development manager, leader and entrepreneur

Time	Economic/Psychological **Management** (Getting results)	Psychological/Social **Leadership** (Leading people)	Social/Economic **Entrepreneurship** (Innovation and Development)
Early 20th century	– Getting results based on labour division and differentiation of roles (Herry Fayol, 1916) Participatory management (Douglas McGregor, 1960) – Replacing the concept of productivity with the performance (efficiency and effectiveness, Peter Drucker)	– Classical leadership (charismatic leader of the old theory) is based on psychological characterristics, personal leader – Max Weber, 1892 (The big men theory, a social, elitist philosophy – Machiavelli) – Tendency to believe "charisma" as an innate leadership ability	– Classic entrepreneurship (Joseph Schumpeter) – based mainly on innovation – the quantity, quality and speed innovation – The evolution of entrepreneurial thinking: changing the emphasis from natural resources, technology and, later, on people
1980	– Extending the concept of performance: performance management – Development of participatory management (management by objective, independent teams – 1970) – Multiplicative management (Andy Grove, 1984) and turbo-management (Denis and Moulin, 1992)	– Leadership type A, J and Z (Ouchi, Jager 1980) which are based on general characteristics of cultural context (leadership in the U.S., Japanese etc.) – Leadership based on principles (Stephen Covey, between 1980-1990) – considering people as spiritual being	– Entrepreneurship development based on knowledge, continuous improvement of things – Strong competitive spirit development of entrepreneurs – Strong focusing solely on profit (and present)
2000	– The new participatory management, French version, (Goguelin Pierre, 1994) based on the integration of authors roles (managers) and actors (performers) – Integration of individual goals to organizational goals – The development of people and organizations together – Management of values – integration of personal values with organizational (Blanchard, O'Connor, 1997) – Intuitive management – Meryem Le Saget, 1992	– Charismatic leadership (charisma is no longer seen as an attribute, but as a social relation, the award – Jay Conger and Rabindra Kanungo 1988) – The charismatic leadership – Johns, 1998 – Transactional leadership (Hollander, 1978) – Transformational leadership – Bass, 1985, the new leader: Bennis and Nanus, 2000)	– The emergence of social entrepreneurship in the '90s and its development especially after the 2000s – The association of classic entrepreneurship (based on financial gain) with social entrepreneurship – The association of change profit with positive impact

Table 1 continued

2020 ⇩	– Changing the paradigm of modern management: designing individual performance results and long-term and very long (at least 25-50 years); – A new paradigm: maximum results with results ecological change, sustainnable – Emphasis on responsebility for future generations; – Development of ecosystem management: human-process-results.	– Development and expansion of transformational leadership; – Focus on individual consideration as a single entity and development of integrated psychological, emotional, intellectual and cultural life; – Development ecosystem: man-team-organization.	– Developing a sustainable culture of social entrepreneurship, cultural, scientific; – Development of entrepreneurial attitudes and social at all organizational levels; – Express profit in terms of valuesocial and human; – Development ecosystem: human-business-community.
Future Tendencies	Eco-Management	Eco-Leadership	Eco-Entrepreneurship

In this development of one hundred years of leadership thought we tend to emphasize the *ecological and ethical* tendencies ever-present lately: the transition from man exploitation to obtain maximum efficiency, to integration, putting together the goals and personal values with those of company, to jointly develop the ecosystem: man-business-community.

For behavioural ecologists, "the best solution is one that provides the body the best chance of survival and reproduction". By analogy, we can say that for contemporary management organizations best solution is to integrate ecological and ethical principles in building our sustainable future.

In this new perspective, as we advance the hypothesis several directions that could shape the new model of leadership. The approach we expect a tightening labour influence division of labour and increase in complexity of individual roles. Tend to be general and specialist (complementary roles), due to increased complexity and flexibility of labour and strong need to bring significant added value to human activity. Another direction of change in managerial thinking can be a paradigm shift maximum results with ecological results, sustainable and predictable, the transition from a strong management focus on the present to future development.

The new role of leader (complementary to the manager) is marked by ecological and ethical trends, taking into account the whole man: stomach, heart, mind and spirit. Expansion of transformational leadership in the

beginning of this century, with emphasis on human consideration as a single entity and integrated development of psychologically emotionally, intellectually and culturally into this direction. We expect to see design in the next long-term development of human potential in an organizational framework for the development, with emphasis on cultural integration (sharing agreement and implementation of individual values, with the organizational and community).

And, referring to entrepreneurship, we can prefigure the coming years some ecological and ethical trends. Development of social entrepreneurship and mainstreaming environmental and ethical entrepreneurial thinking, generating innovations in this regard can cause massive social changes with positive impact, so long awaited. Ecosystem development: man-business-community is not a utopian ideal.

In the current economic and social issues, we can set new coordinates of ecological and ethical leadership in managing resources. Thus, efficiency and effectiveness of new leadership should be measured at the following levels:

– Economic (results, productivity);

– Sociology (social and cultural impact);

– Psychological (individual impact).

In each of these levels of impact we can integrate environmental and ethical criteria:

– Ecological (environmental impact of natural, long-term projects);

– Ethical and equitable to benefit a large number of people, reduce inequalities etc...).

4. Ecosystem leadership: eco-management, eco-leadership and eco-entrepreneurship

To reflect ecological and ethical trends in the new model of leadership, we propose the clarification of environmental results (results cross) and Clean Development (Sustainable Development).

Thru environmental results (*eco results*) we can think long-term health outcomes and which can generate positive impact changes in psychological and socio-cultural environment of the individual. Economic results, in terms of socio-economic and psychological perspective, concern

the results of long-term health, the consumption of natural resources and psychological resources of employees in a predictable future of their regeneration.

The concept of *ecological development* (sustainable development, durable) is introduced at the 1972 Stockholm Conference in discussion about the models of economic development and social and economic consequences of their short and long term. Since the 1980s, the term organic development was replaced by the Durable Development (*Sustainable Development*), which was defined by the World Commission on Environment and Development (WCED) published in Brundland report (*Our Common Future*).

In 1987, United Nations defines sustainable development "as development that meets present needs without compromising the ability of future generations to meet their own needs"[4].

The concept of sustainable development is characterized by Pearce *et alli* (1992) by the following three fundamental premises: Environmental valuable time broadening and equity[5].

Making an analogy with the Enterprise, I could easily find corresponding to these three premises on which the new leadership is called upon to manage:

1. *Valuable organizational* environment or *eco organization* characterized by solidarity, trust, organizational citizenship behaviour, commitment, motivation and satisfaction, hygiene interrelational);
2. *Increasing the time horizon* (long-term planning strategies and short term and reporting management decisions and their impact on long and short term);
3. *Equity* (organizational culture: reducing inequalities and stress factors).

In 2005, the United Nations established the three pillars of sustainable development: economic development, social development and environmental protection[6].

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[4] United Nations, Our Common Future, Oxford University Press, Oxford 1987 *apud* Alexandru T. Bogdan and Dana Comşa, *Eco-Bio-Diplomacy*, Romanian Scientists Academy Publishing, Bucharest, 2011, p. 20.

[5] Pearce, D., Markandya A. & Barbier E. *Blueprint for a Green Economy,* London, The Earthscan Publications, 6th printing 1992 (format 1994).

[6] World Summit Outcome Document, World Health Organization, www.who.int

In 2001, *UNESCO* established the fourth component of sustainable development as cultural diversity, which "is necessary as humanity, as is needed for such biodiversity"[7].

The theory of H. Vancock[8], sustainability is a process that involves developing all aspects of human life, while making economic prosperity, environmental quality and social equity.

In the minds of Nicholas Georgescu-Roegen, "joy of living is the true purpose of economic activity". According to Georgescu-Roegen author, "the main objective of economic activity is self-preservation of the human species"[9].

In 2001, Lester Brown launched the Eco-Economic theory, which highlights the importance of ecology and environmental protection to sustainable development of mankind[10]. According to Lester Brown, "a sustainable society is one that shapes their economic and social system so that natural resources and life support systems are maintained"[11].

Starting with theories of Georgescu-Roegen Vancock and emphasize the idea that sustainable development is reflected in individual prosperity, the joy of living experienced individually. Thus, individual personal development (intrapersonal and interpersonal) is an important dimension that needs to be included in the model of sustainable development – see Figure 1.

Along with the social durability, economic, environmental, cultural diversity and sustainability manifests individual personal development. In fact, durability is an expression of individual social and economic sustainability, cultural and ecological. Self-esteem, dignity, freedom, responsibility of future etc. represents the manifest characteristics of personal development which are in the same time values which guide social and economic sustainable development.

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[7] Alexandru T. Bogdan and Dana Comşa, *quoted work,* p. 20.

[8] A. M. Hasna, *Dimensions of sustainability*, Journal of Engineering for Sustainnable Development: Energy, Environment and Health 2(1), 2007, pp. 47-57 *apud* Alexandru T. Bogdan and Dana Comşa, *Eco-Bio-Diplomacy*, Romanian Scientists Academy Publishing, Bucharest, 2011, p. 21.

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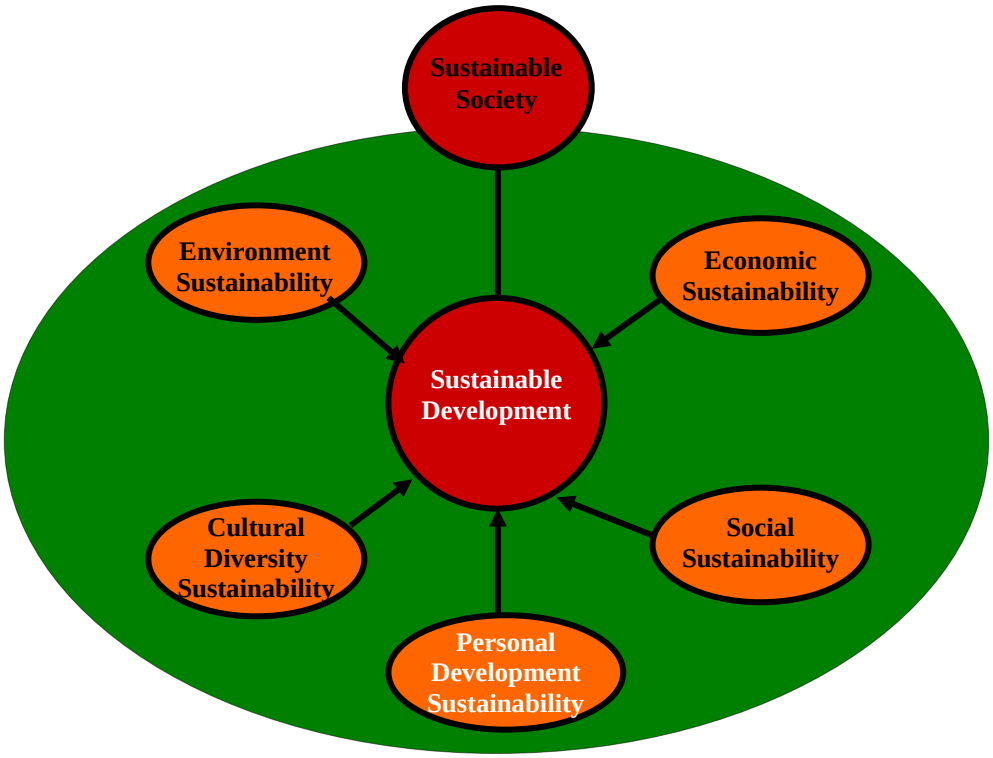

Figure 1. Sustainable Development Scheme.

Source: adapted from model developed by Alexandru Bogdan and Dana Comsa.

A summary of indicators of sustainable development made by the UN [12] and Eurostat[13] shows the following (see Table 2):

Table 2

Sustainable Development Indicators:

SUSTAINABLE DEVELOPMENT INDICATORS	
CATEGORIE	Subjects adapted to the organizational environment
I. PSIHO-SOCIAL	– Equity – health and life style – education (continuous education) – working conditions – Safety and security – Employee description – employee quality – Self fulfilment (capitalisation on human potential) – Long term perspectives

[12] http://antreprenoriat.upm.ro/assets/cursuri/2/anexe/2.1-anexa-1.pdf
[13] http://strategia.ncsd.ro/docs/indicatori_eurostat.pdf

II. ENVIRONMENT (physic and cultural)	– Working conditions (physic conditions) – Quality of organisational culture – Cultural diversity
III. ECONOMIC	– Economic structure • Economic performance • Financial status – Consumption pattern
IV. INSTITUTIONAL/ ORGANIZATIONAL	– The institutional framework, organizational – organizational / strategic consistency.

Source: adapted from model developed by the ONU and EUROSTAT.

The new leadership will need to update, develop and integrate the new skills they thought and behaviour, all relevant indicators of sustainable development.

Integrating ecological perspective on the psycho-socio-economic and cultural development, ecosystem leadership is formed of the entire individual variables (psychological), social, economic and cultural, and of all their interactions in an environment out in a continuous and accelerated changing.

The Universe of ecosystem leadership requires management driver management processes, leadership and entrepreneurship in sustainable and ethical perspective. The roles of manager, leader and entrepreneur acquire new meanings as the corresponding processes eco-management, eco-leadership and eco-entrepreneurship – see Figure 2.

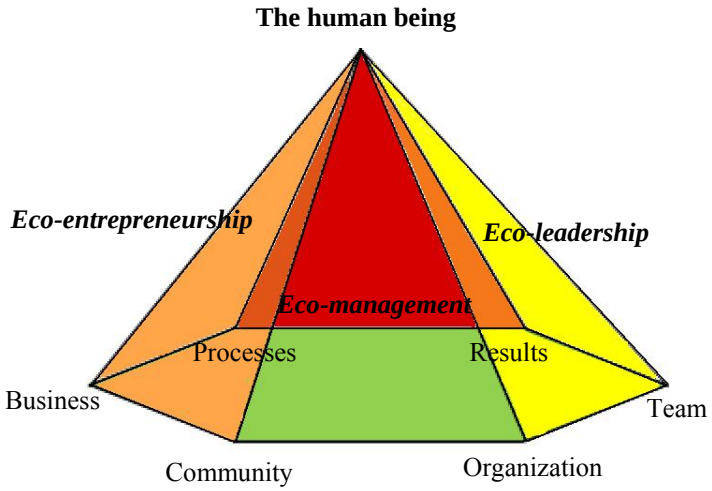

Figure 2. The antropic ecosystem of leading.

Eco-management refers to the science and process to achieve environmental results, predictable long-term, paying attention to resource depletion and their regeneration. Eco-management corresponds to ecosystem man-process-results.

Eco-leadership, because it is a process essentially psychosocial refers to the creation of consensus by transforming together, integrated people, teams and organizations. Eco-leadership corresponds to ecosystem man-team-organization.

Eco-entrepreneurship expresses the creation of surplus value, which generates positive social change, green, long-term predictable. Eco-entrepreneurship corresponds to ecosystem man-business-community (society).

These three closely related ecosystems occurs, interact and integrate in a complex ecosystem, which seeks to address both current needs and future development of the individual, business and society: ecosystem management.

Eco-management. An important aspect in the development of management theory after 80 years is changing the paradigm of modern management. Thus, the premise of modern management – the pursuit of maximum results – though theories are central to management after 80 years, could experience significant changes. In this sense, natural resource depletion, increasing life expectancy of the population and harmonize the interests and organizational and personal objectives are new problems that modern management is required to solve. We are now witnessing of rethinking assumptions and issues that takes into account modern management.

Maximum results are gradually replaced by environmental results (sustainable) which can be obtained without affecting long-term significant reduction of natural and human resources. In this regard, we advance the eco-management concept, which shows the change management perspective on delivering maximum results with results ecological perspective, which can be predicted indefinitely.

Accordingly with eco-management, eco-manager expressed thinking and behavioural skills aimed at achieving environmental results, predictable long-term care for the natural and human resources.

Increasing the retirement age opens up rethinking how individual consumption and conservation of physical and psychological. Development together individual and organizational objectives place the foundations of true sustainable development in future management. Head of

contemporary organizations (in the role of manager, leader and entrepreneur) is required to manage these changes.

G. Hamel's vision, innovation in management, indicates the urgent need to develop an entrepreneurial role and extending the traditional role of manager. Only the entrepreneur is one who can make massive innovations restructure the design thinking to business and organization in future long-term and very long.

Eco-leadership. Growing need for companies to increase their adaptability and competitiveness to cope with frequent changes and rising demands calls for new paradigm of transformational leadership. This new paradigm emphasizes leadership development organizations and people together, creating a valuable enabling individual psychological and intellectual development. The enhancement of human potential, the organization can fulfil its employees has access to a performance that exceeds normal expectations and standards.

Trying to achieve a synthesis of theories about leadership, we can advance some trends in the development of thought leadership: **1.** classical approaches centring on the leader's personality leadership to achieve effective coordination of people; **2.** development in the last 20-30 years of leadership as a method of cultural and intercultural intervention to change national or regional culture, not only at the organizational level and; **3.** the gradual transition on the leader's personality on the relationship between leadership and employees and employees' needs and feelings. In this respect, talk about transformational leadership, which focuses on the employee's personality, the psychological and intellectual development of subordinates.

At the end of the twentieth century several management theories have sought complementarities in the leadership (new participatory management of Pierre Goguelin and intuitive management developed by Mery Le Saget). We can also notice the increasing tendency of leadership theories to include the management (by delivering pragmatic). Thus, transformational leadership seeks by this new approach to the leader and people, to obtain results that could not be obtained by classical methods. Stimulating creativity and innovation of employees is one of the techniques most frequently dialled by the transformational leader. In other words, the pragmatic purpose of transformational leadership is to achieve exceptional performance can be sustained long term.

In this regard, advance eco-leadership concept, which aims to make long-term with people and organizations that is focused on developing ecosystem: man-team-organization.

Eco-leadership takes some of the classic elements of leadership, emphasizing new approach to transformational leadership and the climate and ethical leadership process. Features of eco-leadership's concerns: the focus on principles and values, individual consideration and intellectual stimulation of subordinates, hiring long-term care for the environment and socio-emotional climate, coupled with a collective individual responsebility, taking into account productivity treatment team and the team activities, holistic concern for people, community, society, nature etc.

Eco-leader means thinking and behaviour eco-leadership appropriate.

Eco-entrepreneurship. G. Hamel asked us to build a sustainable business future through innovation. The proposed method it is innovation in management, overcoming beliefs and principles that dominate modern management. But these innovations are possible is needed more than entrepreneurship.

In 2011, Gifford Pinchot introduced the concept of "ecopreneuring": "ecopreneuring" is the way to use people's desire to serve the planet and its people to inspire innovation profitable". Environmental and ethical perspective enriches this new orientation of entrepreneurship – ecopreneuring. Eco-entrepreneur means an expression of a pattern of thought dominated by concepts of ecology and business ethics, positive social change.

Analyzing the evolution of theories on entrepreneurship, we can highlight the following four trends: 1. the constant and persistent innovation in the entrepreneurial dimension (referring to the amount of innovation, innovation and quality innovation speed) and the profit from the exploitation of innovation; 2. inclusion by some authors (after 80) the range size of roles entrepreneurial manager (by delivering results and profit) and leader (by generating change, mission, vision and model behaviour that inspires); 3. Joining profit objective related to social changes generate positive impact, with the development of social entrepreneurship (after 2000) and 4. emergence of the concept of eco-entrepreneurship in 2011 highlight the particularly profitable innovations within ethical or environmental dimension and direct association with them.

Eco-entrepreneurship corresponds to ecosystem man-business-community (society) and is expressed as positive social change, ecological, predictable long-term.

The features of Eco-entrepreneurship refers to: developing a framework and a culture of innovation, initiative and risk taking at all organizational levels, taking into account the production of surplus value as natural resources and human resources development and conservation their gain alignment with social and cultural development etc. Eco-entrepreneur expressed eco-entrepreneurship thinking and behaviour accordingly.

5. Conclusions

The purpose of this theoretical approach was based on theories about management development, leadership and entrepreneurship, to highlight the need for complementarily and the versatility in document management, integration of the three roles, instances of the driver: manager, leader and entrepreneur. Also, current economic and social complexity, responsibility for maintenance of natural resources to human resources development, responsibility for the future, the environment etc. updates the current management approach with ecological and ethical perspectives. The current management requires management driver management processes, leadership and entrepreneurship in sustainable and ethical perspective. Thus, we can talk about current ecosystem management, formed by eco-subsystems: eco-management, eco-leadership and eco-entrepreneur.

Eco-management refers to the science and process to achieve environmental results, predictable long-term, paying attention to resource depletion and their regeneration. Eco-management corresponds to eco-system man-process-results.

Eco-leadership is a process essentially psychosocial refers to the creation of consensus by transforming together, integrated people, teams and organizations. Eco-leadership corresponds to ecosystem man-team-organization.

Eco-entrepreneurship expresses the creation of surplus value, which generates positive social change, green, long-term predictable. Eco-entrepreneurship corresponds to ecosystem man-business-community (society).

These three closely related eco-subsystems occur, interact and integrate in a complex ecosystem, which seeks to address both current needs and future development of the individual, business and society: ecosystem management.

Each subsystem corresponds to a profile of leadership thinking and behavioural skills relative distinctive.

Thinking and behavioural skills expresses Eco-manager and is targeting human-ecosystem functioning process-results (achieving environmental results predictable and very long term).

Eco-leader aims to make long-term with people, teams and organizations and is focused on developing ecosystem: man-team-organization.

Eco-entrepreneur is an expression of a model of entrepreneurial thinking and ethics influenced by ecological concepts, positive social change. Join profit sustainable development of ecosystem-man-business community.

Acknowledgments:

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BIOFUELS CHALLENGE – THE INTEGRATION OF NEW INDUSTRY IN THE FUELS MARKET

Marius CĂPĂȚÎNĂ*

Abstract. *This paper is part of the proposed research topics related to the development of biofuels as an alternative energy resource. The challenge now is to deploy, integrate, and demonstrate the reliability, economics, and environmental benefits of the biofuels at a scale that can lead to a rapid commercialization.*

Keywords: *Biofuels, Fossil fuels, biotechnology, industry, integration of biofuels industry.*

1. Introduction

Biofuels are emerging in a world increasingly concerned by the converging global problems of rising energy demands, accelerating climate change, high priced fossil fuels, soil degradation, water scarcity, and loss of biodiversity.

The rate and scale of biodiversity degradation is significantly weakening the resilience of the natural world and its ability to deliver key services such as climate control, air and water purification and protection from natural disasters.

Since most current modern biofuels are made from food crops, concerns about arable land use competition, risks to food security, vulnerable communities, water resource constraints, and deforestation arise. Meanwhile new crop feedstock are being developed and advanced biofuel production methods using forest, crop, and urban residues, as well as from non-food crops, are also progressing, but have yet to be commercialized and deployed in the marketplace on a large scale comparable with the size of the energy market.

Many countries have a competitive advantage in producing biofuels. Meanwhile, many other countries are unable to meet their biofuel needs from domestic sources (Fig. 1). Therefore, increased biofuel trade holds

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promise. Also, when bioenergy displaces fossil fuels, in transport and power generation, or is produced in conjunction with soil carbon storage in the form of bio-char for example, opportunities arise for trade in carbon emission reduction units.

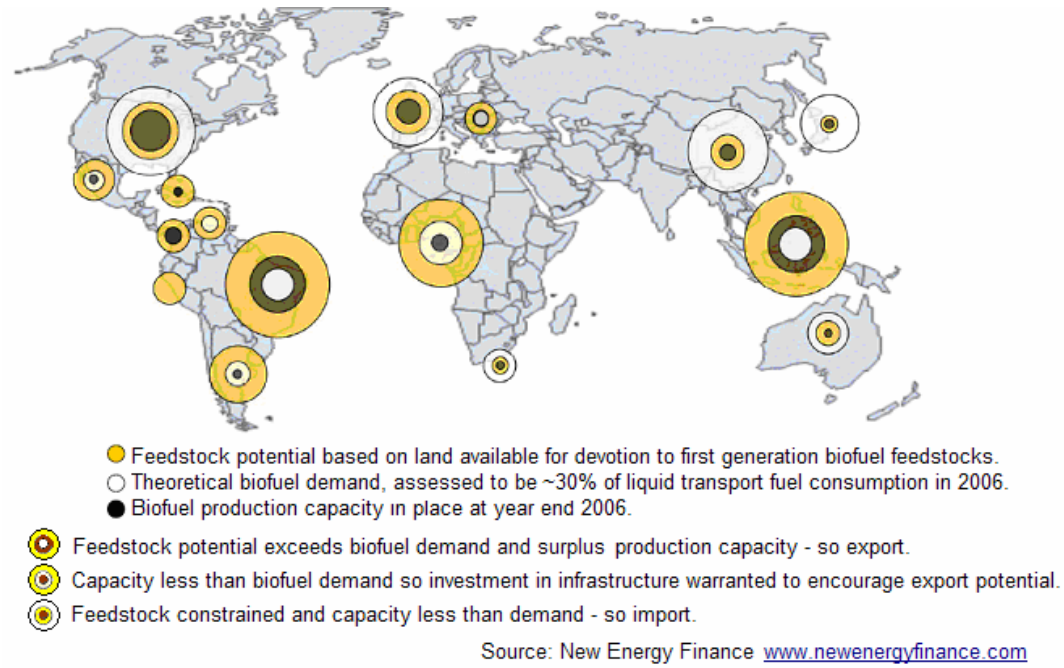

Figure 1. Indication of first generation biofuel feedstock potential s, theoretical biofuel demands and production capacities in place at end of 2006 for selected world regions.

2. Experimental conditions

Improving automotive fuel efficiency and traffic flow is not enough to reduce CO2 emissions in the road transport sector. An integrated approach is required, which includes the development and supply of alternative fuels and a more efficient use of vehicles. The adoption of these measures will make CO2 reduction efforts compatible with economic growth.

We need to decrease our dependence on oil, coal and gas. Not just electricity, but heating, transport and our food system is dependent upon a non-renewable, climate-change causing energy source. The vulnerabilities that are present must not distract attention from the policies and actions that matter most for economic prosperity and well-being in the long-term.

The world has a unique opportunity to develop a next-generation bio product industry in the next two decades. There could be major benefits in terms of job creation, the economy, reduction of greenhouse gases and energy security. The regular supply of agricultural residue can underpin the development of this industry. It is a resource that can be sustainably harvested without altering current agricultural land use patterns. In supplementing food production, this resource theoretically can be turned into a variety of bio products from transport fuels to chemicals and plastics.

We should consider the mix of future transport fuels to have the potential for:

- Full supply of the transport energy demand by 2050;
- Low-carbon energy supply to transport by 2050;
- Sustainable and secure energy supply to transport in the longer term, beyond 2050.

Alternative fuels are the ultimate solution to decarbonize transport, by gradually substituting the fossil energy sources, which are responsible for the CO2 emissions of transport. Other measures, such as transport efficiency improvements and transport volume management, play an important supporting role.

Energy carriers as transport fuels should be given particular attention, as they can be produced from a wide range of primary energy sources. They allow transport to take full advantage of the expected gradual decarburization of the energy system, resulting from a steady increase in the share of non-CO2 emitting energy sources. Energy carriers as fuels also ensure the security of energy supply to transport by providing diversification of energy sources and suppliers, whilst allowing for a smooth transition from fossil to renewable energy sources.

Compatibility of new fuels with current vehicle technology and energy infrastructure, or alternatively the need for disruptive system changes should be taken into account as important determining factors influencing the introduction of alternative fuels.

Demand for road transport is expected to grow dramatically in Emerging Economies. While EU demand is not expected to increase significantly, developing countries, including population rich countries like China and India, are entering their most energy-intensive phase of economic growth as they industrialize, build infrastructure, and increase their use of transportation. These demand pressures will stimulate more

efficiency in energy use and alternative supply, but these alone may not be enough to offset growing demand tensions completely.

Alternative fuels such as electricity, hydrogen, biofuels, synthetic fuels, methane or LPG will gradually become a much more significant part of the energy mix. No single substitution candidate, however, is seen. Fuel demand and greenhouse gas challenges will most likely require the use of a great variety of primary energies. There is rather broad agreement that all sustainable fuels will be needed to resolve the expected supply-demand tensions.

Technical and economic viability, efficient use of primary energy sources and market acceptance, however, will be decisive for a competitive acquisition of market shares by the different fuels and vehicle technologies. Any new fuels should demonstrate their availability, affordability and reliability. Compatibility with existing fuels and vehicle technologies would facilitate a smooth market transition and optimize the total system cost and customer acceptance.

Political and regulatory support will be decisive in the first phase to support the development and market entry of alternative fuels able to respond to the de-carbonization objectives.

Liquid hydrocarbon fuels are expected to remain predominant over the next decades. But the use of electricity, hydrogen, biofuels, synthetic fuels, methane and LPG will steadily increase.

The two main reasons for research into renewable energy sources as an alternative to oil are:

- the significant contribution of transport to emissions of greenhouse gases. Emissions resulting from transport account for 21% of the total emissions of greenhouse gases. As a result, it is necessary to use fuels that are less polluting than oil;
- needs to guarantee the security of energy supplies by diversifying fuel sources. The limited quantity of available oil and the increase in prices of fossil fuels represent increasingly urgent challenges for the transport sector and for national economies.

Fuel demand from the transport sector will climb 20% by 2020 and 46% by 2030 on 2010 levels, according to Bloomberg New Energy Finance projections. This implies a slightly lower annual growth rate compared with the historical average of 2% per year in the last decade. The slight slowdown is caused by the rapid penetration of electric vehicles and

continuously higher efficiencies, all driven by high fuel prices and environmental regulations.

Production of gasoline substitutes, mainly ethanol, is projected to increase from 100bn liters in 2010 to 190bn and 300bn liters in 2020 and 2030 respectively. Production of diesel substitutes will double by 2020, reaching 100bn liters from roughly 50bn today, and will double again by 2030 reaching 200bn liters. These forecasts are relatively conservative: high fuel prices may force countries to remove the free trade constraints and relax their current sustainability criteria.

Total production of biofuels, diesel and gasoline substitutes will nearly double this decade and rise a further 72% over the next, according to our analysis. The historically big biofuel markets and producers – the USA and Brazil – will boost their domestic production by some 60% up to 2020 and then an extra 35% by 2030. While small at present, other markets like China, India and Africa will increase their production at significantly higher rates. As a result, the aggregate share of Brazil and the US will shrink to 45% by 2030 from 67% today. In absolute terms, however, Brazil will still add 26bn and 23bn liters of capacity over the next two decades, and the USA and Canada will together increase capacity by some 35bn in each decade. This is corresponds to 35% of the total cumulative growth of the sector.

Food scarcity has already forced international bodies to put in place tough sustainability criteria for biofuels production. As countries continue to impose tough sustainability standards and the production will shift towards next-generation biofuels (from wood, straw, waste etc.). These technologies are relatively immature and expensive but we expect higher adoption levels to accelerate learning and bring down costs quickly. Hence, we expect first-generation biofuels production to grow slowly until 2020 and remain steady thereafter. In contrast, next-generation biofuels production is forecast to climb more than 10% on average every year between 2010 and 2030.

With regard to investment, small and immature markets such as Africa and Latin America are expected to attract the most asset finance due to abundant resources and strong domestic demand. Over the next 20 years, only 30% of investment on biofuels will be spent in Brazil, the US and Canada. Europe will see significant investment between 2015 and 2020 mainly driven by its Renewable Energy and Waste Directives.

However, financing levels will then decline due to falling demand for transport fuels. Emerging sustainability standards and the need to address food scarcity will mean that some 95% of the total investment ($510bn) on biofuels infrastructure will target next-generation facilities over 2013-2030.

Future biofuel markets could be characterized by a diverse set of supplying and consuming regions. From the current fairly concentrated supply (and demand) of biofuels, a future international market could evolve into a truly global market, supplied by many producers, resulting in stable and reliable biofuel sources. This balancing role of an open market and trade is a crucial precondition for developing biofuel production capacities worldwide.

While domestic mandates ensure the existence of markets, they can also further distort markets for energy and agricultural products. The co-existence of mandates with other policy instruments such as subsidies, tariffs, import quotas, export taxes and non-tariff barriers have not always resulted in effective deployment and efficient production and can restrict the opportunities that biofuels present.

The current negative image of biofuels in some quarters, provoked in part by a rather complex set of national public support schemes, is threatening the fulfillment of their promise and must be addressed. Paramount to a solution is an orderly and defined schedule for elimination of subsidies, tariffs, import quotas, export taxes and non-tariff barriers in parallel with the gradual implementation of sustainable biofuels mandates. These measures will provide the necessary conditions to reduce risks and to attract investment to develop and expand sustainable production. Several different efforts to reach these goals are ongoing including multilateral, regional, and bilateral negotiations, as well as unilateral actions. Ad-hoc public and private instruments such as standards and product specifications and certification may also prove useful for addressing technical and sustainability issues. In addition, the development of a global scheme for sustainable production combined with technical and financial support to facilitate compliance will ensure that sustainability and trade agendas are complementary.

The potential of biofuel production from both traditional crops and energy crops is determined by the area of land, which can be made available, the yield of that land, and the use of biomass and co-products in

other sectors. The production of second generation biofuels from wastes and residues is limited by the availability of these materials.

Sustainability considerations, including life cycle aspects constrain the technical potential in all cases. The extent of the greenhouse gas emissions saving with biofuels depends on the biofuel pathway. According to Directives 2009/28/EC and 2009/30/EC, the CO2 saved from the use of biofuels must be at least 35% of that produced from using fossil fuels. However, this does not include the impact of indirect land use change, which has to be addressed according to the legislative mandates in the Directives.

Biofuels are expected to provide the main contribution for achieving the targets of 10% renewable energy use and 6% greenhouse gas reductions in transport sector by 2020. Bioethanol production in the EU could increase to about 25 Mtoe by 2020, 50 Mtoe by 2030 and 100 Mtoe by 2050 according to biofuel industry estimations (see Fig. 2).

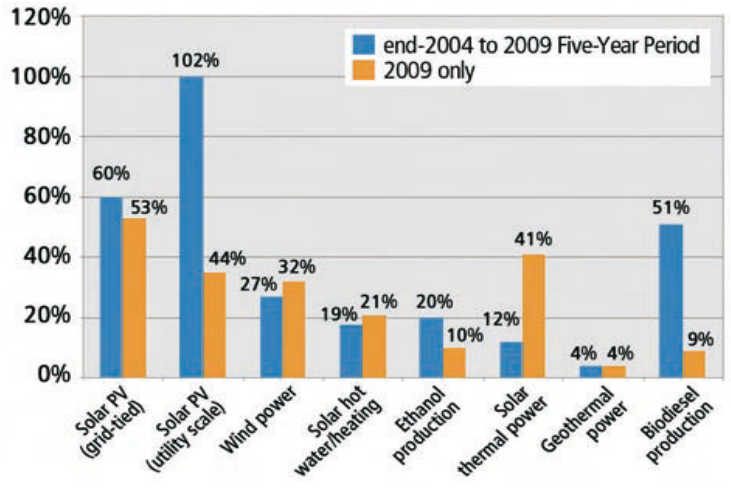

Figure 2. Average Annual Growth Rates of Renewable Energy Capacity, end 2004 to 2009.
Source: http://bioenergy.ornl.gov/resourcedata/index.html

3. Risks and opportunity

We identify two key benefits of biofuels for transport are global in nature: oil savings and greenhouse gas emissions reduction. Behind of this we need for the biofuels industry to identify the opportunities and the risks.

3.1. Opportunities

• Agricultural residues can be harvested with existing techniques and grown again and again each year in perpetuity. Try to use a renewable and sustainable feedstock: Residues from wheat, sugarcane, maize, rice and soybean crops make up the bulk of this resource.

• Increase and diversify farmers' income: Harvesting a sustainable amount of agricultural residue will not interfere with the food chain, but it will provide rural economies with an additional revenue source that will help to increase and diversify farmers' income.

• Create new job opportunities. If the agricultural residues available are converted into next-generation ethanol, then the new employment could be created from today until 2030. Jobs will come from constructing the necessary bio refining capacity, operating these bio refineries and delivering agricultural residues to these plants.

• A smaller crude imports bill: In an Europe scenario, these regions could produce enough to replace around 20% of the forecast 2020 diesel demand, which will provide an important step towards energy independence.

• Generating additional revenues: The Europe who has the potential to generate additional revenues of $2.3 trillion between today and 2020, resulting from the production of next-generation biodiesel when assuming oil is at $100 per barrel. Revenues, under this scenario conditions, climb to approximately 3.4 $ trillion in the same period.

• Reducing greenhouse gas emissions: Looking at overall, biodiesel is responsible for lower emissions by 50% for CO, CO2 78% respectively. Biodiesel contains fewer aromatic hydrocarbons, many of them carcinogens, present in the composition of diesel. Also, particulate emissions are reduced by 20% compared with low sulfur diesel.

• Reducing emissions is not negative engine power loss. That's because biodiesel has cetane number (a qualitative similar octane gasoline) high oil. In fact, many vehicle manufacturers are excited by the prospect of using biodiesel, including relying less engine wear.

• Develop a bio-based economy: the development of a biofuel industry in rural areas could constitute the first step away from a petroleum dependent economy. It will lead towards a more diversified future where renewable agricultural residues become a significant feedstock for both fuel and chemical production (see Fig. 3).

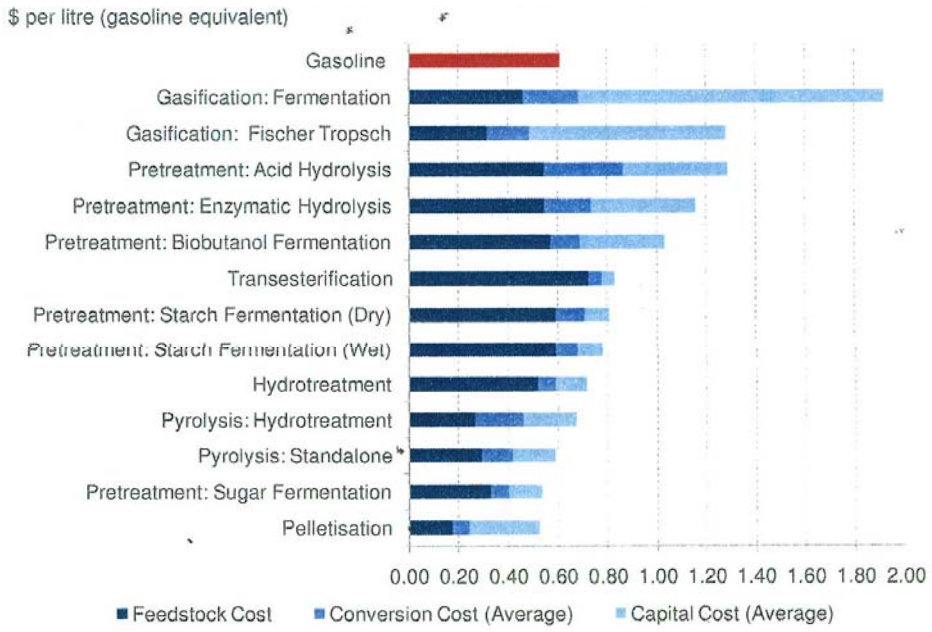

Figure 3. Biofuel pathway total operating costs, December 2009.

Source: Bloomberg New Energy Finance Note: The final biofuel product from each pathway, and its associated conversion cost, has been compared (or levelised) with the energy content of a litre of gasoline; the gasoline price accounts for crude oil at $75 per barrel

4. Risks

There are however few risks witch represent real barrier preventing the industry from unlocking the value of this agricultural residue resource. There are some actions that could be taken by policymakers and other stakeholders to address risks and unlock this potential. However already taken steps to promote a next-generation ethanol industry – the US and Brazil particularly stands out and a biodiesel industry – the UE and China.

We identified the following risks:

• Feedstock supply risk: Temporary incentives for farmers to collect agricultural residue could facilitate the development of a next-generation ethanol value chain.

• Fragmented supply chain: Helping to create a framework for large agricultural residue suppliers, that can aggregate different feedstock streams, will reduce some of the supply risk and instill greater confidence in the eyes of the capital providers.

• Insufficient infrastructure: Investment in rural roads, from the fields and orchards, will facilitate efficient agricultural residue transport and reduce costs.

• High capital costs: Governments support in the form of loan guaranties is vital to reduce the capital costs associated with constructing next-generation bio-refineries.

• Technology risks: Incentives must be locked in for the lifetime of the plant, giving a premium to the first-movers. Investors will then become more comfortable with the project risks, which will mitigate any wait-and-see strategies.

• Product delivery risk: It is imperative to provide stable demand to attract capital to the farming and next-generation bioproduct sectors. It will also give the financial community a long-term market, which will considerably ease raising debt and equity capital.

• Market access limitations: Allow ethanol and biodiesel, both first and next-generation, to replace 20% of the fossil gasoline and diesel supply, which will help remove a "blend wall" that is impeding industry growth, promote flexible fuel vehicles and encourage long-term off take agreements (see Fig. 4).

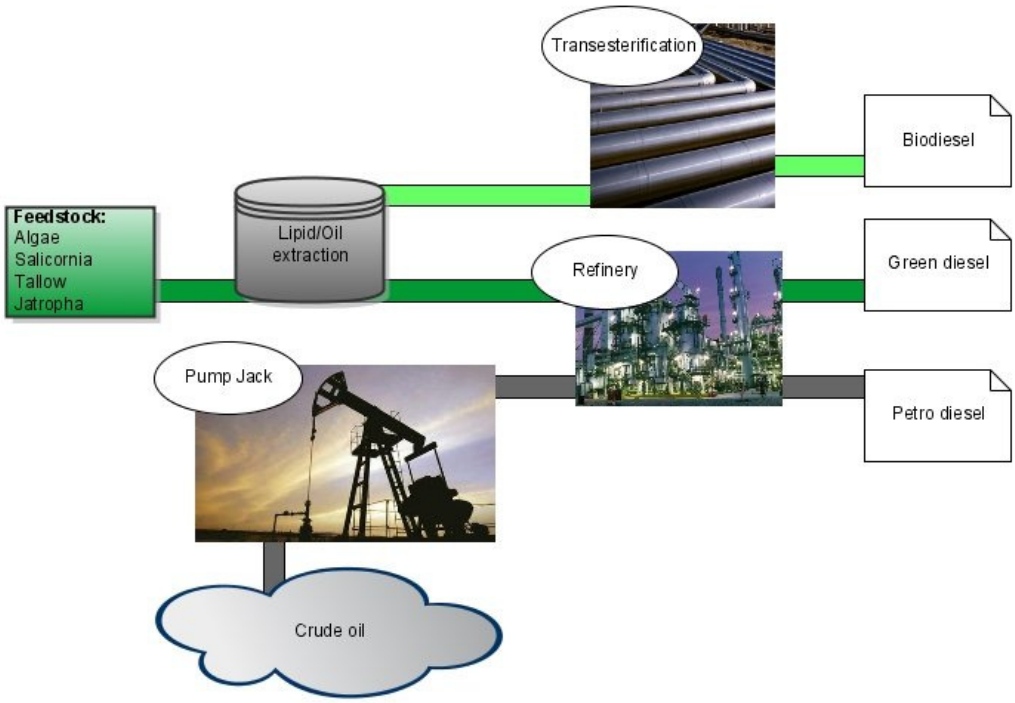

Figure 4. Biodiesel, green diesel and petro diesel.

Source: http://newenrgyfinance.com.

5. Conclusions

The global energy system is entering a phase of rapid transition with potentially far-reaching implications that will unfold in the next decades. Europe has to act before the window of opportunity closes.

During the transition period to 2050, it will also be important to actively manage the change in demand from traditional refineries and to channel fossil fuel products to those transport modes and petrochemical production having the greatest needs. Research will be needed to develop plants and process technologies to utilize biomass for applications that have traditionally been supplied by fossil fuel refineries.

Market developments of biofuels also should take into account the existing and still growing preponderance of diesel over gasoline in the European fuel market, with a split of 65% diesel and 35% gasoline. The resulting strong imbalance of refinery output and market demand in Europe presently is compensated by exporting large amounts of gasoline from Europe, and importing the missing quantities of diesel into Europe. Additional production of gasoline equivalent bioethanol products in Europe exacerbates this imbalance in the fuel market. This imbalance may be reduced by equalizing the excise duty on petrol and diesel fuels and by modifications to refineries to increase the diesel/petrol production ratio.

Biodiesel could come from significant EU potential of feedstock and land available for oilseed crops production. According to present forecasts for EU diesel demand by 2020, a 10% share in total diesel consumption would represent the production of at least 20 Mtoe of biodiesel (probably FAME type). This production could theoretically be obtained from about 4% of the total EU agricultural area. In volume terms, more biodiesel (8.2 Mtoe in 2008) is consumed in Europe than bioethanol (2.2 Mtoe), which is different with regard to the world's major biofuel consumers, the US and Brazil, where the domination of spark ignition engine cars supports a larger share of bioethanol substituting gasoline

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VALUE, PRICES AND THE EVOLUTION TO MODERN TRANSFER PRICING[1]

Olivia CHITIC[*], Andrei BIRMAN[**]

Abstract. *This paper briefly presents the view of the main economic schools on the economic concepts of value and prices with a higher emphasis on three Romanian economic thinkers (N. N. Constantinescu, Constantin Ionete, N. G. Roegen).*

Subsequently the paper highlights that the modern concepts of transfer pricing and transfer prices have been studied through various economic models (Hirschleifer, Eccles, Kanodia) that perceive a multinational company as a micro-economy in itself, leading the concept of value and prices beyond the classical and neoclasical ideas.

However, the conclusion of the paper is that transfer pricing provides new challenges both for the economic theory, with severe implications in modern microeconomics (conduct of new business models), macroeconomics (inflation and its measurement) and taxation of companies. Hence, both the practitioners and the academicians should further enhance the specific models on transfer prices by incorporating the concepts developed by bio-economics (eco-economics, which specially pay attention to the qualitative aspects of value and prices).

Keywords*: value, price, transfer pricing, multinational company.*

1. Brief theoretical considerations on value and prices

According to the Macmillan Dictionary of Modern Economics, „*the price of a good or of one resource is an item which reveals what has to be given up to in order to obtain that good or resource. Ussually, the price is*

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provided in monetary terms, although the payment does not have to be necessarily made in a monetary form"[2].

According to the current International Valuation Standards "*the concept of* ***value*** *represents an economic concept related to the price most likely to be concluded by the buyers and sellers of a good or service available for purchase. Value establishes the hypothetical, or notional, price that typically motivated buyers and sellers are most likely to conclude for the good or service. Thus, value is not a fact, but an estimate of the most likely price that will be paid for a good or service available for purchase at a given time. Therefore, the economic concept of value reflects the view of the market on the benefits of the person that owns the goods or receives the services*"[3]. A similar definition is also provided by DEX, the Romanian explicative dictionary, stating that "**value** means the capability of things, facts, ideas, phenomena of both meeting the existing social needs and attaining the ideals generated by the latter; the sum of qualities making an object, a being, a phenomenon worthwhile"[4].

Price and value have always been central to economics. If price is looked upon as an economic pheomenon, the dictum enunciated as early as the ancient days by Aristoteles and Xenophon postulating that „*price is the amount of currency that a buyer is willing and able to give a producer for a good sold on the market by such producer"*[5] is unanimously acknowledged. As briefly described below, the major economic schools formulated various theories for price and value.

Therefore, in the **classical economic theory,** represented by Adam Smith, David Ricardo, J. B. Say, price's substance lies in the economic value of the transacted goods, such value being determined both by the consumption of manufacturing factors and the remunerations charged by their owners. The prevailing conditions of the market cause price to settle at or around the level of economic value, and usually price does not move away from its economic basis, i.e. economic value. *Classical school*

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[2] Approximate translation from the Mcmillan Dictionary for Modern Economy, CODECS Publishing, Bucharest, 1999, pag. 309

[3] Approximate translation from the International Valuation Standards, Edition VII, 2005, pag. 26

[4] DEX, Romanian Academy, „Iorgu Iordan" Institute, 3rd Edition, Bucharest, 1998, pag. 845

[5] Coralia Angelescu, Dumitru Ciucur, Niță Dobrotă, Ilie Gavrilă, Paul Tănase Ghiță, Constantin Popescu, Cornel Tarhoaca, *Economy, 5th Edition,* The Economic Publishing, The Academy of Economic Studies, Bucharest, 2000, pag. 130

thought out and developed the objective theory of value as determined by work.

In the classical thought, as well as the Marxist thought, value is a historical category specific to the manufacturing of goods, and substance of value is the labour incorporated in the goods. Value is therefore objectively determined, being commensurate with the amount of social work spent to manufacture the goods and incorporated therein. On the market value is socially recognized, as it presents itself as exchange value. As a result, value is a social relation specific to goods-based economy[6].

Similarly to the classical economists, albeit not part of their group, Karl Marx believes that labour is still the foundation of value: "*labour is the only source of value or, more precisely, its very substance*". He goes on to distinguish between use value and exchange value as he believes it is not exchange that regulates the amount of value in a good, but on the contrary, the amount of value of a good regulates its exchange relationships. However, for Marx the value law is not directly the pricing law. As a matter of fact there are many a priced, but valueless, good. This is why Marx in his "*Das Kapital"* considers that the sole source of value is the labour incorporated in the goods manufacturing process and rules out of the class of exchangeable goods any goods that are not products of work but rather gifts of nature (such as ground, forest or water).

In a later stage of the development of economics, **Neoclassical economic theory**, represented by William Jevons, John Clark, Alfred Marshal, Federico Pareto, and Carl Menger, laid down the subjective theory of price, stating that price is determined by the marginal utility and the shortness of the supply of the goods, and the amount in which such goods are available compared to the existing needs and solvent demand. Thus, the greater the marginal utility of a good and the more infrequently available is, the greater its economic value and price are. Based on such factors a relationship is always formed between supply and demand that influences both level and dynamics of prices.

From such perspective, neoclassicism approach deems that all economic goods are valuable, regardless of whether or not they are commodities. Therefore, value is not a historical category, as it occurs both in natural economy and goods-based economy, and the substance of value is the utility of the goods. Value depends upon the mix of utility and

[6] Gheorghe Popescu, *The evolution of economic thinking*, 3rd Edition, Cartimpex Publishing, 2004

quantity and ceases to be „a social relation", as in the classical approach, but instead „a subjective measure" determined by each individual by relating the amount of goods they consume to their own system of needs. „Marginal utility" underlies the formation of value, i.e. the lowest utility of the last consumed item that meets the lowest need.

The brief presentation above helps us observe that **the key distinction between the classical theory and the neoclassical theory as to value and price arises from the primary cause that determines price.** According to the classics, price mostly expresses the goods' manufacturing conditions, how goods are achieved by combining manufacturing factors, with manufacturer acting as „conductor" of price. Instead, in the neoclassical approach price is determined by the prevailing conditions of the market, and how goods' sparseness and marginal utility occur, with the decisive role in the formation and evolution of price being played by buyers. The table below describes a comparative analysis of the classical theory and the neoclassical theory of prices.

Brief comparative analysis on classical theory and neoclassical theory of prices	
Classical theory	**Neoclassical theory**
Value is based on labour incorporated in goods and is a social relation specific to the production of goods.	Value is based on the utility derived by consumers; therefore all economic goods are valuable, irrespective of their commodity or non-commodity status.
Value is consequently determined by its manufacturing cost, i.e. the consumption of manufacturing factors and the remunerations claimed by their owners.	Substance of value is the utility of goods. However, in order to be able to respond to the „paradox of value", the relationship between needs and the available and consumed quantity of goods must be considered, as value therefore depends on the mix of utility and quantity.
On the market value becomes socially acknowledged and acts as exchange value. As a result, value is a social relation specific to the goods-based economy.	Value and price cease to be a „social relation", but „a subjective measure" determined by each individual.
Manufacturer is the „conductor" of price.	Price is determined by the prevailing market conditions, how rarity and marginal utility of the goods occur, and buyers act decisively upon the formation and evolution of prices.

The 20th century economists (such as Keynes, Schumpeter, Knight, Samuelson, Friedman) also approached, directly or indirectly, the issue of value and prices, but they emphasised *market mechanisms and its imperfections*, *its method of control* (liberalism vs. political dirigisme) and *the shift from microeconomic approach, as championed by both classics and neoclassics* (except for Marx) *to macro economy*.

For instance, **J. M. Keynes** never provided a distinct analysis of the theory of value, but postulated a theory of prices laying great store on a specific price, i.e. interest rate, in other words the price of money. Keynes asserted that price of money, like any other price, is determined on the market by the balance between the demand for loans and the supply of temporarily available financial resources. In Keynes' opinion, money supply depends on the current policy of the central bank, whereas the money demand hinges on people's choices to own some of their wealth either in cash or in the form of interest-bearing assets. Keynes classified such choices according to *transaction motive*, *precautionary motive* and *speculative motive*. One can be therefore surmise that Keynes too is a follower of the neoclassical theory and believes that price is a subjective notion as determined by the prevailing market conditions (demand vs. supply), but, critically important, Keynes believes that market alone is incapable of ensuring a proper economic balance, as state is compelled to step in and implement various economic policies. Consequently, the stability of economic system is not tacitly achieved by the „market invisible hand" (Adam Smith), as value and price are two concepts susceptible of substantially deviating from their balancing value.

One the other hand, the followers of the new economics, affiliated to famous **Chicago School**, such as **Frank Knight** and **Milton Friedman**, firmly believed that the neoclassical pricing theory faithfully describes economic reality and free market is the one that can most effectively handle resources and distribute income, without any intervention of the state. Another major economist of the 20th century, **Paul Anthony Samuelson**, attempted through his „neoclassical synthesis" to bring together the supporters of Keynesism, Neoliberalism, Malthusianism, monetarism and other economists, and fostered the idea of mixed economy containing both free market elements and control elements. As to value and prices, Samuelson accentuates both the rarity of resources (objectivity) and the law of decreasing returns (subjectivity), while achieving a balance between classics and neoclassics, between both objective and subjective principles of value.

20th century Romanian economists, including **N. N. Constantinescu** (1920-2000) **Constantin Ionete** (1922-2011) and **N. G. Roengen** (1906-1994) also approached the theory of value and pricing system, while positioning closer to the classical theory and contributing significant inputs as regards the critique of the theory of labour value starting from the developments of the Romanian economy or bioeconomy (Roegen).

Thus, N.N. Constantinescu concludes in his work „*The Theory of Labour Value and Today's World"* (in Romanian, "Teoria valorii muncă şi lumea contemporană" (1984)) that the theory of labour value need not be thoroughly removed from the scholarly sphere as do neoclassics and some of the modern economists who only favour the balance between supply and demand and therefore marginal utility. This would be necessary precisely in order not to let solely the mechanisms of the capitalist system, i.e. seeking business owners' profit, domineer the creation and distribution of value around economy. Constantinescu believes that the law of labour value has not said it last word in history yet. Even assuming new forms, the economic role of labour would not wane, but labour force would consider the fact that its creating power has mounted so greatly that it has generated an affluence of products and services that render both sale and purchase all but useless. However, should this happen, the notion of labour-based economic value in its sense until now would cease to exist. Constantinescu therefore foretold what we are now witnessing in the second decade of the 21st century, namely a surfeit of products and services. In other words, such is overwork today that labour is wasted, it is worthless, and the value of products must be derived employing different methods.

Economist Constantin Ionete approaches prices in particular, showing that price is a unit of consistent consumption of social labour with a system's characteristics. Thus, a systemic approaching of prices proceeds from their dynamic structure, characterized by the internal state of its component elements (costs, net income etc.) subject to a permanent influence by both inputs and outputs and an interconnection with the entire economic system together with its sub-systems. In this respect, Ionete points out that „*the decision-making process in pricing and its institution-nalization involves the employment of econometrics and quantifying methods in general, in order to analyse prices as a complex dynamic system, develop models, and combine the ontological and phenol-menological approach of prices with labour consumption computational methods*[7]".

[7] Constantin Ionete, *Prices and the dinamic equilibrum of economy*, Scientific and Enciclopedic Publishing, Bucharest, 1983, p. 25

In his work „Decline, Entropy, Ecology, Economy" (in Romanian, *Descreşterea – Entropie – Ecologie – Economie* (1979)), within the broader context of entropy law (that can be deemed as the most economic law of all natural laws), Nicholas Georgescu Roegen states that "*economists are fond of saying that there is no such thing as a free meal, that everything must be paid based on its value so that price and value get to always even out. Entropy law teaches us that humankind lives under an even more severe commandment: in entropy terms a meal costs more than its price"*[8]. Unlike neoclassics, who refer to production in terms of value, Roegen considers production in strictly physical terms and, unlike his predecessors who maintained that "labour is the father and the active principle of wealts as the nature (lands) are the mother[9]", he believes that „*the whole history of humankind unequivocally proves that nature too plays an important role in the economic process, and also informs the genesis of economic values*" and, from such perspective, goes on to say „*a non-traditional economist such as I am would add that any input in the economic process is valuable natural resources and any output is worthless garbage"*[10].

2. Transfer pricing: a modern concept of value and prices

In the first part of the article we briefly described the evolution of economic thought on value and price and noted that it has evolved continuously and accompanied nations' economic and social development in time. The dramatic economic development over the last century, primarily driven by the impulse of the revolution of information technology (the IT boom) and the increasing globalisation have led to the unprecedented development of a new approach of managing companies, i.e. the advent of transnational corporations. Such corporations have generated such a complex organization that we can safely say that they are an economic micro-system in its own right, as a single corporation maintains dozens of branches in multiple countries serving multiple functions, such as manufacturer, supplier, trader etc.

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[8] Gheorghe Popescu, Ruben Filimon, *Nicholas Georgescu-Roegen, Evolutionary Epistemology and the Arrow of Time,* Risoprint, Cluj-Napoca, 2009, p. 144

[9] The Economic Writings of Sir William Petty, CH Hull Publishing, vol. 2, Cambridge, Eng., 1899, p. 377

[10] Nicholas Georgescu-Roegen, *Energy, natural resources and economy*, Expert Publishing, 1996, p. 9

In such context, the science of prices and value has been significantly enriched by analysing the matters that characterize the globalisation processes, the decision-making process on penetration of a new foreign market, management of overseas branches, relations between the managers of subsidiaries and the management of repatriation of income. Moreover, extensive exchange of information is now possible on the pricing practices agreed between corporation's branches. It is therefore increasingly clearer that, in a more and more complex world with brand new types of economic management (corporations), the development of a matching pricing system is required, particularly the *transfer pricing*.

Economic practice and theory defined the *transfer pricing* concept as early as mid-20th century as a distinct pricing system, i.e. *the prices charged in the transactions between the branches of a multinational company or between a branch and its parent company* (also referred to as „*affiliated/related parties*" as they have common shareholders and interests).

The matter of transfer pricing in economy was first formalized by Hirshleifer[11] (1956), who claimed that transfer price is the „fair" price only when a transacted good is produced in a perfectly competitive market. If a market has a less than perfect competition, then the „fair" price is the applicable marginal cost, considering several specific requirements.

The Hirshleifer model involves two entities of one multinational company that generate profit: a manufacturer and a distributor. The manufacturer has no foreign market to sell its goods on, whereas the distributor does have such foreign market. Hirschleifer proved that the optimal transfer price is the marginal cost incurred for the manufacturing of the intermediate good or service. Manufacturer must be able to charge marginal costs associated to various manufacturing levels so that the entity that manufactures the end product or provides the final service may choose its optimal manufacturing level. Thus, the optimal transfer price chargeable **by manufacturer to distributor** is the marginal cost incurred for the manufacturing of the intermediate product or provision of the intermediate service. Where a perfectly competitive market exists, a product is transferred at arm's length.

The managers of the two entities (manufacturer and distributor) acting as profit generators („*rational profit maximizers*") will choose those manufacturing levels deemed to be conducive to profit maximization, given that the entities are independent from one another. If the group's

[11] Hirshleifer, J., *On the economics of transfer pricing,* Journal of Business, 1956, pp. 172-184

management (the „*central management*") decides on a transfer price ensuring that the group's profits are optimized, then the independence of the entities will cease to exist. A possible challenge is that the entities' managers' assessment is based on the seeking of profit by each entity individually; as such managers are not stimulated to provide reliable information so that they can preserve their advantage. Therefore, based on such considerations, information may be distorted across the entire group and consequently adverse selection may occur.

The choices and development strategies followed by an organization are informed by the fact that the independence of the organization's entities may outweigh the whole performance of the group. Also, an organization may use a number of organizational forms and processes to choose the optimal transfer price that enables the organization to derive profit. The diversified organizations have therefore employed the „*market-based transfer pricing*", while interconnected organizations resorted to the "*cost-based transfer pricing*". Organization's strategy determines control processes that motivate individuals towards the achievement of the organization's targets, in exchange for the entities' profit being maximized to the detriment of larger profitability.

Based on Hirschleifer's model, economist R. Eccles[12] perceived the group of multinational companies as a „mini-economy" where limited resources must be effectively assigned. Such approach is intended to help identify a transfer price that causes the divisions of a group of related companies conducting sale and purchase transactions with one another to choose the best manufacturing level ensuring that the profit of the entire group is maximized[13].

Eccles' model claims that transfer pricing, as part of an organization's operating and intra-cooperative system, must be consistent with the strategy employed by such organization. Managers of the group's entities perceive performance evaluation and individual reward system as fair when organization's strategy is properly considered in determining the applicable transfer prices. Eccles therefore starts from the assumption of certainty concerning the organizational strategy. Should a suitable organizational strategy, an organizational structure and a transfer pricing scheme be into place, managers will perceive the existing performance evaluation and reward system as fair. In such case, they will be driven to

[12] Eccles R., *The transfer pricing problem: A theory for practice,* Lexington, Mass., Lexington Books, 1985

[13] *Idem*

meet the group's targets, as they will be rewarded for their efforts, all of which will encourage the attainment of objectives at group's and organization's levels respectively.

On the other hand, economist Kanodia (1979) adjusted Hirschleifer's (certainty-reliant) model to consider the uncertainty conditions. **Kanodia's model**[14] assumes that central management uses a linear program based on reliable ("*honest*") reports for both manufacturer and distributor. Group's entities secure an optimal transfer price; however, like in the case of Hirschleifer's model, information may be unreliable (*asymmetry of information*) as no reward system is in place for the management. When such model is adjusted to fit the conditions of uncertainty, distributor is faced with a range of transfer prices for the end product. Together with the element of uncertainty, the management of the corporation's individual entities also receives an incentive, i.e. a percentage of the organization's profits. This state of affairs reflects distributor's risks, as the existing reward system will fail to comply with the Pareto optimum and a maximization of group's profits will be insecure.

Later on, Kanodia advances the notion of risks being split among entities, while setting a range of values for transfer prices and making it conditional upon the final price. In such case, the interaction between related parties is bound to result in a distribution of the group's total profits, with the Pareto optimum being achieved both for manufacturer and distributor. Also, risk splitting is supposed to motivate management to maximize profits.

Therefore, given the models above, we can see that any approach of the transfer pricing matter is primarily based on economic theory. Then and now, manufacturer's economic theory assumes that transacting parties attempt to secure a maximum profit and, even if this fail to happen on a short or medium term basis, a company still plans to derive profit on a long term basis to be able to make investments and expand its business. Economic profit means the return required for an entity to conduct its main business, but it also must include both its future capital investments and the return of the shareholders' investments in the firm (in microeconomic theory's term, this is the basic assumption for the viability of any company).

[14] Myers, Joan K., Collins, Mary K., *An historical review of transfer pricing theories addresing goal congruence within the organization,* p. 3

3. Conclusions

Theory of value and prices has evolved along with society to become the complex science that it is today, still resourceful and providing more and more, increasingly ample approaches. There is now an extensive literature dealing with price and value that has in time led to the development of an ever greater number of schools of thought, each of which with its own contribution in refining upon the existing or new issues related to price and value. The process is still going on thanks to state-of-the-art scientific tools and new approaches that help develop the science of price and value.

The challenges faced by today's increasingly globalized economy, where companies have re-positioned themselves in an integrated market, pave the way to a new type of organization, i.e. *corporation*. In the current business environment, characterized by a marked international economic integration, a transaction price is the outcome of the worldwide ever-moving economic processes experienced by multinational companies in various shapes and forms.

Corporations have generated such a complex organization that they may well be treated as an economic micro-system in its own right, with one corporation maintaining dozens of branches in dozens of countries serving multiple functions, such as manufacturer, supplier, trader etc. In such context, a suitable pricing system for such corporations, namely *transfer pricing*, was bound to be developed. This concept has been adopted relatively recently by the Romanian legislation, however it has a significant impact on businesses' taxable base and automatically on the state budget revenues.

The study of transfer pricing mechanisms is now only barely supported by the existing specialist literature, where the Hirschleifer, Eccles and Kanodia models attempted to extract fair value and determine optimal prices charged in the related party transactions between the divisions of one group of multinational companies.

The specialist literature in the field is still in its infancy in Romania. An avenue for future research would cover the transfer pricing matters from an eco-economic and legal angle, given that transfer pricing related tax inspections have multiplied significantly and the number of transfer pricing disputes is still growing. This is achievable by giving proper consideration to the concepts developed by the *bio-economy (*or *eco-economy)* championed by Nicholas Georgescu-Roegen, i.e. the law of entropy and processes of green economy or economy of limited supply.

Using such concepts would meet a *sine qua non* requirement of today's society, as it would be a specific and immediate thing to do and would also awake people to the genuine value of life and the cost of using limited resources. In other words, to the facts behind today's statistical numbers on the value and price of goods and services, as such numbers are publicly presented without the due critical consideration.

It must be noted that this contribution is attemptedly in line with the contributions of other Romanian economists (e.g. Constantin Ionete) who proved that pricing research obviously cannot limit itself to colligating ontological and phenomenological concepts in economic sciences.

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