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MODELING THE REASONS FOR FIRMS' GROWTH: A CONTROL-THEORETIC APPROACH

Matti ESTOLA*

Abstract. *Static neoclassical framework cannot be applied in modeling time dependent processes or increasing returns to scale in production. The dynamization of the neoclassical theory of a firm by dynamic optimization, on the other hand, assumes inconsistent profit functions with the former. As a solution to these problems, we present a dynamic theory of a firm consistent with the static neoclassical one. A firm's growth may originate from increasing demand or decreasing costs with time, or increasing returns to scale in production (Estola 2001). We model the reasons causing increasing returns in a firm's production process and give a block diagram of the model to reveal its control theoretic nature. (JEL B41, D21, D24)*

Keywords: *Dynamics, firms' growth, control theory, block diagram.*

1. Introduction

According to Philip Mirowski (1989a), neoclassical economics bases on two distinct elements: egoistic economic agents by Adam Smith (utility maximizing consumers by William Stanley Jevons, Carl Menger and Leon Walras) and the mathematical metaphor of classical mechanics. The latter can be understood by the progenitors of the neoclassical theory who were engineer level physicists. Concept equilibrium in economics was borrowed from physics by Nicolas-Francois Canard at 1801 (Mirowski 1989b). Although equilibrium is a *balance of forces situation*, in economics the balancing forces have not been defined. However, to understand the adjustment process we should define the forces that 'push' economic quantities into their equilibrium states in stable cases, or cause their evolution with time in non-stable cases.

The existence of forces acting upon economic quantities can be argued indirectly; every changing quantity (price, wage, exchange rate etc.) tells the existence of reasons (forces) causing these changes. This is analogous with arguing the existence of the gravitational force field by dropping a pen; without the force field the pen would not move. Franklin

* University of Eastern Finland, Faculty of Social Sciences and Business Studies, P.O. Box 111, FIN-80101 Joensuu, Finland, e-mail: matti.estola@uef.fi.

M. Fisher (1983 pp. 9-12) writes: *"... I now briefly consider the features that a proper theory of disequilibrium adjustment should have ... if we are to show under what conditions the rational behavior of individual agents drives an economy to equilibrium. ... Such a theory must involve dynamics with adjustment to disequilibrium over time modeled. ...the most satisfactory situation would be one in which the equations of motion of the system permitted an explicit solution with the values of all the variables given as specific, known functions of time. ... Unfortunately, such a closed-form solution is far too much to hope for. ...the theory of the household and the firm must be reformulated and extended where necessary to allow agents to perceive that the economy is not in equilibrium and to act on that perception. ... A convergence theory that is to provide a satisfactory underpinning for equilibrium analysis must be a theory in which the adjustments to disequilibrium made by agents are made optimally"*.

According to Kenneth Arrow & Frank Hahn (1971, p. 12), the accepted definition for market stability is that of Paul Samuelson (1942) who writes: "*In the history of mechanics, the theory of statics was developed before the dynamical problem was even formulated. But the problem of stability of equilibrium cannot be discussed except with reference to dynamical considerations ... we must first develop a theory of dynamics*". Andreu Mas-Colell et al. (1995, p. 620) write*: "A characteristic feature that distinguishes economics from other scientific fields is that, for us, the equations of equilibrium constitute the center of our discipline. Other sciences, such as physics or even ecology, put comparatively more emphasis on the determination of dynamic laws of change. The reason, informally speaking, is that economists are good (or so we hope) at recognizing a state of equilibrium but are poor at predicting precisely how an economy in disequilibrium will evolve. Certainly there are intuitive dynamic principles: if demand is larger than supply then price will increase, if price is larger than marginal costs then production will expand"*.

2. Dynamic Control Theoretic Model

We base our modeling on the principles stated by above mentioned authors. We define a force vector acting upon the use of inputs of a firm, and use this force in modeling the dynamics of production in real time. The possible asymptotic steady-state of a firm is the neoclassical one: marginal revenues equal marginal costs for all inputs, and the equilibrium use of every input maximizes the firm's profit. To define the *economic forces acting upon the use of inputs of a firm,* we assume that the firm's managers

like to better the firm's situation if possible, as Fisher stated above. We believe that '*economic agents' desire to better their situation*' is the fundamental cause for the observed dynamics in economies.

Dynamic control theoretic models of firms' behavior completely base on dynamic optimization; see Alain Bensoussan et al. (1974) or Alpha C. Chiang (1992). In physics, however, Hamilton's and Newton's modeling principles yield the same equations of motion, and Newton's method applies differential equations while Hamilton's principle requires dynamic optimization. Due to this relative simplicity, most engineering applications of control theory rely on Newton's principle. In engineering models it is also common to present a block diagram of a system before its behavior is analyzed formally (see S. A. Marshall (1978) or Katsuhiko Ogata (1997)). We propose a similar simplification for control theoretic modeling in economics as Newton's principle offers in physics. The *force vector* that causes the dynamics of use of every input of a firm guides the firm with time into its profit maximizing state, and so dynamic optimization is not needed. The Newtonian type of a *dynamic law for the firm's adjustment of its use of inputs* is used as a building block in our model as is common in engineering (see Fig. 1). By the model we study the reasons for production dynamics at firm level.

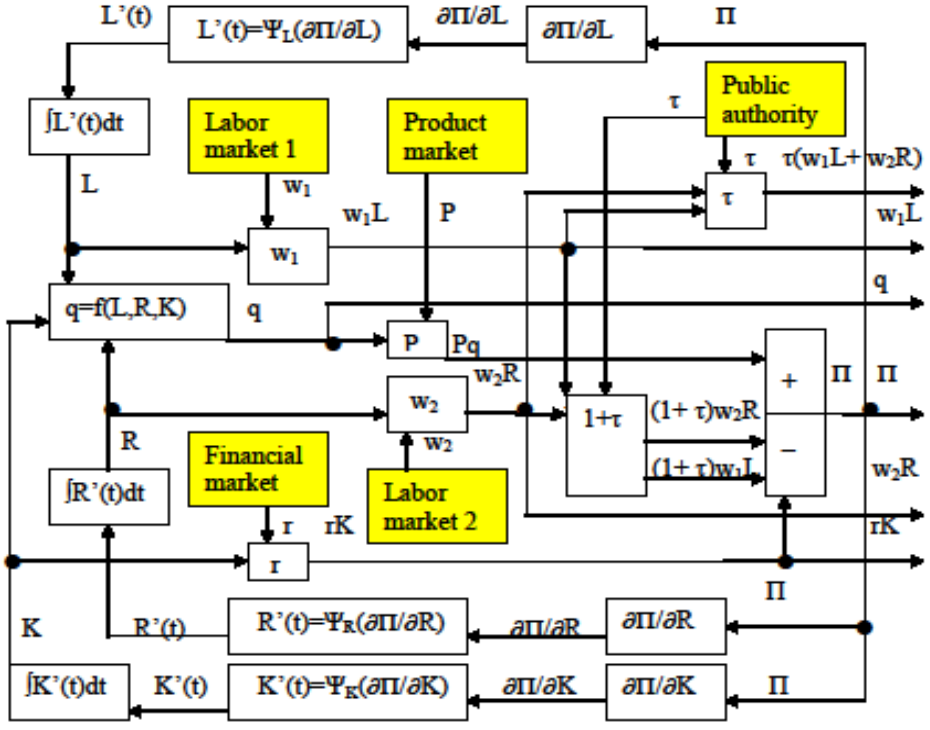

Figure 1. Block Diagram of the Production System of a Firm.

In Figure 1, the ‘flows’ denoted by arrows are named by the ‘flowing’ quantities. Symbol • means that the crossing ‘flows’ are connected, that is, the same flow is in both lines; otherwise crossing lines are assumed not to interact with each other. White rectangles affect the ‘flows’ as is shown, and yellow rectangles of external impulses to the system. For every rectangle, the input and output flows are named. In the single [+/–] – box, the monetary flow entering the upper part is added with a positive sign, and those entering the lower part are added with a negative sign. The output flow from this box is the profit Π. The diagram shows how profit-seeking, the ultimate goal of the firm, controls the production process. All three inputs in the production are adjusted by a closed-loop mechanism where the feed-back bases on the marginal profitability of the input. The real output of the system is q, and the monetary outputs are $w_1 L$ and $w_2 R$ for the two types of labor, $\tau(w_1 L + w_2 R)$ for the government, rK for the lenders of foreign capital or investors of own capital, and Π to the firm’s owners. The main definitions are:

$$q = f(L, R, K), \;\; \Pi = Pq - (1+\tau)w_1 L - (1+\tau)w_2 R - rK,$$

$$\partial\Pi / \partial L = P(\partial f / \partial L) - (1+\tau)w_1; \quad \partial\Pi / \partial R = P(\partial f / \partial R) - (1+\tau)w_2,$$

$$\partial\Pi / \partial K = P(\partial f / \partial K) - r, \;\; x'(t) = \Psi_x(\partial\Pi / \partial x), \;\; x = L, R, K.$$

The theory of endogenous economic growth by Paul Romer, Robert Lucas etc. rose as a critique to Robert Solow’s (1956) model. Romer (1990) explains macro-level economic growth by firms' investments in *human capital*, and Lucas (1988) measures an individual's human capital by his *skills*. Although Romer and Lucas both claim that the development of human capital is the *unobservable magnitude or force behind economic growth*, by human capital they mean different things. The reasons that increase the efficiency of labor may be exogenous or endogenous for a firm. Exogenous reasons are *learning by doing at work* – that takes place inside firms but does not require an investment in it – and better education or technological level in the society. Endogenous reasons are an increase in the number of capital goods or more effective ones available for workers, and firms' investments in production methods and employees' skills; the last two can be included in the category of ‘human capital’. We model the role of these elements in the growth of a firm’s production and show that the ‘unobservable human capital’ is not a necessity for economic growth. Every factor that increases the productivity of inputs or reduces the costs of a firm contributes its growth.

3. Kinematics of Production

We denote by $q(t)\,(unit/y)$ the flow of production of a firm at time moment *t*. Unit y may be one day, two weeks etc. The accumulated production of the firm till time moment *t*, $Q(t)\,(unit)$, is:

$$Q(t) = Q(t_0) + \int_0^t q(s)ds, \qquad Q'(t) = q(t), \qquad Q''(t) = q'(t),$$

where $Q(t)\,(unit)$ is the accumulated production of the firm till time moment *t*, $Q'(t) = q(t)\,(unit/y)$ the momentous flow, and $Q''(t) = q'(t)\,(unit/y^2)$ the momentous acceleration of production at time *t*. This kinematics is a necessary prelude for production dynamics analogous with Newtonian mechanics[1].

4. Dynamization of the Neoclassical Theory

A common way to dynamize the static neoclassical theory of a firm is to assume that the firm maximizes its expected future profit. We omit uncertainty and assume the firm's profit function for time unit y as $\Pi(q(t),t) = P(t)q(t) - C(q(t))$, where $P(t)\,(\$/unit)$ is the price of the product of the firm, $q(t)\,(unit/y)$ the flow of production, and $C(q(t))\,(\$/y)$ the cost function. The dynamic optimization problem for the current value of the firm's profit from time $(0, t_1)$ is:

$$\max_{q(t)} \int_0^{t_1} F(q(t),t)\mathrm{d}t = \max_{q(t)} \int_0^{t_1} \mathrm{e}^{-rt}\Pi(q(t),t)\mathrm{d}t, \qquad (1)$$

where e^{-rt} is discount factor with constant interest rate $r(1/y)$ (see Appendix Part *A*). The necessary condition for (1) – with possible boundary conditions – is the following Euler -equation:

$$\frac{\partial F}{\partial q} - \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\partial F}{\partial q'(t)}\right) = 0 \Rightarrow \mathrm{e}^{-rt}\frac{\partial \Pi}{\partial q} = 0 \Rightarrow \frac{\partial \Pi}{\partial q} = 0.$$

The necessary condition for (1) thus equals with that of static neoclassical theory. Dynamic optimization was used, however, to get an equation of motion for $q(t)$. The above shows that for this function $\Pi(q,t)$ should depend on $q'(t)$, but $q'(t)$ does not exist in profit functions in the

[1] A system of measurement units for economics is given in De Jong (1967). Measurement units are in parenthesis after the quantities.

literature of static neoclassical theory. Static neoclassical theory and its dynamization by dynamic optimization thus assume inconsistent profit functions (see Chiang (1992 pp. 49, 69, 292) and Avinash K. Dixit & Robert S. Pindyck (1994 pp. 254, 359)).

5. The Production Process of a Firm

We study the production of a one-product firm using labor, capital goods, and human capital (knowledge) as inputs. The production function is $q = f(L, K, R, t)$, where $q(unit/y)$ is the flow of production of the firm, $L(h/y)$ the labor input of the firm in ordinary production, $R(h/y)$ the labor input of the firm in the production of *human capital*, $K(\$)$ the value of the physical capital of the firm, and time t represents possible exogenous technological development. All partial derivatives of the production function are assumed positive.

If the physical capital of the firm is financed by loans, the interest costs are $rK(\$/y)$ where interest rate $r(1/y)$ is determined in the financial market. If capital is financed by equities, the interest costs rK are paid to the shareholders (equal r is assumed in both cases). Capital goods are assumed not to deteriorate, and the possible redemption of the loan capital is omitted; we can thus think that capital is financed by equities. For simplicity, perfect competition is assumed in the two labor markets so that the firm has no power concerning wages $w_1, w_2(\$/h)$ for these two types of labor. The profit of the firm from time unit y is:

$$\Pi(t) = P(t) f(L(t), K(t), R(t), t) - (1+\tau)[w_1(t)L(t) + w_2(t)R(t)] - r(t)K(t),$$

where τ is fixed assumed social security rate. The time derivative of the profit is:

$$\Pi'(t) = \frac{\partial \Pi}{\partial P} P'(t) + \frac{\partial \Pi}{\partial L} L'(t) + \frac{\partial \Pi}{\partial K} K'(t) + \frac{\partial \Pi}{\partial R} R'(t) +$$
$$+ \frac{\partial \Pi}{\partial w_1} w_1'(t) + \frac{\partial \Pi}{\partial w_2} w_2'(t) + \frac{\partial \Pi}{\partial r} r'(t) + \frac{\partial \Pi}{\partial t}. \qquad (2)$$

Equation (2) shows that changes in the two wages and interest rate affect the profit, but these quantities are beyond control of the firm's managers. Quantity $\partial \Pi / \partial t$ shows that elements like workers' learning, better education in the society etc. – that take place with time and create no costs for the firm – positively affect the firm's profitability. The variables

the firm's managers can affect are the unit price, the two labor inputs, and the capital input. The adjustment rules for these quantities are:

$$x'(t) > 0 \quad if \ \frac{\partial \Pi}{\partial x} > 0, \quad x'(t) < 0 \quad if \ \frac{\partial \Pi}{\partial x} < 0,$$

and:

$$x'(t) = 0 \quad if \ \frac{\partial \Pi}{\partial x} = 0, \ \ x = P, L, K, R.$$

These rules make the first four additive terms on the right hand side of Eq. (2) non-negative, i.e. by adjusting in this way the managers increase the firm's profit with time. These adjustment rules are in line with the neoclassical theory that corresponds to situation $\partial \Pi / \partial x = 0, \ x = P, L, K, R$ with proper necessary conditions guaranteeing the state as the profit-maximizing one. We thus extend the neoclassical analysis by a dynamic adjustment that explains how the firm will reach its optimum in a stable case. Permanent growth and the possible collapse of the firm take place in non-stable cases.

A relation fulfilling the above rules is:

$$x'(t) = \Psi_x\left(\frac{\partial \Pi}{\partial x}\right), \ \ \Psi'_x\left(\frac{\partial \Pi}{\partial x}\right) > 0, \quad \Psi_x(0) = 0, \quad x = P, L, K, R. \tag{3}$$

The first order Taylor series approximation of function ψ_x in the neighborhood of the optimum $\partial \Pi / \partial x = 0$ is:

$$\Psi_x(y) \approx \Psi_x(0) + \Psi'_x\ (0)(y - 0) = \Psi'_x\ (0)y.$$

With this approximation, we can write Eq. (3) as:

$$x'(t) = \Psi'_x\ (0)\frac{\partial \Pi}{\partial x} \iff m_x x'(t) = \frac{\partial \Pi}{\partial x} \tag{4}$$

were:

$$\Psi'_x\ (0) = \frac{1}{m_x}.$$

Now, $L'(t)$ and $R'(t)$ with unit h / y^2 are the firm's acceleration of use of these two types of labor. Following Newton, we interpret the positive constants $m_x = 1/\Psi'_x\ (0), \ \ x = L, R$ as the inertial factors (*masses*) of the adjusting quantities. These factors originate from the legislation for over-time work, the time needed to find skillful workers etc. The measurement unit $(\$ \times y^2) / h^2$ of factors $m_x, \ \ x = L, R$ makes Eq. (4) dimensionally well-defined, i.e. both sides have equal unit, see De Jong (1967).

With these assumptions, Eq. (4) with $x = L, R$ exactly corresponds to Newton's equation: $ma = F$ where $a = x'(t)$ and $F = \partial\Pi / \partial x$ with unit $\$/h$.

Equation (4) with $x = P, K$ is not exactly the same as Newton's formulation because $P'(t)$ and $K'(t)$ are the flows of *P,K*, respectively. However, we still identify $\partial\Pi / \partial x,\ x = P, K$ with units *unit/y* and 1/*y*, respectively, as the *forces the firm's managers direct upon these quantities*, and constants $\psi'_x(0) = 1/m_x,\ x = P, K$ as the inverses of the inertial factors related to *P* and *K*. These inertial factors originate from the time and costs needed for price changes, installing new machines etc. The higher these factors, the greater are $m_x,\ x = P, K$ with units *unit*^{2}/\$ and1/\$, respectively. Weiss (1993), for example, find price inertia in concentrated industries.

System (4) is then:

$$\begin{pmatrix} m_P & 0 & 0 & 0 \\ 0 & m_L & 0 & 0 \\ 0 & 0 & m_R & 0 \\ 0 & 0 & 0 & m_K \end{pmatrix} \begin{pmatrix} P'(t) \\ L'(t) \\ R'(t) \\ K'(t) \end{pmatrix} = \begin{pmatrix} \partial\Pi / \partial P \\ \partial\Pi / \partial L \\ \partial\Pi / \partial R \\ \partial\Pi / \partial K \end{pmatrix}. \qquad (5)$$

Estola (2001) shows that increasing demand and decreasing costs with time increase the production of a profit-seeking firm. We can thus omit these cases and so we assume the unit price to stay fixed, $P'(t) = 0$. The block diagram of model (5) is in figure 1. It shows how the managers of the firm control the inputs L, R, K in a closed-loop way, and labor, financial, and product markets open the system for external effects via quantities w_1, w_2, r, P. Public sector may act as an open-loop controller of the system by parameter τ (see Marshall (1978)).

In the following we omit uncertainties to keep the modeling simple. However, uncertainty can be added in the analysis by replacing the quantities in the firm's managers' decision-making by their expected values (see Estola (2001)).

6. Increasing Returns to Scale in Labor and Capital

First we show that growth may occur due to increasing returns to scale in the traditional inputs. We assume a Cobb-Douglas type of production function:

$$q(t) = f(L(t), K(t) = A\left(\frac{L(t)}{L_0}\right)^{\alpha}\left(\frac{K(t)}{K_0}\right)^{\beta},$$

where A with unit *unit/y* is a technology constant, L_0, K_0 with units h/y and \$, respectively, the values of the two inputs at time 0, and α, β positive numbers. In this form the function is dimensionally homogeneous, and the profit function with unit $\$/y$ is:

$$\Pi(t) = PA\left(\frac{K(t)}{K_0}\right)^{\beta}\left(\frac{L(t)}{L_0}\right)^{\alpha} - (1+\tau)w_1 L(t) - rK(t).$$

The adjustment system for the two inputs is:

$$\begin{pmatrix} m_L & 0 \\ 0 & m_K \end{pmatrix}\begin{pmatrix} L'(t) \\ K'(t) \end{pmatrix} = \begin{pmatrix} \partial\Pi/\partial L \\ \partial\Pi/\partial K \end{pmatrix}, \tag{6}$$

where the components of the force vector $F = (\partial\Pi/\partial L, \partial\Pi/\partial K)$ are:

$$\frac{\partial\Pi}{\partial L} = \frac{\alpha AP}{L_0}\left(\frac{L(t)}{L_0}\right)^{\alpha-1}\left(\frac{K(t)}{K_0}\right)^{\beta} - (1+\tau)w_1,$$

$$\frac{\partial\Pi}{\partial K} = \frac{\beta AP}{K_0}\left(\frac{L(t)}{L_0}\right)^{\alpha}\left(\frac{K(t)}{K_0}\right)^{\beta-1} - r.$$

The force vector shows how the exogenous variables P, w_1, r affect the adjustment, and that government can affect the system by parameter τ. Due to the non-linearity of System (6), its dynamic behavior is studied by phase diagrams. The slopes of the demarcation lines $L'(t) = K'(t) = 0$ in coordinate system (L, K) are:

$$\left.\frac{\mathrm{d}K}{\mathrm{d}L}\right|_{L'(t)=0} = \frac{(1-\alpha)}{\beta}\frac{K}{L}, \quad \left.\frac{\mathrm{d}K}{\mathrm{d}L}\right|_{K'(t)=0} = \frac{\alpha}{(1-\beta)}\frac{K}{L}, \quad L, K > 0.$$

The attract/repel – character of the demarcation lines depends on the following partials:

$$\frac{\partial L'(t)}{\partial L} = \frac{\alpha(\alpha-1)AP}{L_0^2 m_L}\left(\frac{K(t)}{K_0}\right)^{\beta}\left(\frac{L(t)}{L_0}\right)^{\alpha-2},$$

$$\frac{\partial K'(t)}{\partial K} = \frac{\beta(\beta-1)AP}{K_0^2 m_K}\left(\frac{L(t)}{L_0}\right)^{\alpha}\left(\frac{K(t)}{K_0}\right)^{\beta-2}.$$

The behavior of the system thus critically depends on the values of α, β (see Appendix Part B).

Case 1: 0<α, β<1. In this case both inputs obey decreasing returns to scale. Both demarcation lines are then upward sloping in coordinates (*L*,*K*), and the corresponding phase diagrams are in figures 2 and 3. The equilibrium state $L'(t) = K'(t) = 0$ is a sink in figure 2 $(\alpha + \beta < 1)$ and a saddle in figure 3 $(\alpha + \beta > 1)$. Figure 2 displays a dynamic extension for the neoclassical theory. Figure 3, on the other hand, shows that permanent growth in the use of the inputs (and also in *q* through the production function) is possible when the two inputs together obey increasing returns. If the initial values L_0, K_0 are great enough, permanent growth takes place while small L_0, K_0 lead to the collapse of the firm. The profit of a growing firm will increase with time.

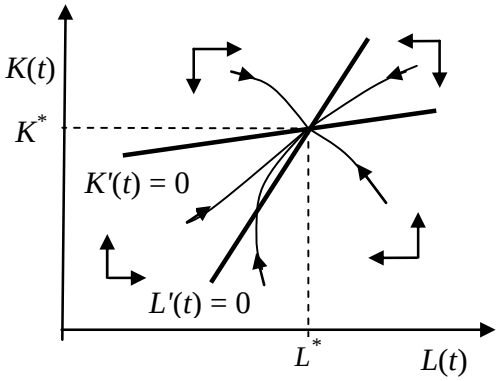

Figure 2. Decreasing returns in both inputs.

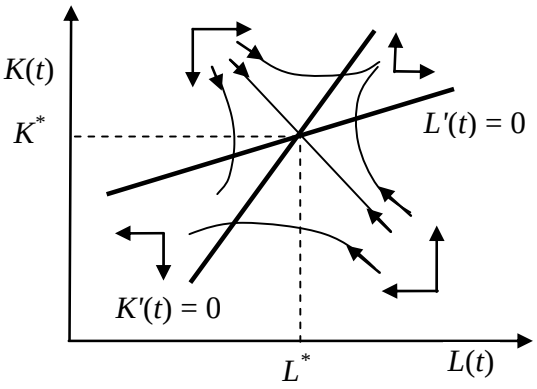

Figure 3. Increasing returns in the two inputs together.

Case 2: α<1, β>1. Here labor obeys decreasing and capital increasing returns to scale. Line $L'(t) = 0$ is now upward and line $K'(t) = 0$ downward sloping in coordinates (L, K). The equilibrium is a saddle (Fig. 4). Permanent growth is possible if the initial values L_0, K_0 are great enough while low values for L_0, K_0 lead to the collapse of the firm. Only firms with K_0 great enough can survive and their profitability increases with time.

Case 3: α,β>1. Here capital and labor both obey increasing returns to scale. Both demarcation lines are now downward sloping in coordinates (L, K). The only possible phase diagram is in figure 5 because the case line $L'(t) = 0$ steeper implies $\alpha + \beta < 1,$ which is impossible. The equilibrium in figure 5 is a saddle. Permanent growth is possible if L_0, K_0 are great

enough while low values for L_0, K_0 lead to the collapse of the firm. If L_0, K_0 are great enough, the firm grows permanently and increases its profitability with time.

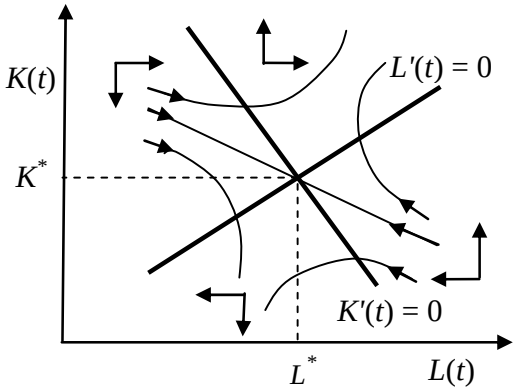

Figure 4. Increasing returns in capital and both inputs.

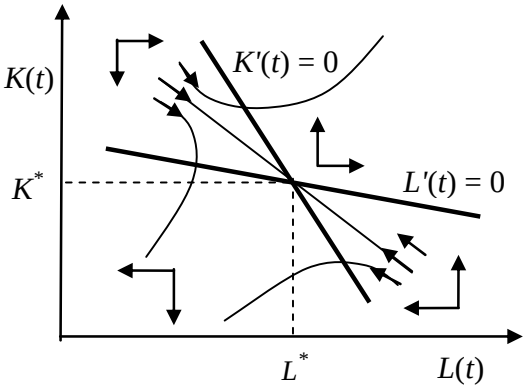

Figure 5. Increasing returns in both inputs.

We omitted the case $\alpha > 1, \beta < 1$ because it is symmetric to that in Case 2. In figures 2-5, changes in exogenous variables P, w_1, r, τ move the positions of the demarcation lines. If the initial state of the system is the equilibrium, a move in one demarcation line starts an adjustment toward the new equilibrium state in figure 2 and away from the new equilibrium in figures 3-5, unless the initial point happens to be on a saddle-path.

7. Increasing Returns to Scale in Human Capital

Next we omit physical capital and concentrate on the role of human capital in the production process. The production function of the firm is assumed as:

$$q(t) = BH(t)\left(\frac{L(t)}{L_0}\right)^{\alpha}, \qquad H(t) = D\left(\frac{R(t)}{R_0}\right)^{\gamma}$$

where $L(h/y)$ is the labor input as earlier, $R(h/y)$ the labor input in the production of human capital $H(\$/y)$, and $B(unit/\$), D(\$/y), a, y$ are positive constants. Notice that H is the flow – and not the level – of human capital, and only increases in human capital are assumed to affect q.

Human capital is measured by its monetary value when sold to other firms. The profit function is then:

$$\Pi(t) = PA\left(\frac{R(t)}{R_0}\right)^{\gamma}\left(\frac{L(t)}{L_0}\right)^{\alpha} - (1+\tau)[w_1 L(t) + w_2 R(t)], \quad A = BD.$$

This model is identical as in the previous section when R is replaced by K, γ by β, and $(1+\tau)w_2$ by r. Again, either of the two types of labor may obey increasing returns to scale, or they may together cause increasing returns to scale in the production. We could have added in this analysis physical capital, too, and get results where every combination of the three inputs may cause increasing returns to scale in the production. Other forms for the production function could also have been assumed with similar results.

The theories of Lucas (1988) and Romer (1990) base on increasing returns to scale in production due to human capital. However, our modeling shows that the somewhat unclear concept of human capital is not a necessity for economic growth. Similar results are obtained with increasing returns for any input, or because several inputs together obey increasing returns. The block diagram in figure 1 gives a hint of how a more detailed description of the production process could reveal elements where efficiency can be increased.

8. Conclusions

In the static neoclassical theory of a firm, time is abstracted away, and increasing returns to scale are not allowed. A different framework is thus needed for modeling economic growth at micro level. As a candidate we introduced a dynamic extension for the static neoclassical theory, analogous with the Newtonian formulation in physics. The constructed models are of control theoretic nature that is demonstrated by a block diagram in figure 1. Our main results are: 1) Permanent growth may occur due to increasing returns to scale in any input or a combination of inputs of a firm. 2) The input mix of a growing firm will change with time toward greater profitability. 3) The managers of a profit-seeking firm control the production process in a closed-loop way, and government may act with taxes as an open-loop controller of the process. A decrease in interest rate, if controllable by the monetary authority, can also be used in promoting growth as the defined force vector shows.

In real life there exist factors that slow down and eventually stop the growth of a firm, like increasing wage level, the saturation of the market, the appearance of competing firms, etc. However, we have evidence of long-lasting growth of corporations like IBM, HP, Nokia etc. Even though these growth processes may not last forever, we believe that it is more meaningful to model these as explosive processes rather than to assume that these firms have been approaching their equilibrium states last 20 years, as the neoclassical theory claims. We believe that there are elements in the production processes of these firms that allow them to grow in a profitable way, which elements we modeled here. However, because firms' production methods change with time, one specific model may not keep its accuracy too long.

Appendix

Part A: Continuous time interest rate $r(1/y)$ is defined as the growth rate of invested money $x(t)(\$)$:

$$r = \frac{x'(t)}{x(t)} \Longleftrightarrow x'(t) = rx(t) \Rightarrow x(t) = x(t_0)\mathrm{e}^{r\times(t-t_0)}.$$

The unit $\$/y$ of $x'(t)$, where y is a time unit, explains that of r. The last equation is the solution of the differential equation with fixed r. With $t_0 = 0$, the interest factor is e^{rt} where time t has unit y. The exponent of e is thus dimensionless.

Part B: The necessary conditions for the critical point $\partial\Pi/\partial L = \partial\Pi/\partial K = 0$ to maximize the profit are:

$$\frac{\partial\Pi}{\partial L} = \frac{\alpha AP}{L_0}\left(\frac{L}{L_0}\right)^{\alpha-1}\left(\frac{K}{K_0}\right)^{\beta} - (1+\tau)w_1 = 0,$$

$$\frac{\partial\Pi}{\partial K} = \frac{\beta AP}{K}\left(\frac{L}{L_0}\right)^{\alpha}\left(\frac{K}{K_0}\right)^{\beta-1} - r = 0.$$

The sufficient condition for profit maximization is that the first minor determinant of the Hessian matrix is negative, and the second is positive. The Hessian matrix is:

$$H = \begin{pmatrix} \partial^2\Pi/\partial L^2 & \partial^2\Pi/\partial L\partial K \\ \partial^2\Pi/\partial K\partial L & \partial^2\Pi/\partial K^2 \end{pmatrix}.$$

The first minor of H is $H_1 = \partial^2\Pi / \partial L^2$, and the second minor equals the determinant of the Hessian $|H|$ is:

$$| H |= \frac{\partial^2\Pi}{\partial L^2}\frac{\partial^2\Pi}{\partial K^2} - \left(\frac{\partial^2\Pi}{\partial L \partial K}\right)^2,$$

were:

$$\frac{\partial^2\Pi}{\partial L^2} = \frac{AP\alpha(\alpha-1)}{L_0^2}\left(\frac{K}{K_0}\right)^{\beta}\left(\frac{L}{L_0}\right)^{\alpha-2},$$

$$\frac{\partial^2\Pi}{\partial K^2} = \frac{AP\beta(\beta-1)}{K_0^2}\left(\frac{K}{K_0}\right)^{\beta-2}\left(\frac{L}{L_0}\right)^{\alpha},$$

and:

$$\frac{\partial^2\Pi}{\partial K \partial L} = \frac{AP\alpha\beta}{L_0 K_0}\left(\frac{K}{K_0}\right)^{\beta-1}\left(\frac{L}{L_0}\right)^{\alpha-1}.$$

Thus: $$| H |= \frac{\alpha\beta P^2 A^2}{L_0^2 K_0^2}\left(\frac{L}{L_0}\right)^{2(\alpha-1)}\left(\frac{K}{K_0}\right)^{2(\beta-1)}[(\alpha-1)(\beta-1)-\alpha\beta].$$

If $0 < \alpha < 1$ then $H < 0$. On the other hand, requirement $| H |> 0$ corresponds to $\alpha + \beta < 1$. Thus for the critical point to be a maximum – as is assumed in the neoclassical framework – neither of the two inputs separately or together can obey increasing returns to scale. The stability of the system, too, depends on the Hessian matrix, see for example McCafferty (1990 p. 138). The trace of the Hessian matrix is:

$$Tr(H) = \frac{\partial^2\Pi}{\partial L^2} + \frac{\partial^2\Pi}{\partial K^2} = AP\left(\frac{L(t)}{L_0}\right)^{\alpha}\left(\frac{K(t)}{K_0}\right)^{\beta}\left(\frac{\alpha(\alpha-1)}{L^2} + \frac{\beta(\beta-1)}{K^2}\right).$$

The system is stable if $| H | > 0 \iff (\alpha-1)(\beta-1) > \alpha\beta$ i.e. $\alpha + \beta < 1$ and $Tr(H) < 0$, which occurs certainly if $0 < \alpha, \beta < 1$; see (Fig. 2).

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ABOUT DISTRIBUTION OF MONEY IN A FREE MARKET ECONOMY

Karl E. KÜRTEN[*] and F. V. KUSMARTSEV[**]

Abstract. *We study a sophisticated model of a market belonging to the class suggested originally by Angle et al (see Review [1] and references therein) where a fixed number of trading agents exchange and transfer money. We show that the probability distribution of money, income or wealth resulting in the long-term trading process may take a specific form depending on the amount of money rotated in a single turnover process, where all agents are involved. These distributions are associated with a stable steady state of the macroscopic dynamical trading processes and may describe different market economies. The structure of these distributions depends crucially on average income, democracy, the standard of life and other features associated with political and economic structures of the market economy at equilibrium and may be described by a few parameters, only. One of these parameters can be called a temperature, which is similar to one introduced earlier by Yakovenko and collaborators [2,3] and connected with an average money which economic agents have. Such parameter may separate hot and cold markets which behaviour is different. Specifically for some "cold" market economies when the temperature is smaller than average amount of money per agent we find the Boltzmann distribution found before by Yakovenko et al [2,3]. In such market there is a large amount of goods flow and money and the market is associated with countries having a population with high average income and standard of life. However for hotter countries when the temperature tends to the average amont of money per agent this distribution is changing and may take both a Poisson form which gradually transformed from conventional Boltzmann form, when the level of life increases. On the other hand for very cool countries, when the temperature is significantly smaller than average amount of money per agent there arises another form of the money distribution – a Bose-Einstein one [4]. That may arise for very cold market economies, when the most of money are accumulated only in a few economic agents. It is associated normally with not well developed countries having lower level of life, when only a small amount of money and goods flow taken part in the trading processes or in cases when financial crises arises.*

Keywords: *Market economy, Bose-Einstein distribution, average income, gamme distributions, gamble trading.*

[*] Faculty of Physics, Vienna University, 5, Boltzmanngasse, A-1090 Vienna, Austria.
[**] Department of Physics, Loughborough University, Leicestershire, LE11 3TU, UK.

1. Introduction

We are all now witnesses of the present huge financial crisis started in 2007 and at the present in culmination stage. The crisis has been triggered by a liquidity crisis and next collapses of large financial institutions in the United States banking system and around the world. The immediate bailout of banks by national governments was an attempt to save the situation however the downturns in stock markets around the world and the housing market suffered by a far large dip than expected, resulted in numerous evictions and foreclosures. In summary the financial crisis of 2007-2010 started with the US subprime mortgage crisis and still experts are placing different weights upon particular causes of the crisis. The complexity and interdependence of many of the causes, as well as competing political, economic and organisational interests, have resulted in a variety of point of views describing the origin of the crisis. One of the issue discussed is the high corporate and consumer debt levels. The latter cause of the crisis is related to a distribution of money in society and especially related to a part of the population which have a large or medium debt. In the present paper we discuss a simple network model of the market economy with a fixed amount of rotated money and a fixed number of trading agents, who are selling and buying some goods and therewith paying or exchanging money. The flow of the goods is not taken into account, and the focus within this model is on the distribution of the money, which arises in the course of long trading processes. In other words, we are interested in the question: "What is the shape of the money distribution in the equilibrium state in the long term limit of the free market economy?". Such distribution has been recently studied and compared with existing experimental data [2,3]. This finding has attracted attention of a broad scientific community. In turn that stimulated to reconsider main concepts, which are underlining modern financial econometrics.

2. Model

To describe the free market trading processes we propose a model system which consists of N economic agents specifying a network, where each agent i (the buyer) chooses one single partner j (the seller) at

random [1]. The total amount of money on a market is fixed and equal to M. We assume that, when two partners are connected they are trading according to some trading law specified by the interaction given below. In the first instance we consider the simplest case when the update rule for the network is stochastic and the network connectivity is annealed (that is at each time step of the time evolution the randomly chosen agent picks a new partner at random).

Initially all agents are given a certain amount of money drawn from an arbitrary probability distribution $p(t = 0)$. This initial state is not necessarily taken from a uniform probability distribution used in previous works [2,3]. At each time step a randomly chosen agent i acts as a buyer, while the connected randomly chosen agent j acts as the seller. We assume that the amount of the transaction is proportional to the actual funds of the buyer agent i which is a plausible assumption. As the result the wealth of the *i*-th agent decreases as:

$$m_i(t+1) = m_i(t) - p\, m_i(t), \tag{1}$$

while for the *j*-th agent the money increases as:

$$m_j(t+1) = m_j(t) + p\, m_i(t). \tag{2}$$

The model we propose here is reminiscent of Angle's model [1] who introduced two classes of sellers specified by the probabilities p_i and p_j, representing different attitudes with respect to buying and selling. In other words the whole population has been divided a priori into two classes with p_i and p_j being inversely proportional to their educational level, that is p_i and p_j are small or large.

First we would like to consider two limiting cases, which allows to obtain exact mathematical results. The first case is when the probability of the money exchange vanishes $(p = 0)$. In this case the original distribution of money remains which is $m_i(t+1) = m_i(t)$ for all i. In the second case each buying agent is spending all his money in each transaction $(p = 1)$. As the result he is loosing all his money and after that is expelled from the next trading processes, i.e. from the market. That is $m_i(t+1) = 0$ after the first time step. At the same time each seller is gaining that is $m_j(t+1) = m_j(t) + m_i(t)$. Thus, the seller absorbs the whole fortune of agent i. After a transient phase all sellers

except one vanish and all the money will be in the hand of this one single agent.

The time evolution of the models seems to relax towards an equilibrium probability density distribution specified by the gamma distribution:

$$P_\gamma(x) = \frac{\beta^k x^{k-1} exp(-\beta x)}{\Gamma(k)}, \tag{3}$$

where the parameter k specifies the shape, while inverse β defines the scale and the tail, respectively. The parameters of the gamma distribution depend strongly on the rate of the money exchange, that is on the value of the parameter p or on the topological structure of the financial trading network. We note that our trading network is equivalent to a gas of D-dimensional particles [5]. Effectively, the parameter k may be related to the number of degrees of freedom of the particles of this D-dimensional gas system. In this analogy each trading agent represents a particle. Then the trading processes of the economic agents are equivalent to the exchanging energy of the gas particles which occurs in mutual collisions. In this analogy the parameter $k = D/2$, where D is the dimension of the space where the gas exists. Then the pre-exponential factor of this gamma distribution may be related to a density of states for this D-dimensional gas. The usage of this analogy may indicate that the parameter k is proportional to the number of the degrees of freedom of an average economic agent, that is the space dimension D. Here the average is $< m > = k/\beta = kT$, where we call the parameter T as a temperature of the market. The variance is $\sigma^2 = kT/\beta$. For $k > 1$ the distribution has a maximum at $x_{max} = (k-1)T$ and for large values of k the Gamma distribution converges to a Gaussian distribution with the same moments. For $k = 1$ we have the exponential distribution:

$$P_\gamma(x) = \beta\, exp(-\beta x). \tag{4}$$

3. Numerical Experiments and Simulations of the market as long term trading

Now let us consider a more general situation, when the value p is small. This means effectively that all agents spend only a small fraction of the capital they have. That is they are very cautious not to spend too much.

As a result of such trading the distribution of money is taking the bell shaped gamma distribution form (see figure 1).

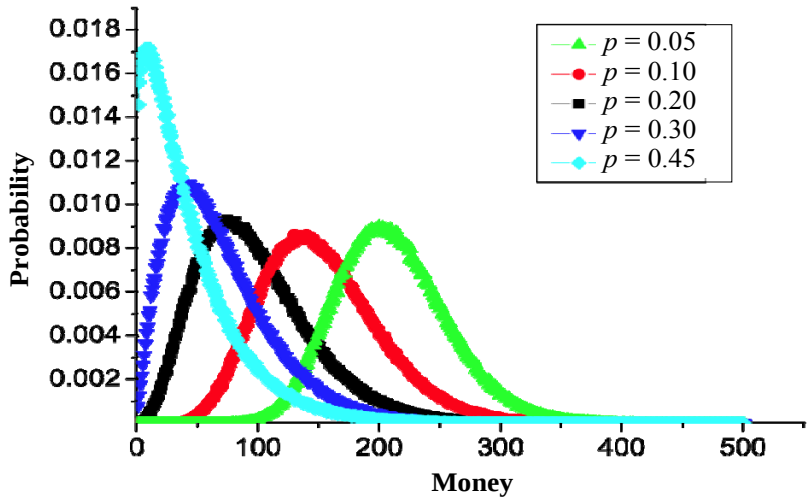

Figure 1. The stationary distribution of money created in a result of the long-term evolution of a free market. The market is characterised by the parameter p, which is associated with the effective fraction of the money of economic agent which he uses in a single trading process. Here we have presented cases when p = 0.05 , 0.10, 0.20, 0.30, 0.45.

At the value $p = 0.05$ the money distribution is described by the bell shaped gamma distribution form (see, the green line) with parameters $k = 21.3$ and $\beta = 0.1$. The position of the peak of the curve corresponds to M/N, i.e. the money average over all agents, while the area under the curve corresponds to the normalised total amount of money circulating on the market. Such a distribution implies that the majority of agents have roughly the same amount of money about M/N. The fluctuations describing the money exchange of the trading agents around the average are defined by the half-width $\Gamma = \sqrt{2 \ln 2}\sigma$ which corresponds here to 54 money units. It is naturally to ask the question: "what is the origin of such a nearly Gaussian distribution of money"? The mean of the distribution corresponds to the value $< m > = k/\beta = kT$. When the value of the parameter p increases the bell shaped curve is shifting its position to the left. In addition there arises a high-money tail which may be described by exponential type (or the Boltzmann type) distribution. This is most

clearly seen when the probability is represented in the logarithmic scale (see figure 2).

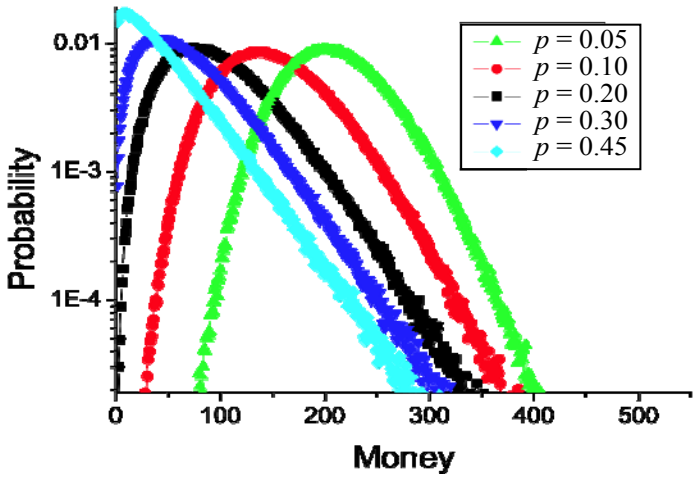

Figure 2. The distribution of money associated with low values of p (when $p = 0.05,\ 0.10,\ 0.20,\ 0.30,\ 0.45$) in logarithmic scale. The lowest values correspond to Gaussian-like form while large values correspond to more dominant, exponential, Boltzmann distribution. In such a scale one may see clearly the Boltzmann distribution when $p = 0.45$, which has a gaussian part or a parabolic part just near the maximum only at very small amount of money, $m < 20$.

The exponential tail of the gamma distribution corresponds to the linear part of the curve in this figure, while the central part near the maximum corresponds to a parabolic type curve. One may notice from figure 2 that when the parameter p increases the parabolic curves describing the maximum associated with different p values become more asymmetric. This asymmetry goes together with the creation of a larger high-money exponential tail. The larger the value p the longer the exponential tail and the narrower the bell shaped parabolic part of the gamma distribution associated with the maximum of this distribution. In fact for $p = 1/2$ the only exponential tail remains while the parabolic part and the maximum vanishes (see, the light blue curve presented in figure 3).

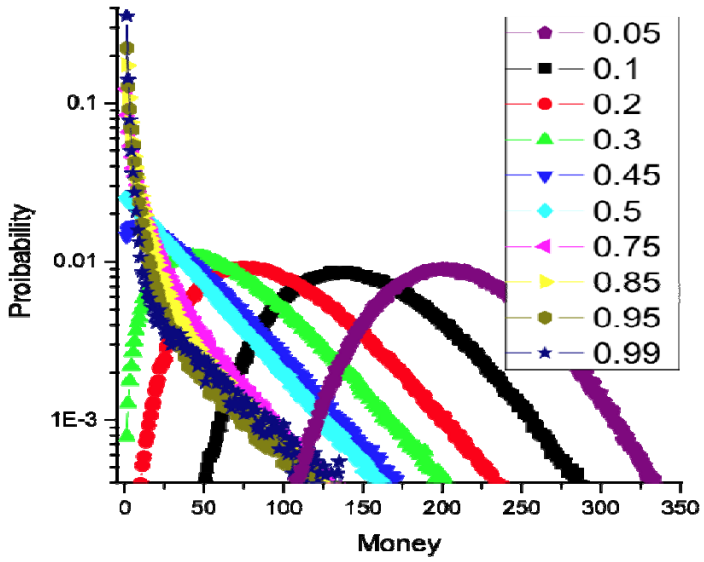

Figure 3. The evolution of the distribution of money when the parameter p changes. Each separate curve corresponds to a distribution associated with a fixed value of the parameter p. Here we present the distributions for $p = 0.05$, 0.10, 0.20, 0.30, 0.45, 0.5, 0.75, 0.85, 0.95 and $p = 0.99$ values. In the logarithmic scale one may clearly see the changes of the distribution from gaussian-like having a clear maximum at $m > 0$ to exponential or Boltzmann type. Finally at large values of p and small money there arises a change in the distribution form especially this concerns to the low money region. That is when $p > 1/2$ the distribution takes the form of Bose-Einstien distribution.

First question arises: what is the origin of this Boltzmann like tail in the gamma distribution? Recently it was found by an intensive analysis of available statistical data associated with different developed countries that such a distribution does indeed exist while it is complemented by a Pareto power law tail [2,3]. Originally, Yakovenko et al [2] have predicted a Boltzmann form of money distribution on the basis of his assumption that in each trading transaction the money is conserved, i.e. due to the law of money conservation. He has assumed that money is conserved and this yielded the Boltzmann distribution in a manner as Boltzmann has originally derived that distribution for classical statistical systems. A comparison and next studies (see, for details, Ref. [3]) found an excellent agreement between the distribution predicted by the theoretical model based on the money conservation law with the statistical data of the income distribution in many developed countries. In his papers Yakovenko et al.

have introduced the temperature of the market with the meaning as an average amount of money per an agent. Such a discovery has created an intensive interdisciplinary discussion between physicists and economists on the question what is an origin of such an distribution in real life, where the total amount of money may not be conserved. Recently it was also shown that such a Boltzmann distribution corresponds to the most optimal configuration of the market where the money are distributed between a fixed number N of economic agents [4]. Since this exponential tail corresponds to the high-money region of the distribution. According to an analogy with the Boltzmann distribution one may state that this part may characterise the most optimal and realistic equilibrium part of the money distribution. However, we still have to answer the question why with increasing values of p, that is for more gambling economies, the gaussian-like form of the gamma distribution is gradually replaced by the exponential one.

Thus, numerical simulations show that for $0 < p < 0.5$ there arises an asymmetric Gaussian-like distribution of money with skewness $2/k^{1/2}$. This distribution is well fitted by the gamma distribution and that has a deep physical sense, because the trading equilibrium network corresponds to a gas of D-dimensional particles. For $p = 1/2$ the distribution transforms into a pure exponential (see, the table 1, where the parameter k =1, while the gas has the dimension $D = 2$). This limit can be explained by symmetry arguments. In short, here each agent spends exactly half of his money during each transaction. For different values of the parameter p the results (the values of the parameters for the resulting gamma distribution) are presented in the table 1:

Table 1

The parameters of the gamma distribution
of a network of trading agents.

p	k	β
0.05	21.3	0.1
0.10	9.58	0.063
0.20	4.	0.0354
0.30	2.32	0.033
0.40	1.45	0.029
0.45	1.2	0.0285
0.50	1.	0.028

As it can see from table 1 the parameter p corresponds to a fraction of money which a buyer is spending in each transaction. The parameter $\beta = 1/T$ defines the inverse scale of the distribution function and is equivalent to the inverse temperature of the gas or of the market, T. The parameter k corresponds to a dimension of a gas which can be put in a correspondence to this trading network, where the money plays a role of the energy of the gas particles.

We observe that when the parameter p increases from zero number of the degrees of freedom of the D-dimensional gas or its spacial dimension decreases very fast from $D = 40$ and are equal to $D = 2$ for the value $p = 1/2.$ On the other hand the scale factor β roughly triples.

4. Bose-Einstein distributions

However when the value p increases and becomes larger than $p_c = 1/2$ there arises another transformation of the Boltzmann distribution: the exponential distribution is replaced by a Bose-Einstein one. The exponential tail is associated with the linear curve presented on the figure 3. This behaviour exists when the money values belongs to the interval $30 < m < 200,$ while for values of $m < 30$ we see that there arises a power law. This separation between these two types of different behaviour becomes more pronounced, when the value p approaches 1. However in the majority of the region when $1/2 < p < 1$ the money distribution can be described by the following universal fitting formula, known as Bose-Einstein distribution:

$$P_{BE}(x) = \frac{n_0}{\exp\left(\frac{m-\mu}{T}\right)-1}. \qquad (5)$$

To give an example, for the value $p = 0.75$ the money distribution is presented in the figure 4 in logarithmic scales on both coordinates. The model calculations are presented by triangular points, while the fitting curve is presented by continuous green line.

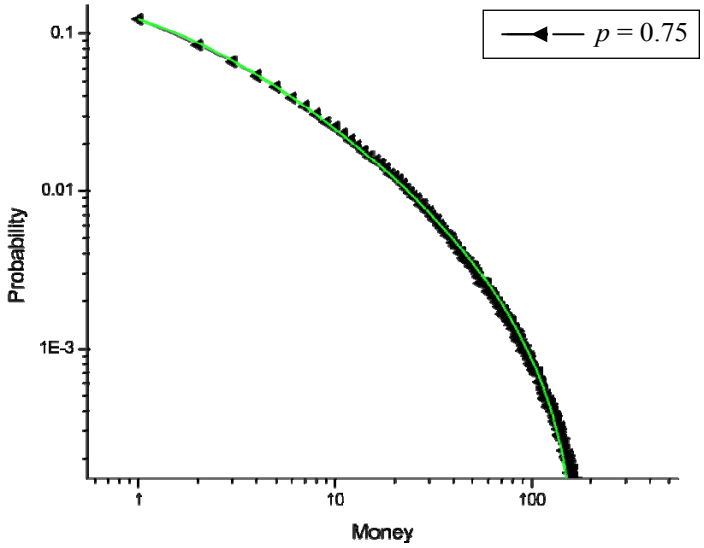

Figure 4. Fit of the money distribution for the parameter $p = 0.75$ with the Bose-Einstein distribution. The value of the chemical potential has been taken equal to $\mu = -1.58$ with temperature $T = 53$ and normalization constant $n_0 = 0.006$.

Note that the absolute value of the chemical potential $\mu = -1.58$ in the fitting curve is significantly smaller than the effective temperature $T = 53$. In general, for $p > 0.5$ the distribution can be well approximated by the Bose-Einstein distribution (Eq. (5)).

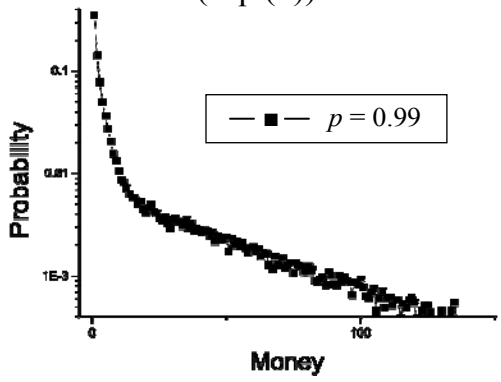

Figure 5. The distribution of money associated with the value $p = 0.99$ in logarithmic scale. One may see that at large values it is a straight line, i.e. the exponential or the Boltzmann distribution, while at small money region it has a different behaviour. The total distribution can be fitted to Bose-Einstein distribution form (see, eq. (5)).

If we compare this distribution with the one of the D-dimensional gas, then this gas must be considered as a quantum gas and will consist of boson particles at temperature T. Its spatial dimension will be equal to

$D = 2$. The parameter n_0 will correspond to a normalisation factor. In this analogy the parameter μ will correspond to the chemical potential of these bosons. The values of all these parameters depend on the parameter p, which control the transferred money fractions.

Table 2

p	μ	T
0.50	–273.	38.59
0.55	–19.8	44.78
0.60	–8.67	50.13
0.75	–1.61	46.29
0.85	–0.64	33.4
0.90	– 0.27	30.4

Table 2: The parameters of the Bose-Einstein distribution of a network of trading agents. For such a distribution the parameter p is corresponding to a fraction of money which each buyer is spending at each transaction. The parameter T corresponds to the temperature of the gas or the market temperature and scales the money distribution, see also the Table 1. The parameter μ corresponds to a chemical potential of a two-dimensional gas which can be put in a correspondence to this trading network, where the money plays a role of the energy. The value of n_0 is a normalisation factor.

From table 2 one may see that for $p > 0.5$ the money distribution can be still described by the $D-$dimensional gas analogy while the space of the $D-$dimensional gas is fixed by $D = 2$ for the whole parameter range of parameter p changes. However when a fraction p of the buyer money rotated in each transaction increases the value of the chemical potential increases and tends to zero. In the tail region we always have a conventional Boltzmann form. For the value $p > 0.9$ we notice a new phenomenon – a separation of the market into two classes of low and high income. The Bose-Einstein distribution fits still well the money distribution however it seems to break down into two regions or two scales: the region associated with small money values and the second one – the high money region. Thus, the system is effectively decomposed into two classes having the lower and the higher incomes. Each of these classes is described well by its own Bose-Einstein distribution, but associated with different parameters such as the average money scale, or the market temperature, T and the value of the chemical potential, μ. In a very

narrow region there is a qualitative crossover of these two Bose-Einstein distributions. Such a Bose-Einstein distribution of money has been recently derived on the basis of statistical mechanics [4], provided that the free economy market is considered as a complex system displaying a chaotic behaviour. Such a distribution may effectively describe a formation of financial crisis as a Bose-Einstein Condensation phenomenon as well as economic growth of human society. In the present case where the Bose-Einstein distribution has been found as a fitting curve these physical arguments may be also applied. From physical point of view the small value of $|\mu|$ relative to the value of T means that the system is very close to the possible Bose-Einstein condensation phase transition in this system, which arises when the chemical potential $|\mu|$ vanishes exactly. When this happens there arises so-called Bose-Einstein Condensed (BEC) state, where the majority of agents have zero, or have essentially no money. From an economic point of view these "condensed" agents are dead for the market economy. They are in the BEC ground state which is different from the active trading state in which the rest of the agent, do exist. The condensed agents with zero money may be activated by debt, although this may lead to other problem or by a luck when they will sell some product sucessfully. Note, that when the value of the trading parameter p reaches 1, the state of the market is exactly in crisis or in the Bose-Einstein Condensed State. There, practically all trading agents except one have no money. This means that they are condensed and form a new form of state known as the Bose-Einstein one.

5. Discussion

In the present work we have studied a simple model of the market with a fixed number of N economic agents interacting in pairs. Originally before a start of the trading processes all agents have different amounts of money with equal probability. At each time step towards equilibrium the agents form a temporary random network with connectivity $k = 1$. As the result of numerous trading events the probability distribution reaches a state of equilibrium described by the gamma distribution. The financial transactions between agents have been characterised by the parameter p. We studied the time evolution of the money distribution between agents when the parameter p varies between 0 and 1. The small values of p correspond to a market where trading is limited by transactions associated with small amounts of money in a comparison with an amount money

which an agent is spending in a trading process. In such a case of the "safe market economy" agents are very cautious to use all their money in a single trading event. While when $p > 1/2$ the agents are "gambling", that is they to use the largest part of their money in their individual single trading processes. We found that the shape of the money distribution depends drastically on the parameter p. The total summary shapes of different distributions associated with different values of the parameter p have been presented in the figure 6. One may see that the safe market economy arising at small values of $p << 1/2$ corresponds to a gamma distribution where the majority of economic agents have approximately the same amount of money (peaked around or very close the average M/N).

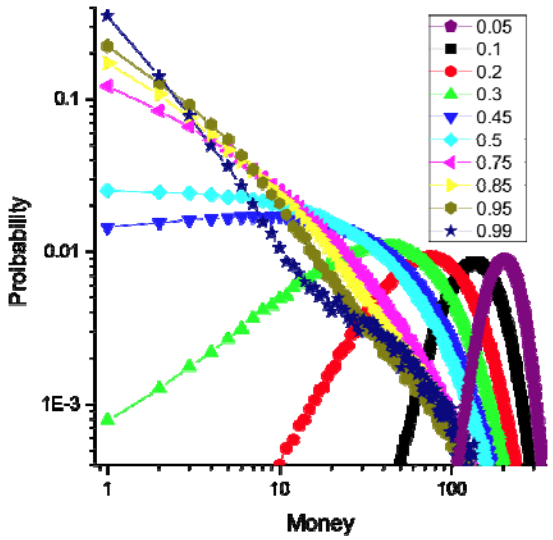

Figure 6. The evolution of the distribution of money when the parameter p changes in log-log scales. When the value of the spending fraction, p, increases, the shape of money distribution changes dramatically, from Gaussian or Poisson form at very small p to a Bose-Einstein distribution, when $p > 1/2$. When p is close to 1, the distribution is split into two parts of agents having small and large amount of money.

With increasing p the situation gradually becomes worse and there appear more and more poor people. While at values $p > 1/2$ there arises a "gambling" market where the majority of economic agents lost their money. We relate such a state of economic agents with a so-called Bose-Einstein "condensed" state where particles have no energy. In the particular case no money corresponds to no energy in the physical system. Strictly speaking the Bose-Einstein condensed state arises when the value

of the chemical potential, $\mu = 0$ and the number of agents who have no money is of the order of the total number of agents, N. However in the present case we do not expect a strict phase transition, which appearance in physical systems depends on many factors such as the space dimensionality of the system and others. Therefore we will use these arguments about a formation of a condensed state from economic agents, only qualitatively. We call all agents with no money as being in condensed state, even when the chemical potential values are nonzero, i.e. negative. This is strictly speaking not a condensed state but a pre-course of that state only, since the Bose-Einstein distribution described a normal (non-condensed state) of the system. The condensed state arises when appear more agents with no money than that described by the Bose-Einstein distribution. From figure 6 where the distribution is presented in the log-log scale we see that some agents lost their money at the value $p = 0.20,$ although in such a case the number of zero money agents is still very small (definitely, not a macroscopic number) and still well described in the framework of the Bose-Einstein distribution. We call such an appearance of the zero money agents as the pre-course of the "condensed" state. The number of such pre-course "condensed" agents increases when the value of parameter p increases. From figure 6 one may see that already when $p = 1/2$ (the light blue curve) the number of agents in the pre-course condensed state is a noticeable fraction of the total number of economic agents on the market also still we do not see the Bose-Condensation yet.

6. Conclusions

In conclusion, we have considered a simple network model of a free market economy described by the parameter p associated with the fraction of money used in individual financial transactions. We have demonstrated that market with gambling trading, i.e. when $p > 1/2$ is very risky and unavoidably leads to a fact that some significant fraction of economic agents will loose their money and condense into a state without money. The next participation of these agents in the market is prohibited unless they will loan the money and receive the debt or be very lucky to sell successfully their property or wealth. On the other hand people get poorer and poorer and most of the people have no money to trade at time period $t_0,$ however then suddenly there might arise immense fluctuations when a person without money can trade a wealth and becomes rich again. On average there are few rich people on the market, i.e having a lot of money.

But most of the people remain poor for the long time period t observing from one time step to other time step how some people suddenly becomes rich. One can easily avoid such fluctuations by always keeping an amount of savings money which has been done in quite a bit of models, see for example the Ref. [5] and the reference therein. In this case we have also noticed that when the parameter p is very close to 1 there arises a formation of two classes which are described by different Bose-Einstein distributions. We plan to consider this case and the generalisation of the market with debt in our next publication. On the other hand the market with small values of the parameter p that is when the economic agents use a small fraction of their money in the financial operations has a strong tendency to the money equal distribution where all agents have nearly the same amount of money and all agents are active on the market. We believe that this is the model of a stable market.

Acknowledgments

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MACROSTATE PARAMETER AND INVESTMENT RISK DIAGRAMS FOR 2008 AND 2009

Anca GHEORGHIU and Ion SPÂNULESCU*

Abstract. *In this paper are made some considerations of the application of phenomenological thermodynamics in risk analysis for the transaction on financial markets, using the concept of economic entropy and the macrostate parameter introduced by us in a previous works [15,16]. The investment risk diagrams for a number of Romanian listed companies in 2008 and 2009 years were calculed. Also, the evolution of the macrostate parameter during financial and economic crisis in Romania are studied.*

Keywords: *econophysics, stock-exchange markets, entropy, macrostate parameter, economic crisis.*

1. Introduction

During the first decade of 21st century a new border science between physics and economy, named econophysics, was emerged. At the beginings, econophysics used mostly statistical physics and mathematics methods to characterize and model a range of economic and financial processes, particularly in capital markets, income distribution, interests, and so on (see for example [1-10]).

In the last years, many researchers included in their papers some models based on analogies between the economical phenomena and phenomena from other fields of physics such as thermodynamics, electricity, spectroscopy, phase transitions physics, reliability theory and so on [11-16].

In this paper, for the analysis of the risk in the financial market transaction, is appealing to the phenomenological thermodynamics methods and to the statistical physics results concerning statistical interpretation of the entropy and the equilibrium conditions of the physical systems.

In our previous works [15,16] some considerations upon economical information value were made and used in order to introduce a new econophysics and technical index for the technical analysis of the stock-market diagnostic named macrostate parameter. With the help of this defined macrostate

* Hyperion University of Bucharest, 169 Calea Călăraşilor, St., Bucharest, Romania.

parameter, the investment risk diagrams for a number of Romanian companies listed at the stock-market in 2006 and 2007 have been established.

In this paper, using the same macrostate parameter and the economic development statistics, the investment risk diagrams for Romanian companies listed in years 2008 and 2009 have been calculed.

2. The Macrostate Parameter

As it was shown in the previous papers [15,16], besides its intrinsic value, characterized by the utility value and trade value, an information type value which determines the denomination, role and importance of any product or service, were considered.

In case when the number of information is large it can be spoken about an information beam with dual aspect, similar to a photon beam or other elementary particles (electrons, protons etc.) characterized by a determined motion mass, impulse, energy etc. [16].

As it was shown in [16] taking into account the above consideration the shares as well as money or economic-financial information about the type volume, or prices of the shares are compared to the particles from an information beam rather by similitude and not by identification with objects from the physical reality. In this case as it was shown in the papers [15,16], for a more complete understanding of the stock evolution from the point of view of the price and transacted volumes, the product **price × transacted volume** can be assimilated to the impulse of a particle (which symbolize the respective financial information) defined by the product pV similar to the impulse $p = mv$ of a particle of mass m and speed v. Such an index can deliver ampler useful information regarding the "inertia" degree or stability of an asset (shares, financial instruments etc.) than the price, p, or the transacted volume, V, taken separately.

In the like manner, all the information from the financial market can be assimilated with the particles of a gas of impulses $p = mv$ confined in a precinct ("financial boiler") that is the very capital market (spot markets, forward markets etc.). In this situation it is plausible enough to apply the same principles, laws and results from thermodynamics, kinetic-molecular or statistical physics to describe the assemble of particles states – called microstates – in which the particles that symbolize the information about the shares (or other financial instruments) from the virtual precinct which can exist at various moments. Every "particle-information" contained in the financial boiler (virtual precinct) is characterized – in a first phase – by

the product price × volume of transacted shares, i.e. by the parameter $a = pV$ as we have seen above.

After a determined time, as a result of the succession of a numerous microstates which appear because of the agitation and the mixture of the constituent particles, the system reach an equilibrium state which is a **macrostate** that can be described by measurable macrostate parameters [17].

By financial (or economic) macrostate we understand the assembly of all the information and decisions materialized in the share price and the transacted volume (individual and for all the day, hour or minute of transaction) when we refer to a quoted emitter, or to the quote of the stock-market index.

So, if we consider $a = pV$ parameter, a microstate for the capital market is given by the assemble of the price and share's volume situation at a very moment t. Starting from the definition of entropy $S = k \ln W$ in thermodynamics, we can introduce a similar parameter named **macrostate parameter**, for the financial markets:

$$P_M = k_B \ln W_B \tag{1}$$

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

As it was shown in the papers [15,16], the macrostate parameter P_M of the financial markets is given by [15,16]:

$$P_M = \frac{1}{N} \sum_{t=1}^{N} \frac{a_t - a_{t-1}}{a_{t-1}} = S_e \tag{2}$$

where N is the number of microstates and $\frac{a_t - a_{t-1}}{a_{t-1}}$ represents the normalized volatility given by [15,16]:

$$Vol_n = \frac{P_t V_t - p_{t-1} V_{t-1}}{P_{t-1} V_{t-1}} \tag{3}$$

with: $a_t = p_t V_t$ and $a_{t-1} = p_{t-1} V_{t-1}$.

In equation (2), S_e represents the economic entropy, being determined and equal with the macrostate parameter P_M [16].

As a general conclusion, in the papers [15,16] in was shown that from the econophysics point of view, the macrostate parameter P_M is a measure of the disorder (entropy) from the capital market, being similar to the thermodynamic entropy from physics. Its size shows directly the uncertainty degree from the economic (financial) point of view for various transacted

companies, being able to constitute a measure of the attractive degree of assets on the medium or long term.

As in paper [16], where we established the investment risk diagrams for Romanian companies listed at the stock market in 2006 and 2007, in this paper, the investment risk diagrams for Romanian companies listed in 2008 and 2009 using the state parameter P_M have been calculed (see Fig. 1 and Fig. 2).

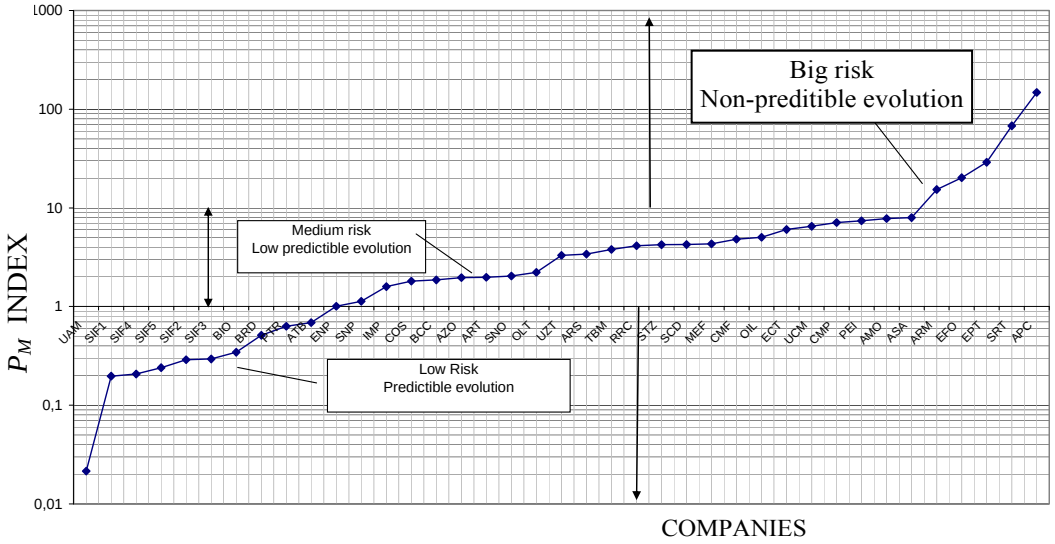

Figure 1. Investment risk diagram for 40 romanian companies quoted at Bucharest Stock-Exchange Market (BVB) during 2008 year.

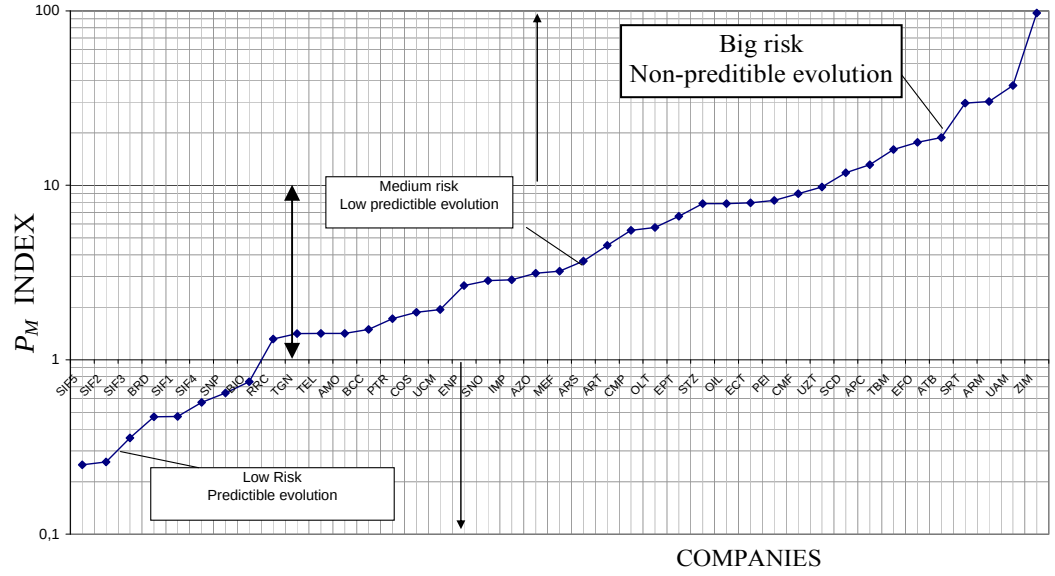

Figure 2. Investment risk diagram for 40 romanian companies quoted at Bucharest Stock-Exchange Market (BVB) during 2009 year.

3. The Influence of the Economic and Financial Crisis on the Macrostate Parameter

As expected, each listed company suffered the impact of the economic and the financial crisis triggered in 2007-2008. The question is: How will evolve the macrostate parameter P_M for companies during the economic and the financial crisis which in Romania has reached its zenith in years 2008-2009?

For the energy or the petroleum companies or for the producing related equipment companies (OIL, PEI etc.) is found that this parameter greatly increased, reaching a very clearly pronounced maximum that was maintained in 2008-2009 (Fig. 3 and Fig. 4).

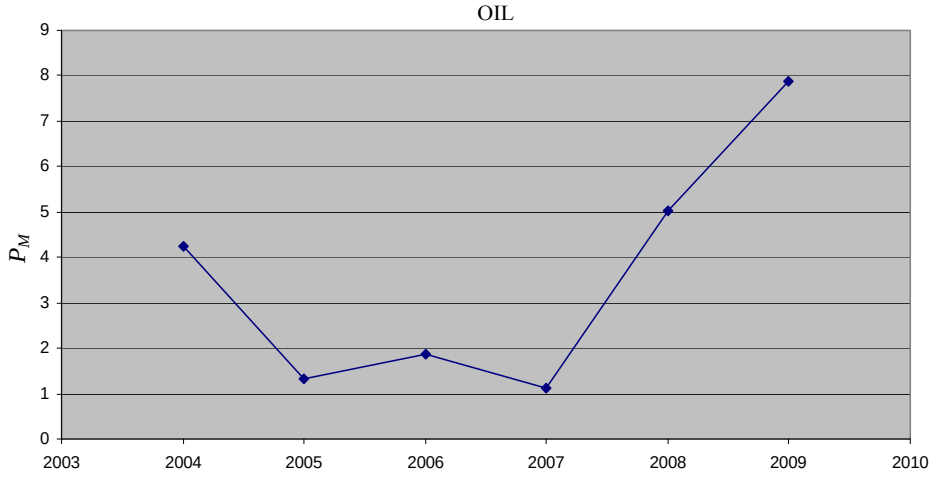

Figure 3. Time dependence of P_M for OIL Company during 2004-2009 years.

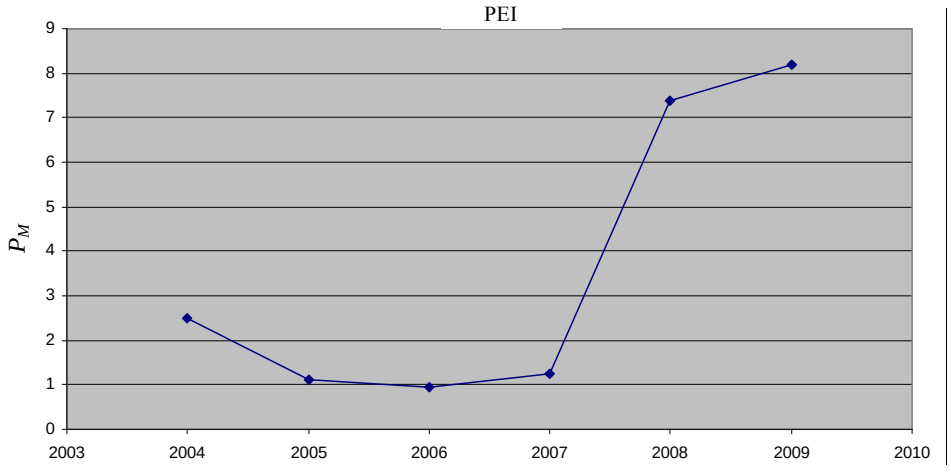

Figure 4. Time dependence of P_M for Petrol-Export-Import Company during 2004-2009 years.

Other companies, more stable like BRD, COS, SNP etc., which were subjected to the infusion of capital or to the capital increase etc. proved to have a normal behavior, without high peak values of the parameter P_M. The variation of P_M for these companies is given in figures 5, 6 and 7.

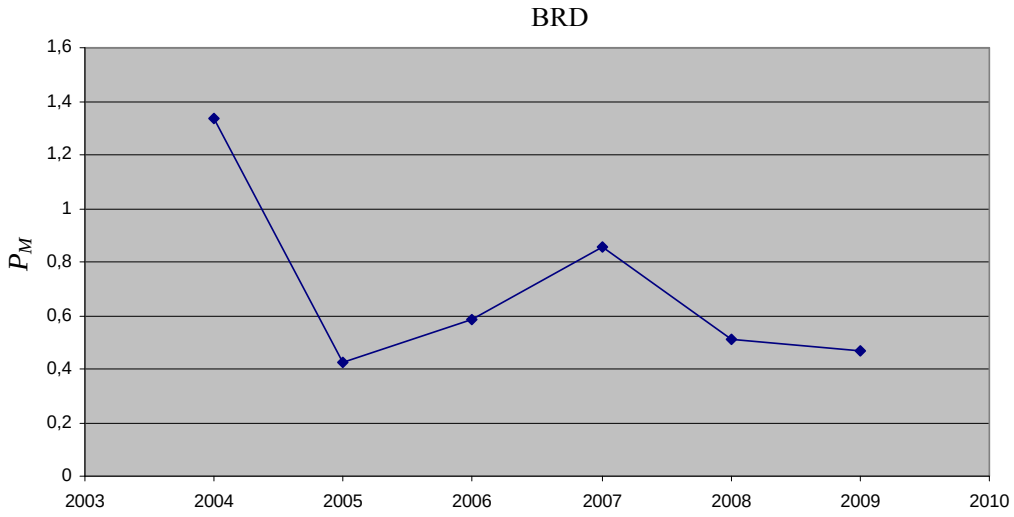

Figure 5. Time dependence of P_M for BRD Societé Generale during 2004-2009 years.

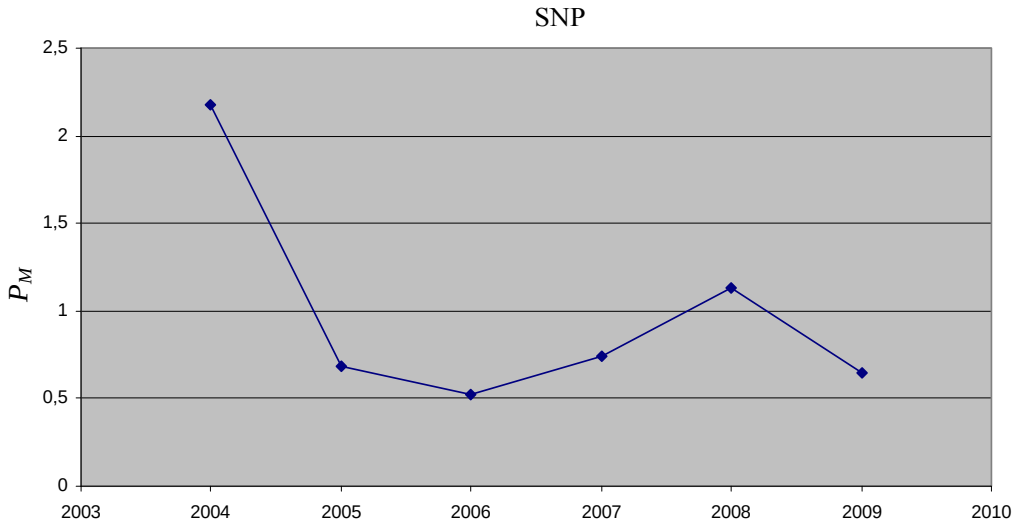

Figure 6. Time dependence of P_M for SNP Company during 2004-2009 years.

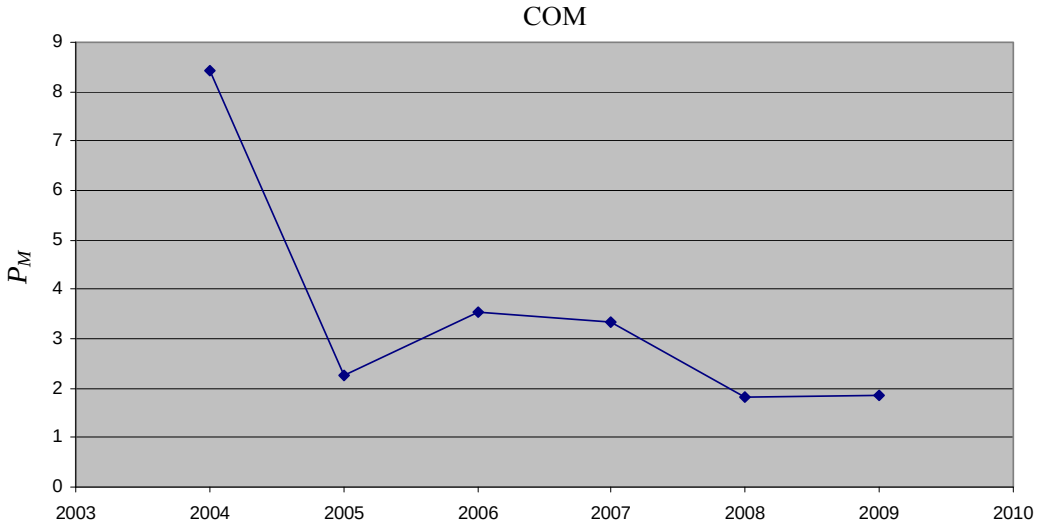

Figure 7. Time dependence of P_M for Compa-Sibiu Company during 2004-2009 years.

Thereby, as well as other financial or economic indexes, the macrostate parameter P_M proved extremely sensitive to the economic and the financial condition changes, and properly reflects the condition and the degree of uncertainty for the companies that have presented obvious difficulties during of crisis and/or recession so as shown in figure 3 and figure 4.

5. Conclusions

In this paper we continue the investigations over the application of physics methods and especially of phenomenological thermodynamics for business processes modeling, especially in the capital markets field.

Using the economic entropy concept or the macrostate parameter introduced in previous papers [15,16], the investment risk diagrams for a number of Romanian companies listed in years 2008 and 2009 have been calculated. The macrostate parameter evolution during the economic and financial crises for some Romanian companies were also studied.

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A COMPUTATIONAL APPROACH TO BAYESIAN STOCHASTIC CLASSIFIER FOR MARKETING DATA MINING

S. S. MISHRA*

Abstract. *Nowadays, data mining is one of hottest areas of research related to various fields such as marketing, economics, surveillance and optimization of profile-practices etc. Data mining is a process of extracting decisive information on the basis of pattern explored from data given. Valid and unbiased samples are drawn from the cross sectional population area in order to discover the pattern of the data. In this paper, we attempt to dig out mine of marketing data to efficiently classify the significantly profitable and normally profitable merchantable materials by developing Bayesian stochastic classifier and its computing approach.*

Keywords: *Naive Bayes classifier, computing algorithm, C++, marketing data mining, SPM, NPM.*

1. Introduction

Data mining is one of the hottest areas of research in physical as well as biological sciences. Data mining refers to the process of extracting patterns from data and in turn it supplies decisive information to take effective and efficient decisions to the problems arising out of various fields of marketing, surveillance, optimization of profiling practices etc. Data mining can be used to uncover patterns in data but is often carried out only on samples of data. The mining process will be ineffective if the samples are not a good representation of the larger body of data. Data mining cannot discover patterns that may be present in the larger body of data if those patterns are not present in the sample being "mined". Inability to find patterns may become a cause for some disputes between customers and service providers. Therefore data mining is not fool proof but may be useful if sufficiently representative data samples are collected. The discovery of a particular pattern in a particular set of data does not necessarily

* *Department of Mathematics and Statistics, Dr RML Avadh University, Faizabad, India.*

mean that a pattern is found elsewhere in the larger data from which that sample was drawn. Therefore, a verification and validation of patterns on other samples of data is a must (Cabena, et.al 1997, Edelstein&Herbert, 1999). Data mining has wide ranging application in surveillance, marketing, bioinformatics and geographical information systems and combat of terrorism etc. (National Research Council, 2008). Two plausible data mining techniques in the context of combating terrorism include "pattern mining" and "subject-based data mining".

One of the burning areas of data mining is the application of data mining techniques to spatial data. Spatial data mining follows along the same functions in data mining, with the end objective to find patterns in geography. Geographic Information Systems (GIS) have existed as two separate technologies, each with its own methods, traditions and approaches to visualization and data analysis. Particularly, most contemporary GIS have only very basic spatial analysis functionality. The immense explosion in geographically referenced data occasioned by developments in IT, digital mapping, remote sensing, and the global diffusion of GIS emphasises the importance of developing data driven inductive approaches to geographical analysis and modeling. These applications include offices requiring analysis or dissemination of geo-referenced statistical data, public health services searching for explanations of disease clusters, environmental agencies assessing the impact of changing land-use patterns on climate change and geo-marketing companies doing customer segmentation based on spatial location (Han et.al, 2000; Kantardzi, 2003).

Data mining is frequently used in customer relationship management where its applications can contribute significantly to the system at core level. Instead of randomly contacting a customer, marketing system can zero in on the high likelihood of offers by using technical and sophisticated methods for optimizing resources so that prediction for the most likely offers can be made. In this regards, clustering technique can also be used to automatically discover such segments and groups which are potentially useful in the data set. Businesses employing data mining may see a return on investment, but also they recognise that the number of predictive models can quickly become very large. Rather than one model to predict which customers will churn, a business could build a separate model for each region and customer type. Then instead of sending an offer to all people that are likely to churn, it may only want to send offers to customers that will likely take to offer. And finally, it may also want to determine which customers are going to be profitable over a window of time and only send the offers to those that are likely to be profitable. In

order to maintain this quantity of models, they need to manage model versions and move to automated data mining. Data mining can also be helpful to human-resources departments in identifying the characteristics of their most successful employees. Information obtained, such as universities attended by highly successful employees, can help HR focus recruiting efforts accordingly. Additionally, Strategic Enterprise Management applications help a company translate corporate-level goals, such as profit and margin share targets, into operational decisions, such as production plans and workforce levels. Another example of data mining, often called the market basket analysis, relates to its use in retail sales. If a clothing store records the purchases of customers, a data-mining system could identify those customers who favour silk shirts over cotton ones. Although some explanations of relationships may be difficult, taking advantage of it is easier. The example deals with association rules within transaction-based data. Not all data are transaction based and logical or inexact rules may also be present within a database. In a manufacturing application, an inexact rule may state that seventy three percent of products which have a specific defect or problem will develop a secondary problem within the next six months. Market basket analysis has also been used to identify the purchase patterns of the Alpha consumer. Alpha Consumers are people that play a key roles in connecting with the concept behind a product, then adopting that product, and finally validating it for the rest of society. Analyzing the data collected on these type of users has allowed companies to predict future buying trends and forecast supply demands. Data mining is a highly effective tool in the catalog marketing industry. Catalogers have a rich history of customer transactions on millions of customers dating back several years.

2. Application of Data Mining in science and economy

Data mining tools can identify patterns among customers and help identify the most likely customers to respond to upcoming mailing campaigns. In recent years, data mining has been widely used in area of science and engineering, such as bioinformatics, genetics, medicine, education and electrical power engineering In the area of study on human genetics, the important goal is to understand the mapping relationship between the inter-individual variation in human DNA sequences and variability in disease susceptibility. In lay terms, it is to find out how the changes in an individual's DNA sequence affect the risk of developing common diseases such as cancer. This is very important to help improve

the diagnosis, prevention and treatment of the diseases. The data mining technique that is used to perform this task is known as multifactor dimensionality reduction (Robert et.al., 2009; Pascal et. Al. 2007; Pang-Ning et.al. 2005).

Computer science and biology fuse in the relatively new disciple of bioinformatics. This interdisciplinary work is driven by the need to analyze and make sense out of the vast amount of data that is produced, when biological systems are studied. Data mining has already been successfully applied for business problems. Insurance companies assess insurance risks and other highly competitive markets like the telecommunication industry use data mining to predict customer churn. Throughout the economy similar such knowledge-discovery methods are used to optimize productivity and the understanding of data mining as a tool for optimization is fairly good understood in this area. Those positive experiences are tried to be adopted for science. Science and especially biology produce vast, complex and noisy data of unseen proportion. An example for this is the human genome project. The sequence of the whole human *DNA* poses a new challenge for data mining and computer science. Data mining algorithms and machine learning has exponential complexity and sometimes require parallel computation. Before we take a look at examples of data mining in biology, we need to define what it actually means. The term data mining or also known as Knowledge-discovery in Databases (*KDD*) is explained in the book Principles of Data Mining as ”The nontrivial extraction of implicit, previously unknown, and potentially useful information from data” and ”The science of extracting useful information from large data sets or databases”. This definition is quite general. In some cases it is extended to include all possible means of knowledge-extraction that is available to gain the most possible understanding of the data. There are many ways how data can be exploited. Data mining can be divided into two main groups; supervised and unsupervised techniques. Supervised algorithms require a posteriori knowledge and experience with the data. Classification and decision trees are examples of this approach and can be used to verify a hypothesis. A priori techniques do not need knowledge. They discover relations by their own. Clustering is used to detect similarities a priori. The a priori algorithm is fundamental for data mining. Such statistical approaches usually lag the ability to detect non-linear relations but provide understandable results (decision trees). New advances in artificial intelligence like neural networks and genetic algorithms support the pattern recognition process to find non-linear relations. There are a lot of patterns in biology which are not understood and data mining helps to

discover novel and hopefully useful information. Data mining is used in the prediction of gene relations in a genome, understanding of relations for region activation in the brain and the prediction of protein folding resulting from changes in the *DNA*. The understanding of the human brain and functional composition of brain activities is a challenging task of biology in these days. Research is this area is heavily dependant on image recognition. Functional-Magnetic Resonance Imaging is used as the basis of data retrieval. The resulting 3D images show locations of interest of increased positron activity. Two kinds of functional associations in the human brain are of interest in the international study called" Computationally Intelligent Methods for Mining 3D Medical Images". One is to understand the association of damaged brain regions and the resulting neuropsychological deficits. This might be of interest to assess probable damage before a brain surgery. The second interest is to identify activation patterns for different tasks. Subjects are asked to perform different tasks and the activation of brain regions is measured. This helps to identify the regions necessary for a specific task (example: learning). Current techniques are either too computationally expensive or not accurate enough. The study tries to tackle that problem in two ways. Adaptive recursive partioning is used to reduce the domain and a neural network is used for classification of this data. To identify discriminate regions in Alzheimer disease patients statistical, adaptive statistical methods and neural networks are compared. Neural network outperformed both statistical methods inaccuracy of the prediction of affected regions. So far, we have dwelt upon number of scopes wherein the techniques of data mining can be efficiently used to help decision making. Here, our focus is to investigate the marketing data mine for segregating two mutually exclusive classes of merchantable materials (Agrawal et. al., 1996; Sergios & Konstantinos, 2009; What100700a.htm; Wang, 1999; Xingquan & Ian 2007; Peng et. al., 2008).

In this paper, a fresh attempt has been made to mine the marketing data in order to efficiently classify the significantly profitable and normally profitable merchantable materials by developing Bayesian stochastic classifier and its computing approach so that organizations working in the environment of cut-throat competition and state-of-the-art and newly discovered knowledge can take the decision in their favours.

3. Material and Methods

Supervised and unsupervised techniques are very fundamental to understand the concept of classifier of data mining. Supervised learning is

a machine learning technique for deducing a function from training data which is based on posteriori knowledge i.e. past experience. Association function in between beers and crisp, diapers and wine, bread and butter is sought from the past information of the data. Supervised algorithms require a posteriori knowledge and experience with the data. Classification and decision trees are examples of this approach and can be used to verify a hypothesis. Unsupervised teachings or priori techniques do not need knowledge. They discover relations by their own. Clustering is used to detect similarities a priori. A priori algorithm is fundamental for data mining. Such statistical approaches usually lag the ability to detect non-linear relations but provide understandable results (decision trees). New advances in artificial intelligence like neural networks and genetic algorithms support the pattern recognition process to find non-linear relations. A **training set** is a set of data used in various areas of information science to discover potentially predictive relationships. Training sets are used in artificial intelligence, machine learning, genetic programming, intelligent systems, and statistics. In all these fields, a training set has much the same role and is often used in conjunction with a test set. Use in artificial intelligence, machine learning, and statistics, u**se in intelligent systems**. In general, an intelligent system consists of a function taking one or more arguments and results in an output vector, and the learning method's task is to run the system once with the input. A **test set** is a set of data used in various areas of information science to assess the strength and utility of a predictive relationship. Test sets are used in artificial intelligence, machine learning, genetic programming, intelligent systems, and statistics. In all these fields, a test set has much the same role. Many procedures have been developed to search through large collections of data for potentially useful or interesting relationships. For example, regression analysis was one of the earliest such approaches to be developed. The data used to construct or discover a predictive relationship are called the training data set (Fig. 1). Most approaches that search through training data for empirical relationships tend to overfit the data, meaning that they can identify apparent relationships in the training data that do not hold in general. A test set is a set of data that is independent of the training data, but that follows the same probability distribution as the training data (Fig. 1). If a model fit to the training set also fits the test set well, minimal overfitting has taken place. If the model fits the training set much better than it fits the test set, overfitting is likely the cause **(**Apte, et.al. 1999; Caruana and Niculescu, 2006; Despina et.al. 2002).

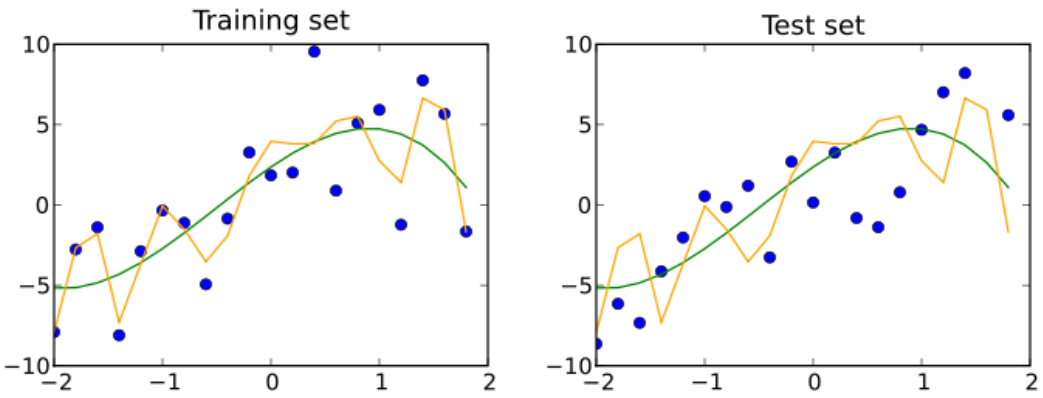

Figure 1. Training set and Test set.

4. Algorithms used in Data mining and Naive Bayes classifier

There are two main algorithms in the field of data mining (Hastie, 2001):

Regression Algorithm: It gives us conditional prediction of response variable for the value of predictors.

Clasiifying algorithm: It makes mutually exclusive groups, for example significantly and normally profitable articles.

A **Bayes classifier (**Harry, 2004**)** is a simple probabilistic classifier model which is based on Bayes theorem, supervised learning, maximum likelihood, training set and test set. This is also called the independent feature model. A naive Bayes classifier assumes that the presence (or absence) of a particular feature of a class is unrelated to the presence (or absence) of any other feature. For example, a fruit may be considered to be an apple if it is red, round, and about 4 rue inch's" in diameter. Even though these features depend on the existence of the other features, a naive Bayes classifier considers all of these properties to independently contribute to the probability that this fruit is an apple. An advantage of the naive Bayes classifier is that it requires a small amount of training data to estimate the parameters (means and variances of the variables) necessary for classification. Because independent variables are assumed, only the variances of the variables for each class need to be determined and not the entire covariance matrix.

5. The construction of naive Bayes probabilistic model

Abstractly, the probability model for a classifier is a conditional model:

$$p(C \mid F_1, \ldots, F_n)$$

over a dependent class variable C with a small number of outcomes or *classes*, conditional on several feature variables F_1 through F_n. The problem is that if the number of features n is large or when a feature can take on a large number of values, then basing such a model on probability tables is infeasible. We therefore reformulate the model to make it more tractable. Using Bayes' theorem, we write:

$$p(C \mid F_1, \ldots, F_n) = \frac{p(C)\, p(F_1, \ldots, F_n \mid C)}{p(F_1, \ldots, F_n)}.$$

In plain English the above equation can be written as:

$$\text{posterior} = \frac{\text{prior} \times \text{likelihood}}{\text{evidence}}.$$

Now the "naive" conditional independence assumptions come into play: assume that each feature F_i is conditionally independent of every other feature F_j for $j \neq i$. This means that:

$$p(F_i \mid C, F_j) = p(F_i \mid C).$$

The discussion so far has derived the independent feature model, that is, the naive Bayes probability model. The naive Bayes classifier combines this model with a decision rule. One common rule is to pick the hypothesis that is most probable; this is known as the maximum a posteriori or *MAP* decision rule. The corresponding classifier is the function classify defined as follows:

$$\text{classify}(f_1, \ldots, f_n) = \arg\max_c \, p(C = c) \prod_{i=1}^{n} p(F_i = f_i \mid C = c).$$

6. Application of Naive Bayes Classifier in Marketing Data minig

In this section, we present a real world example and we try to illustrate so that model can be made applicable in real life. Here is a worked example of naive Bayesian classification to the material product classification problem. Let the size of materials in the population be 2*M*.

Let the population be divided in two parts each having size M. A training set of size m (say) is randomly selected from half of the population of size M and test set is selected from remaining population of size M. Out of size m, we aim to segregate the size m in two mutually exclusive classes based on its feature. One is of significantly profitable materials (*SPM*) and another is of normally profitable materials (*NPM*). For example, let sample size be 5 say x_1, x_2, x_3, x_4, x_5 in which mutually exclusive materials occur in a specified order (particular case) as:

$$x_1 \rightarrow SPM, x_2 \rightarrow NPM, x_3 \rightarrow SPM, x_4 \rightarrow SPM\, x_5 \rightarrow NPM.$$

Here, material is defined as $M = \langle m_1, m_2, m_3 \rangle = \langle m_i, i = 1,2,3 \rangle$ = ‹tea, bread and butter› (say).

Consider the problem of classifying materials by their features, for example into significantly profitable and normaly profitable materials. Suppose that items are drawn from a number of classes of materials which can be modelled as sets of items where the (independent) probability that the i-th item of a given material M occurs in a class C (of materials *Ms*) can be written as:

$$p(m_i / C).$$

(For this treatment, we simplify things further by assuming that items are randomly distributed in the class – that is, items are not dependent on the feature).

Then the probability of a given material M, given a class C, is:

$$p(M / C) = \prod_i (m_i / C).$$

Now we desire to know that what is the probability that a given material M belonging to a given class C?. That is what we want to determine $p(C / M)$. Now by definition:

$$p(M / C) = \frac{p(M \bigcap C)}{p(C)} \text{ and } p(C / M) = \frac{p(M \bigcap C)}{p(M)}.$$

Bayes' theorem manipulates these into a statement of probability in terms of likelihood:

$$p(C / M) = \frac{p(C)}{p(M)}\ p(M / C).$$

Assume for the moment that there are only two mutually exclusive classes, significantly profitable and normally profitable *SPM* and

NPM respectively such that every element (item) is in either one or the other as:

$$p(M/SPM) = \prod_i (m_i / SPM) \text{ and } p(M/NPM) = \prod_i (m_j / NPM)$$

where $m_i + m_j = m$.

Using the Bayesian result above, we can write:

$$p(SPM/M) = \frac{p(SPM)}{p(M)} \prod_i (m_i / SPM),$$

and:

$$p(NPM/M) = \frac{p(NPM)}{p(M)} \prod_i (m_j / NPM).$$

Dividing one by the other gives:

$$\frac{p(SPM/M)}{p(NPM/M)} = \frac{p(SPM)}{p(NPM)} \frac{\prod_i (m_i / SPM)}{\prod_i (m_j / NPM)}.$$

Which can be written as:

$$\ln \frac{p(SPM/M)}{p(NPM/M)} = \ln \frac{p(SPM)}{p(NPM)} + \ln \frac{\prod_i (m_i / SPM)}{\prod_i (m_j / NPM)}.$$

Finally, the material can be classified as follows. It is significantly profitable material if $\ln \frac{p(SPM/M)}{p(NPM/M)} > 0$, otherwise it is normally profitable material for the organization.

7. Computing Algorithm and Numerical Demonstration

We use the following computing algorithm to numerically demonstrate the model's finding (Mishra, 2009).

- Begin
- Input
- $x \leftarrow$ Compute Prob (*SPM*)
- $y \leftarrow$ Compute Prob (*NPM*)
- $z \leftarrow x/y$
- $x1 \leftarrow$Compute *LKH*(*SPM*)
- $y1 \leftarrow$Compute *LKH*(*NPM*)
- $z1 \leftarrow x1/y1$

- $z2 \leftarrow z*z1$
- if $z2>0$
- *SPM*
- Else
- *NPM*
- Output
- End.

Let any organization produce five items in total with $p(m_i, M)$ following binomial distribution i.e. $p(m_i, M) \sim B(m, M)$, $m_i + m_j = m$, $i \neq j$.

This is expressed as $B(m_i, M) = m_{Cmi} p^{mi} q^{m-mi}$.

Hypothesis: Three materials chosen from the entire class of materials of the organization are significantly profitable.

Now, by using the above computing algorithm and implementing in *C*++, we can easily compute:

$$L(SPM) = 3^{15}/2^{10} \times 5^5$$

and:

$$L(NPM) = 2^{15} / 3^{10} \times 5^5; \; p(SPM) = 3/5; \; p(NPM) = 2/5$$

$$\frac{p(SPM/M)}{p(NPM/M)} = \frac{p(SPM)}{p(NPM)} \; \frac{\prod_i (m_i / SPM)}{\prod_i (m_j / NPM)}.$$

This implies that $\ln \frac{p(SPM/M)}{p(NPM/M)} > 0$, which further implies that $p(S/M) > p(N/M)$. This testing based on the log-likelihood ratio provides sufficient scientific evidence to accept the proposition of the problem.

8. Disscussion and Conclusion

Hence keeping the logic finally obtained in previous section, organization should zero in more on *SPM* to earn the profit with normal attention to *NPM* together. In spite of their naive design and apparently over-simplified assumptions, naive Bayes classifiers have worked quite well in many complex real-world situations. In 2004, analysis of the Bayesian classification problem has shown that there are some theoretical reasons for the apparently unreasonable efficacy of naive Bayes classifiers. Still, a comprehensive comparison with other classification methods in 2006 showed that Bayes classification is outperformed by more current approaches, such as boosted trees or random forests. The final step of knowledge discovery from data is to verify the patterns produced by the

data mining algorithms occur in the wider data set. Not all patterns found by the data mining algorithms are necessarily valid. It is common for the data mining algorithms to find patterns in the training set which are not present in the general data set, this is called overfitting. To overcome this, the evaluation uses a test set of data which the data mining algorithm was not trained on. The learnt patterns are applied to this test set and the resulting output is compared to the desired output. For example, a data mining algorithm trying to distinguish profitable material from store would be trained on a training set of sample items. Once trained, the learnt patterns would be applied to the test set of materials which it had not been trained on; the accuracy of these patterns can then be measured from how many emails they correctly classify. A number of statistical methods may be used to evaluate the algorithm such as *ROC* curves. If the learnt patterns do not meet the desired standards, then it is necessary to reevaluate and change the preprocessing and data mining. If the learnt patterns do meet the desired standards then the final step is to interpret the learnt patterns and turn them into knowledge.

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ECONOMIC MACRO REALISM VS. MICRO IDEALISM IN QUANTUM PHYSICS' VISION – A SHORT TERM PLEA OR A LONG TERM DEFENCE FOR THE INTEGRATION OF QUANTUM PHYSICS' THOUGHT IN ECONOMICS

Ion IORGA-SIMĂN and Gheorghe SĂVOIU[*]

Abstract. *Some typical methods and models from quantum physics' way of thinking are more adequate to the medium and long term future of economics. This paper anticipates the improvements of the quality in the classical research of economics, through some of the new and still typical quantum physics' way of thinking able to perform economical analysis, better than econometrics or economic statistics, in general. Another aspect of this article is related to the significance of the integration of the quantum physics' thought, or of quantum mechanics, into the statistical evaluation of the economic results, beginning in the very next the future. This could be also a consequence of the experience generated by the global crisis in the economic world. The thinking of quantum physics or of quantum mechanics does not exclude, through generalization, the macroscopic world, to which reference is made, under the name of world economy, macroeconomics and macro-results. The laws of quantum physics are the most general laws of nature also for the reason that they start from the wave equation (function). Even the economic result is somehow, between the energy of the wave and the statistical. The contemporary debate about the future of economics must defence the importance of the new alliances with physics, but especially with quantum physics. The application of quantum theory in economics implies the fact that the sum total of the information concerning a certain particle or an economic entity must be contained in the wave function or in the energy function of the economic activity which is associated to it, as the formalism of the wave functions is considered adequate because their predictions are in keeping with the experiments and economic evolutions. The basic laws of quantum physics and mechanics describe the physics of the sub atom world, but the macroscopic world is itself a final case of that science of the greatest*

[*] University of Pitesti, 1 Târgul din Vale, St., Piteşti, postal code 110040, Argeş County, Romania, e-mail:gsavoiu@yahoo.com and ioniorgasiman@yahoo.com

generality as we can see from economic point of view. In the thinking of quantum physics and mechanics, an entity of a sub atom particle, such as the electron, could behave not only as a particle, but also as a wave. This is the major change for economic thought. Even economic entity is not a particle, sometimes it is activity and results during the same time, like in quantum physics. That odd quantum effect is supposed to disappear, in accordance with the thinking of quantum physics, when the entities become bigger. But the contemporary capitalism trend is the one of the individual level. In the normal world, this effect does not exist, but the macroscopic world cannot however explain its own behaviour without it. The authors believe that a short term plea or a long term defence must solve the problem of a new thought in economics inspired by the quantum physics. In addition to this main purpose, the paper could be a good explanation for a better understanding of the crisis and recessions.

Keywords: *quantum physics, quantum economics, macro realism, micro idealism, particle, economic entity, wave, economic activity.*

1. Introduction

Economics' history underlines how economists have sometimes aligned the field of economics with physics, culminating in the currently dominant neoclassical and modern schools. There are a great diversity of schools of economic thought: from the Austrian economists, German Historical School, English Historical School, French Historical School, Institutionalists, Marxists, Utopians and Socialists, Behavioral economists, Chaos theorists, Keynesians, Neo-Keynesian Synthesis and post-Keynesians, Neo-Ricardians, Agency Theorists, Chicago school, Constitutional political economists, Public choice theory, Non-Standard Economy to New School for Social Research and many others [1,2,3,4].

Most economists regard their discipline as an independent science, one humanistic discipline, of course. But, in the common understanding, physics remains the best developed of the sciences, also is considered the most adequate way of thinking about reality, and economics ought to be modeled on physics more than on mathematics, econometrics etc. [5]. One of the most radical criticisms of the economic thought considers economics as an applied of the most important method from physics in all economic phenomena. This is Mirowski's radical thesis, and in his opinion, the physics' model has determined in detail the sum and substance of economic theory from the Physiocrats, down to the present. Economists have directly translated the models of physics in use in their time into economic categories (incidentally, this does not exclude the influence of economic concepts and macro realism in physics). Even the father of

economic science, Adam Smith define wealth as stock, but not because this definition was dictated to him by a simple observation of the economy, and quite the contrary, he was influenced by Cartesian physics, and stock, in Smith's view the substance of value, corresponds to the mass that is conserved in Cartesian physics. And soon, in economics thought stock is made by particles, and utility, the basic concept of neoclassical theory, is identical with energy.

Far from understanding the simultaneity of macro realism and micro idealism, economics failed in analysis of the utility, while in quantum physics utility succeed to be regarded as an entity incorporated in goods and services (somehow indestructible and indeterminate like in the continuity of particle in energy of the wave).

Another way of illustrating the similitude between economics and physical science, that is all too often ignored, consists of an accusation that was made by Benoit Mandelbrot, through a theoretical point of view, underlying that a very large part of economic theory is just physical theory with the words changed. The most of all economics' paradigms are just physical ones, from elasticity to equilibrium, from measurement to evaluation etc.

Physics was born fundamentally in a demonstrative or reductive way of thinking and then, with Newton's ideas, became also an universal science. Physics developed a real universe of labour between theoretical and experimental work. This process has led to disunity within physics of one kind, but also to a more complex set of interactions within physics and, as it has become a fundamental science [6]. A distinctive feature of the economical sciences is that, while these share with physics the descriptive and explanatory application of mathematical statistics – in population and probabilistic interpretations – it seems to lack strict and universal laws of the sort "recognized" in physics. The profound implications of physics in the fields of economics or social sciences have already created econophysics, sociophysics, and quantum economics. Econophysics and sociophysics seek to integrate the physics' methods, models, and laws with classical economics' and sociology's theory and thinking, seeing this new domain of applied physics as an unlimited one. Econophysics and sociophysics replace conventional ways, with the new and broader views of physics' thinking. Could be quantum physics a different direction of a new and modern applied physics' way of thinking? What means Quantum Economics in this new context?

2. Economic Macro Realism vs. Micro Idealism in Quantum Physics' Vision

Each science defines and is defined by a certain type of thinking. The logical thinking, maybe the only type of thinking present in all the attempts of human cognition, proposes the solution of the direct definition, but it also capitalizes in frequent situations the one of the denial of the negation, by defining the opposite and then „per a contrario", of all that is not the opposite thus confined. In the case of a presentation about efficiency and effectiveness, two concepts which have a visibility out of the ordinary in the contemporary economics and in the macro realism specific to it, must be defined, first, the economic thinking or that of the degree of economy whose fundamental products certainly are both the one and the other. But in order to define the thinking of the degree of economy, we should get down one more step from the high tower of logical thinking and begin with what is defined as human activity, next to the notions of its immediate results or effects, in other words with the primacy of efficaciousness. There certainly was a thinking of the efficaciousness, easier to be defined by opposition with the thinking of the non-efficaciousness. The thinking of the non-efficaciousness precedes the organization and the institutional. The thinking of the non-efficaciousness remains that type of thinking which is able to establish the existence of a result without obtaining it in an effective way or to record the presence of an object with certain properties, respectively without being able to identify it [7]. A number of two limit-situations, in which the human beings and their natural way of cogitating are involved, become illuminating examples:

(a) an odd number ($2n$ +1) of messages is communicated to "n" receivers (obviously in positive whole numbers), but it cannot be clearly individualized nor specifically named how much has each received, although it results nevertheless that one of the receivers has received at least 3.

(b) an arbitrator (an observer) in an extended multilateral negotiation finds out that he/she has an unopened envelope left, representing the anonymous request of a negotiator, when all the parties have gone, after having practically concluded the agreement, and he/she assumes that one of the parties is in the situation of a round in which his/her own conditions do not appear in the final signed agreement (the arbitrator not being able to identify the negotiator nor to stop him/her and return the envelope).

The different degree of non-efficaciousness of the exemplified situations (a) and (b) raise an essential problem of the thinking of the

non-efficaciousness, respectively the possibility of the clear delimitation of the principle non-efficaciousness from the practical non-efficaciousness [8,9]. Another important type of non-efficaciousness results from the contrast between the accuracy of the effects as information estimated with global character and those with local character (individual, spatial or momentary). Contrary to the appearances, the local effects, where the detailing is excessive are more difficult to estimate than the global ones, where compensation and approximation are omnipresent. On a general economic level, the thinking of the efficaciousness dominates, as a simple consequence of the observation that all the activities manifest themselves through effects whose huge diversity always has a well-individualized owner. One can unconditionally state that the primacy belongs to efficaciousness or, in another way of speaking, to economic macro realism. Analogously, the economic thinking is always identical with particle, but in an aggregative manner. Classical economics has meant also a modality to reunite individual realism in a macro formula, through origins in the sphere of the thinking of efficaciousness. Classical economics had always a first option for particle (unit, entity, individual, person, family, household, agent, financial or non financial corporation and agency, labour market or other market, territory, region, country etc.). The continuous aggregation inside the economic phenomenon makes finally from some micro entities only one economic macro attitude called macro realism. Classical economics deals only with a certain aspect of reality, the macro realism of this sort of "economic reality", many times of an optimum manner, in which man employs scarce resources, and thus it has encouraged the application of quantitative and formal methods, to gain intellectual legitimacy associated with the virtues of precision and objectivity. The absence of scenarios was also a characteristic option for classical economics. Even the economic aggregate subjects are somehow made from the same simple units that are individuals: entity, person, family, household, agent, financial or non financial corporation and agency, labour market or other market, territory, region, country etc.), economic systems are increasing day by day, in the human and natural environments like physical, biological and social types.

The contemporary capitalism trend becomes more and more one of the individual level. That means a multiplication of the firms' number on economic reality and also on internet nearby 10^{10} and perhaps more than 10^{20} specific products and services, during the next 50 years. Thus economic reality could be more adequate for quantum physics' models and methods. In the nowadays economic world, this effect still does not exist,

but the macroscopic world cannot however explain in the next future its own behavior without it.

But what has this to do with quantum economics? First let us try to define the specificity of quantum physics' way of thinking.

Quantum physics remains the powerful science for studying subatomic particles. Very small particles at very high velocities behave differently from billiard balls and solar system planets and there are some non-intuitive effects of trying to observe and pinpoint features of individual particles. Quantum physics emerge from classical statistical physics or classical statistics [10]. A typical quantum system describes an isolated subsystem of a classical statistical ensemble with infinitely many classical states. The state of this subsystem can be characterized by only a few probabilistic variables. Their expectation values define a density matrix if they obey a "purity constraint". Then all the usual laws of quantum follow, including Heisenberg's uncertainty relation, entanglement and a violation of inequalities. No concepts beyond classical statistics are needed for quantum physics – the differences are only apparent and result from the particularities of those classical statistical systems which admit a quantum mechanical description. The rule for quantum probabilities follows from the probability concept for a classical statistical ensemble. In particular, the non-commuting properties of quantum operators are associated to the use of conditional probabilities within the classical system, and a unitary time evolution reflects the isolation of the subsystem.

But first of all, despite the scientific character of quantum physics, this incredible way of thinking offers and takes a spiritual perspective in which there are no separate parts, in which everything is fluid and always changing, from particle or atom to wave or energy, from material to spiritual, from macro realism to micro idealism etc.

It is through our thoughts that we transform this ever-changing energy into observable reality. Therefore, we can create our reality with our thoughts. With quantum physics, science is leaving behind the notion that human beings are powerless victims and moving toward an understanding that we are fully empowered creators of our lives and of our world. Quantum physics shows that what's happening on the inside determines what's happening on the outside. It says that our world is shaped by our thoughts. Quantum physics' way of thinking is the nearest thought to the universe, and even beyond universe.

The original connection between quantum physics and thought was made by David Bohm in 1951. The human brain is no Turing Machine. Roger Penrose tries to prove that our consciousness is non-algorithmic, and

that we seem – to our conscious selves – able to make decisions in a flash. He finds that this could be explained only by quantum physical thought processes that proceed in sub-graviton parallelism until they reach graviton level, when they collapse and produce a conscious thought [11].

Both Roger Penrose and Amit Goswami note that where quantum physics seems mystical, it is because it is not complete, stable, or a finished theory. Since quantum theory cannot explain the collapse of wave functions adequately we should not try to use to explain more complex phenomena either. We need better tools. Obviously, the brain is composed of particles obeying quantum laws (a notable case is that the retina accepts photons, which are small enough to behave strangely in terms of classical physics). Quantum physics is strange. So is consciousness. Maybe there is something in common between the two. The indeterminism in quantum physics is commonly modelled in a wave function – which is a combination function of possible outcomes, and determining the outcome is commonly termed "collapse of a wave function".

Penrose says that consciousness as a side effect of running an algorithm is not possible. Amit Goswami completes this idea, and reconciling macro realism with micro idealism is possible in quantum physics' way of thinking because of six main reasons [13]:

– quantum state of a system is determined by the Schrodinger equation, but the solution of Schrodinger equation, the wave function is not directly related to anything that can be seen by someone;

– quantum objects are governed by the Heisenberg uncertainty principle: it is impossible to measure simultaneously and with certainty pairs of conjugate variables such as position and momentum;

– the paradox of wave-particle duality consist of quantum objects, needing for a solution which involves interpretation and philosophy;

– discontinuity and quantum leaps are truly fundamental features of quantum systems behaviour;

– physical reality could be or not a coherent superposition;

– under certain conditions (for example, when energy levels of atoms are separated by very small spaces), quantum mechanical predictions could be reduced to those of classical mechanics.

Macro realism arises whenever economics appear, but difficulties are more and more significant because of the quantum nature of reality.

Very much as the measuring process gets us acquainted with quantum thinking, the concepts of statistical collective and ensemble, being tantamount to a number of sequences of probabilities and mean values of the variables of quantum physics, allow the mental associations among

molecules or particles, and economic agents, or subjects. The world of physics thinking can impose to economical thought the probabilistic character of its forecasts, even in the case of a pure statistical collective, gradually eliminating the exclusively deterministic models of prognosis specific to classical economics.

Probabilistic density will thus generate prevision's models, based on the probabilistic thinking structured in distinct scenarios. The merit of the quantum physics is that of acknowledging its limits in foreseeing future events, centred on the principle of uncertainty, and becoming familiar to future economics, as well. Economical thinking will also take over, in future, the simultaneity of the states of particle or wave, from quantum statistics, in an alternative approach to the various specific units defined through binary states.

Finally, the quantum economics is the scientific compromise between the economic vision and quantum physics' thought. Quantum economics means also the coalition and the equilibrium between the two sciences. [14] This coalition has three steps:

– the coalition must have "positive measure" (the coalition "matters", in the general sense);

– the both sciences (economics and quantum physics) prefer the new allocations of the common sense of thinking;

– the total endowment of the coalition must be sufficient for them to conduct to a better understanding of the economic world (more atomized and thus continuum).

3. Why is necessary the Integration of Quantum Physics' thought in the Economic science?

To measure statistically or anyhow the economic processes is uncertain the developed tools and indicators for such measuring are inadequate and limited but even they were developed to perfection they still would not be able to measure these processes because the processes by themselves are uncertain. The intervention of quantum physics is absolutely necessary for using better qualitative methods and more generalized way of thinking. Quantum physics does not emerge from classical statistics like econometrics or economic statistics. A typical quantum system describes an isolated subsystem of a classical statistical ensemble with infinitely many classical states. The state of this subsystem can be characterized by only a few probabilistic observables (variables). The quantum method of description of market agents' movement (or simply quantum economics) leads to

probabilistic mechanism of forming of demand and supply functions and market price at which sale transactions are carried out in the market. Quantum equations of motion and interpretation of their solutions will, of course, be different from those in classical economies [15].

Quantum economy is a quantum economic model of a finite economic system that consists of an economic subsystem (or simply economy) with a certain number of buyers and sellers (economy agents) and its external environment (institutions) with certain interactions between economy agents, and between the economy agents and institutions. All quantum models that describe finite economic systems are based on using quantum physical models of the corresponding abstract or virtual finite physical systems consisting of point bodies with different parameters and different interactions among them. Quantum economy in the large sense is a field of science about physical modeling of finite economic systems by means of corresponding finite physical systems and studying of such economic models with the help of quantum mechanics methods. In this sense it can be called also quantum economics. Quantum economy can also be seen as a new subsection of econophysics which gives quantum physical models for finite economic systems. Whereas traditional econophysics subsections give physical models for infinite economic systems that allows to use statistical physics methods for their description [16].

The principal aspect in developing a physical model is a selection of function which helps us to describe economy dynamics, like movement of buyers and sellers in price space. As such a function in classical economy the economists can chose the agent's trajectory in a price space supposing implicitly that behavior or movement of the market agent comes to establishing a price for goods and commodities at every point of time by negotiations or information exchange both between economic agents and agents with external environment. It looks like economic agents adjust their trajectories to each other based on their principal concerns for their own and common profit that leads to some determination in their behavior or movement in price space.

The evolution of the economic processes could be given only by "parameters of expansion, contraction or sometimes the both" so they can develop in "certain areas" to "certain extend" and then changed or adjusted, it may be done in a way to disperse accumulating energy so instead of big wave: the ways energies are accumulated and create big waves is the example of each market appreciation: which is positive for the economy to the extend of providing additional capital and equity thus expanding individual capitalization and investing. Quantum physics can

imagine a better solution of these three economic situations. Quantum physics is compatible with three distinct metaphysical 'packages', one in which the agents (particles) are regarded as individuals, one in which they are regarded as energy (wave) and one where the both possibilities are accepted.

There is an essential contemporary difference between quantum physics and quantum economics. The uncertainty of observation in the quantum physics quantities relates not only ever changing realities but also the ways of observations.

The main issue is measuring and observing in the quantum economics is putting parameters after analyzing of the information when the difference between economical quantities and final observations are even greater hence the measurements start from the same or even totally opposite points so the relevance between and among these measurements is based on their directions, length and the angles of their projections (in fact these are more and more scientific bias of the economics).

4. Conclusions

Why physics can contribute more than any science to economics development?

Theoretical economics is more and more dominated by pure mathematics, instead of a new way of thinking, like quantum physics can be. With a few exceptions (game theory approach or assumptions about stock price fluctuations etc.) pure mathematics has contributed to economics in a relative manner comparing with physics in general (and especially with quantum physics potential). Physics, in general, can work with real market data, can also derive empirical laws and construct phenomenological theories, and statistical physics has useful approaches to economic systems, composed of many interacting parts. Quantum physics can change the entire way of economics' thinking, due to interacting units in economics are thinking agents with adaptive strategies and they are not so far from the not "mindless" particles obeying simple microscopic laws.

The macroscopic state does not separately determines microscopic system states, but probabilities for those states to be realized in the macroscopic system. The essential role devolves upon the probability density, or that of the phases, a density that is capable of completely describing a new type of state, called the statistical state, of the state of the ensemble. Knowing the macroscopic parameters now becomes possible, at once with defining the probability density...

5. A final remark

In this paper, we try to demonstrate the necessity, opportunity and versatility of quantum physics on future economical decisions based on statistical information as usual. A final remarque is related to the significance of the integration of the thinking of quantum physics into the economic and statistical thinking of the future. The thinking of quantum physics does not exclude, through generalization, the macroscopic world, to which reference is made, in economics or statistics as well, under the name of populations and economies. The laws of quantum physics are the most general laws of nature, also for the reason that they start from the wave equation (function).

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NEW ECONOMY Section

ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN THE TWO DEFICITS IN ROMANIA

Elena PELINESCU, Petre CARAIANI*

Abstract. *In this paper we analyze the impact of various macroeconomic variables on the current account keeping in mind that one major signal of the current crises was the increasing the internal and external deficit. In order to analyses the relation between the two deficits in Romania we used linear regressions and VAR's techniques. Our result showed that there is a higher impact of the saving rate on current account deficit as compared to the investment rate impact. We also proved that increasing the wages and exchange rate fluctuations have strong effects on the worsening of the current account. In the long run, the fiscal instruments should be the more active so that to reach a sustainable current account and fiscal deficit. This is an ongoing study to be further extended with analysis regarding the fiscal deficit during the current financial crisis. JEL Classification: F32, C32.*

Keywords: *econometric analysis, current account, VAR model, OLS model.*

1. Introduction

The globalization process has modified the economic environment so that the concept of equilibrium between savings and investments at the national level has dramatically changed. The liberalization of the capital flows and the growing degree of integration of the financial markets, of the goods and services markets and finally of the labor markets make possible the transformation of economies to a „savings importer" while others become „savings exporters". Under the circumstances that the differences between the returns on investments will persist, the savings-investment balance will become sustainable in the long run for the "savings importer" countries which will finally lead to a review of the restrictions on the finance means of the external deficit.

* Institute for Economic Forecasting, Romanian Academy, email address: Elena-_Pelinescu@yahoo.com

In a recent study, Copaciu and Racanu (2006), starting from this reality of the contemporary economy, mention that "the liberalization of the capital flows at the global level (and more recently, the almost complete liberalization of the transactions of the capital account for most of the emerging economies) will lead in time, as capital inflows are the mirror image of the deficit, to wider and more persistent deficits, relative to the past period". This opinion is also shared by Herrman and Jochem (2005) who reveal the risks that a big current account deficit poses, especially for the countries that are preparing for the EMU. However they conclude that the level of this deficit should be analyzed relatively to the level of development of each particular country. They bring as argument Greece and Portugal, which at the beginning of this century had current account deficits of 7.3% and 10.4% from GDP respectively, and which it afterwards reduced without a policy of currency devaluation.

The current situation in Romania is characterized by a persisting trade deficit, with a tendency to worsen, which is financed by the inflows of capital due to the spread between the domestic and external interest rates and by the transfers of money from Romanian workers abroad. Romania has passed during the last three years through levels of current account deficit of over 8% from GDP (comparable to those in Hungary between 2003 and 2004 and Slovakia between 2001 and 2002[1]).

Following the "5% doctrine", adopted by the IMF specialists and the private investors at the end of '90's, any current account deficit of over 5% (sometimes this limit is reduced to only 4%) is considered as unsustainable and as raising a high risk factor. The causes of these high deficits are to be found either in excessive expenditures generated by lax monetary, fiscal or wage policies, or, as the recent studies on the current account underline, in the supply side factors, like the savings excess in some regions or countries which have to be invested anywhere it is profitable. The economic literature mentions that in the large countries, with open economies, the twin deficits may appear as a result of expansionary fiscal policies, the current account deficit being of 50% from the reduction of the budgetary revenues in GDP).

In Romania, like in other countries, the current account deficit can be explained by the worsening of the savings-investment balance, the gap between savings rate and investments rate fluctuation between 8.3% in

[1] Marek Dabrowski, *Current account imbalances and monetary union* (conceptual issues), CASE paper prepared for the third EUROFRAME Conference on Economic Policy Issues in European Union, Berlin, June 2, 2006, table 1, p. 2 quoted as source WEO, 2006, Table 31, p. 225.

1992 and 6% in 2003, to 8.7% in 2004 and over 8% in 2006[2]. Analyzing the dynamic of the current account in the transition economies between 1990-1996, Roubini and Wachtel (1998) conclude that the improvement in the current account in Romania in the 1993-1996 period to an average of 3.8% relative to the 7.5% in the 1990-1992 period was due to the improvement in the savings rate in the public sector, while the savings rate in the private sector was relatively stable. The economic policies, either directly or implicitly, through the effect on the savings-investment balance, cannot be neglected in explaining this phenomenon.

The finance of this deficit was realized through the net direct investments of capital which grew in Romania from over 1.3 billions euro in 2000 to 5.2 billions euro in 2005 and to 7.9 billions euro in the first 11 months of 2006. These levels reveal that Romanian economy is attractively for the foreign investors. Moreover, after 2000, the current account deficit was also financed by the entries of transfers of money from the Romanian workers abroad as current transfers (which were estimated at 1.3 billions euro in 2004 and at 2.8 billions euro in 2005[3]) which are continuing to grow. The revenues from labor grew from 86 millions in 2004 to 752 millions euro in 2005 and 667 millions euro in the first 11 months of 2006, thus helping the current account deficit diminish.

In this general context, the paper investigates the determinants of the current account. In this sense we use both annual series of data (for the period 1990-2010) from the monthly bulletins of the National Institute of Statistics (INS), the Annual Reports of the National Bank of Romania (NBR) for the Balance of Payments and monthly series from the NBR bulletins and from the Ministry of Finance (MF) for the period January 1997 and October 2006.

2. An Econometric Analysis of the Relationship between the Two Deficits

The analysis of the relationship budget deficit – current account deficit can start from the analysis of the internal correspondent of this relation, namely from the savings-investment decision at the level of

[2] According to Bloomberg Forecasting for 2006 quoted in Copaciu, I. Răcanu, *The External Balance of Romania – qualitative and quantitative approaches,* NBR working Paper 18, p. 23.

[3] M. Copaciu, I. Răcanu, *The External Balance of Romania – qualitative and quantitative approaches,* NBR working Paper 18, October 2006, p. 19.

national economy. This can be either directly or indirectly influenced by the changes in the level of taxation of wages, changes in custom duties, in the VAT or in other taxes.

A graphical analysis of the dynamic of the two deficits reveals the fact that until 2000, their dynamic was almost symmetrical. The worsening of the budget deficit is to be found in a similar worsening of the current account deficit as one can see from the figure 1.

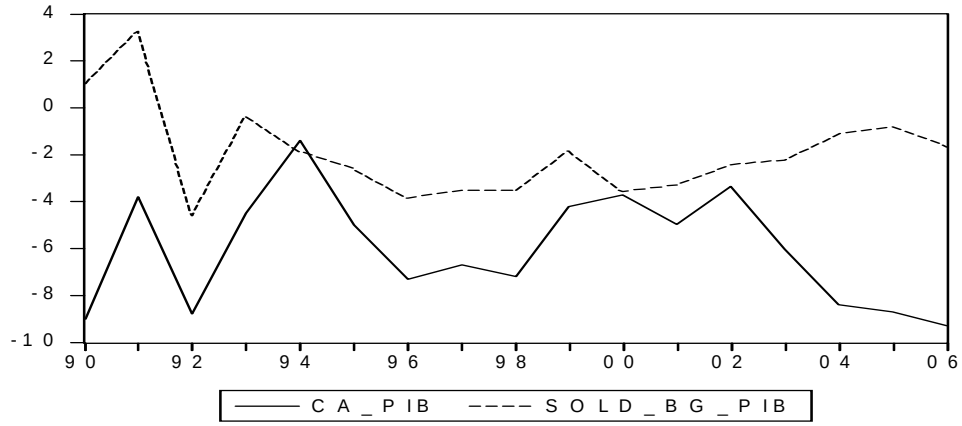

Figure 1. The Dynamic of the share in GDP of the budget deficit and current account in Romania.

Source: Authors' Computations using data from the Balance of Payments, NBR 1990-2005 and data from MF and INS.

The figure suggests that this comovement stopped after 2002 when the worsening of the current account deficit was not accompanied by a similar dynamic of the fiscal deficit which started to have a tendency to improve, based on a tight fiscal policy. What is clear is that after this year, the private sector has pressured more on the current account. This implies that the changes in the economic policies after 2002 led to a worsening of the current account, even under the circumstances in which the fiscal deficit was kept under control.

2.1. The Impact of the Savings Rate and of the Investment Rate on the Current Account Deficit

As a first step we analyze the of the current account deficit as a share of GDP using as explanative variables the gross savings rate and the investment rate (the share of gross fixed capital formation in GDP), in a

VAR model. The Test regarding the number of lags indicates that 2 lags are the most fit according to AIC and SIC criteria:

CA_PIB= -2,036*CA_PIB(-1) –11,034*CA_PIB(-2)– 2,532*RATA_INV(-1) – 11,579*RATA_INV(-2)+

[-0,78550] [-3,88114] [-0,91897] [-3.87937]

2,2116*EC_BRUTA_PIB(-1) + 11,5088*EC_BRUTA_PIB(-2) + 5,2394

[0,82761] [3,87352] [1,45256]

RATA_INV= -3.073*CA_PIB(-1) + 3,955*CA_PIB(-2) – 2,733*RATA_INV(-1) + 4,075*RATA_INV(-2)

[-0,66164] [0,77658] [-0,55359] [0,76211]

+ 3,6415*EC_BRUTA_PIB(-1) – 4,2141*EC_BRUTA_PIB(-2) + 7,0121

[0,76053] [-0,79160] [1,08498]

EC_BRUTA_PIB = - 5,4293*CA_PIB(-1) – 6,3437*CA_PIB(-2) – 5,5924*RATA_INV(-1) -

[-1,30187] [-1.38703] [-1.26141]

6,6733*RATA_INV(-2) + 6,2057*EC_BRUTA_PIB(-1) + 6,4653*EC_BRUTA_PIB(-2) + 11,4406.

[-1,38981] [1,44355] [1,35268] [1,97163]

where CA_PIB stands for the current account deficit as a share of GDP, RATA_INV for the investment rate and EC_BRUTA_PIB for the savings rate.

In order to analyze the impulse response functions we choose a Cholesky type decomposition with an adjustment for the degree of freedom in which the order is the following: the deficit of current as share of GDP, the savings rate, the investment rate.

The figures show that the shocks in the savings rate and in the investment rates have significant but different effect in the short run (see Fig. 2). These effects accord with the economic theory: they are positive for the savings rate and negative for the investment rate. For the second impulse response function we can notice that after a time-horizon larger that 4-5 periods (years), the confidence interval contains zero, and it also become larger and larger which suggest an incertitude and the possibility of an insignificant effect in the long run.

The second possibility of analysis of the variation of variables in the VAR methodology consists in decomposing the variation of the variables on the sources of fluctuations. This decomposition offers us information regarding the sources of fluctuations both in the short and in the long run.

In order to decompose the variation we choose again Cholesky decomposition, the time-horizon being of 20 periods.

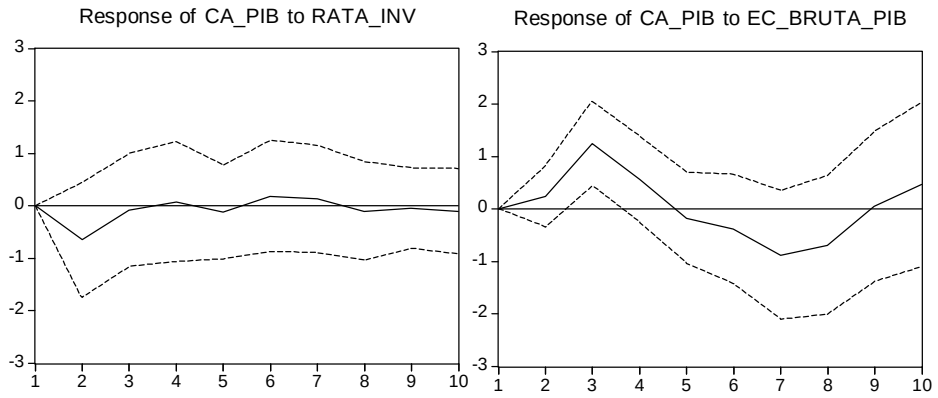

Figure 2. Response to Cholesky One S.D. Innovations ±2 S.E.

Source: Authors' Computations.

In the very short run (2 years), the variation of the current account deficit in GDP is explained mostly by its own fluctuations. But their explanative power decreases in time toward 55%, as we see in the table 1.

Table 1

The Decomposition of the variables fluctuations

Periods	S.E.	CA_PIB	RATA_INV	EC_BRUTA_PIB
1	1.606801	100.0000	0.000000	0.000000
2	1.830245	85.79109	12.50186	1.707048
3	2.218392	58.74535	8.636490	32.61816
4	2.288957	55.19887	8.226200	36.57493
5	2.479375	61.04922	7.268266	31.68252
6	2.638623	63.00186	6.902514	30.09562
7	2.787364	56.65439	6.397358	36.94826
8	2.879335	53.46003	6.125248	40.41473
9	2.957940	55.85766	5.825388	38.31696
10	3.099248	57.40553	5.421897	37.17258

Cholesky Ordering: CA_PIB RATA_INV EC_BRUTA_PIB

Source: Authors' Computations.

The share of the other variables as an explaining source of variations grows in the long run up to 30% for the savings rate. However it does not succeed to have a dominant effect. The explanative power of the investment rate decreases from 12% in the short run to 5% in the long run (10 years). Thus the main source of the deficit is suggested to come rather from the consumption side than the investment side.

2.2. The modeling of the current account with the help of the linear regression

We model the impact of the fiscal policies on the current account by following the steps described below:

a) We verify the explanative power of the variables that were included in the regressions by applying the Granger statistic test on the deseasonalized monthly series. The results show that for 1 or 2 lags, the causal relationship between the current account and the budget deficit is in a double sense – the two variables influence each other. For more lags, 3 or 6, the Granger causality test is only from the current account deficit to the budget deficit. The Granger causality relation from the current account deficit to the Fisc_sal indicator is weak while the relationship between VAT and the current account deficit is strong: the VAT causes in a Granger sense the current account deficit with 1 to 5 lags. For 1 or 2 lags the Granger relation between custom duties and the current account deficit is in a double sense while for more than 2 lags, it becomes unilateral.

b) We verify the stationarity of the series used in the multiple regression of OLS type. The ADF test results indicate that the series are stationary of zero order, so that they are I(0) (no trend or constant). The only exceptions are the imports and the exports which are stationary of order zero with constant and trend.

We present now our OLS model, which was used in determining the factors that influence the current account deficit. In the bracket squares we put the t-statistics. R^2 and adjusted R^2 are of 0,740369 and of 0,719389, respectively, indicating that the variables used in this model explain over 70% of the changes in the current account deficit. The signs are the expected ones: the deficit has a positive relation with the imports (increases in the imports lead to bigger deficits) and it has a negative relation with the exports: as the exports grow, the current account deficit decreases.

LOG(CA_DEFICIT_SA) = -3.604*LOG(X_SA) + 4.441*LOG(M_SA) –

[-7,4364] [9,6736]

- 0.024*(DEF_BG_SA(-5)/DEF_BG_SA(-6)) -1.978*DUMMY9905 – 1.295*DUMMY_00_12+

[-2,3746] [-4,4039] [-2,821984]

5.590*DUMMY0409 - 0.817*DUMMY9712 – 3.483*LOG(CURS_EURO/CURS_EURO(-1))-1.464

[8,76856] [-1,75053] [-1,6032] [-1,7426]

We can notice one unexpected result, different both relative to the expectations and to the results of the VAR on annual data, the coefficient of the budget deficit is negative, while a positive one was expected. A simple explanation comes from the budgetary surpluses which were registered in some of the months of 1997-2000, and after this period, it registered frequent budgetary surpluses. It is also important to underline that the exchange rate leu-euro had a negative influence. This is understandable when thinking that the policy of NBR was to use the exchange rate as a tool to keep the current account deficit under control for the 1997-2001 periods. After this period, NBR opted for using the exchange rate as a nominal anchor, so that the depreciation process tempered.

A third aspect is that the appreciation of the national currency after 2004, due to the massive inflows of capital, both by foreign direct investments and by the private transfers (including here the revenues of the Romanian workers from abroad) did not affect the negative relationship between the current account deficit and the fluctuations of the national currency relative to the euro (Fig. 3). The revenues of the Romanian workers abroad had a strong impact on the Romanian economy, helping, together with the foreign direct investments, to finance the current account deficit. This is why, although the current account deficit is high, it remains sustainable as long as these sources of finance continue to exist.

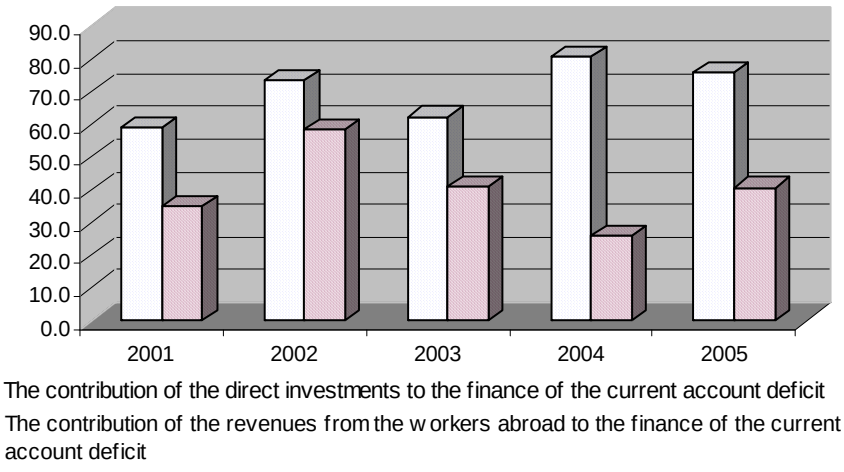

Figure 3. The Contribution of direct investments and of revenues from the money transfers from Romanian workers abroad to the finance of the current account deficit.

Source: Computations using data from the Balance of Payments for 2001-2005 periods.

The data from the national statistics regarding the money transfers from the workers abroad, relative to the other macroeconomic indicators,

reveal the same pattern of dynamic for Romania and Bulgaria. These massive inflows of revenues helped the nominal and real appreciation, but also contributed to the current account worsening.

We apply the model for testing the power of forecasting for the January 1997-October 2006 period and find that the model has a good forecasting power for this sample as we can see figure 4.

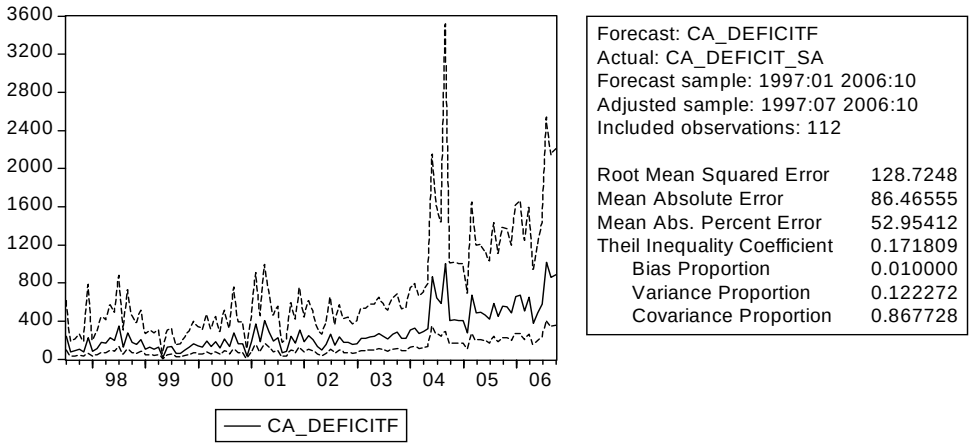

Figure 4. Testing the Forecasting Power of the Model.

Source: Authors' Computations.

By this test we verified the predictive power of the current account deficit function of the known determinants (that is, imports, exports and exchange rate) to which we added the consolidated budget deficit. The results are satisfying.

3. Modelling the impact of wage policies on the current account

We characterize the impact of the changes in the wages on the current account using the VAR techniques. In the VAR modelling, I used variables with monthly frequency. The current account is represented by the current account deficit, as a volume. The wage policy variables are the net real wages and the gross real wages. The net and gross nominal wages, are deflated using the price index with a fixed base in october 1990. The variables were deseasonalized using the Census X-12 procedure available in Eviews.

Model A.

The first VAR model is a bivariate model that takes as endogenous variables the net real wages and the current account deficit. Based on the

SIC informational criteria we choose a three lags VAR. We also included a few exogenous variables that stand either for the shocks at the level of exports (2004), or for the inflationary shocks that influence the dynamics of real wages (1997), or for populist wage increases (1996). The estimation was done for the January 1996 – December 2005 period. We present below the model:

SN_R_SA = 0.787*SN_R_SA(-1) + 0.328*SN_R_SA(-2) - 0.146*SN_R_SA(-3) - 1.36e-05*SCA_SA(-1) - 9.57e-05*SCA_SA(-2) + 1.43e-05*SCA_SA(-3) + 0.0703 - 0.192*D9612 - 0.0157*D9702 + 0.001*D0408 + 0.106*D0409

SCA_SA = 82.894*SN_R_SA (-1) - 260.714*SN_R_SA (-2) + 116.199*SN_R_SA (-3) + 0.278*SCA_SA (-1) + 0.135*SCA_SA (-2) + 0.372*SCA_SA (-3) + 132.06 - 595.064*D9612 - 117.921*D9702 - 1249.1041*D0408 - 510.151*D0409

We can notice that the net wages have a negative effect on the current account, which results by summing the corresponding coefficients for the current and lagged real net wages from the equation of the current account.

The figure 5 presents the impulse response function of the current account to the shocks in the real net wages. As the coefficient from the regression equation of the current account show, a shock in the real net wages leads to a bigger current account deficit. The effect stabilizes after one semester, and then it slowly diminishes.

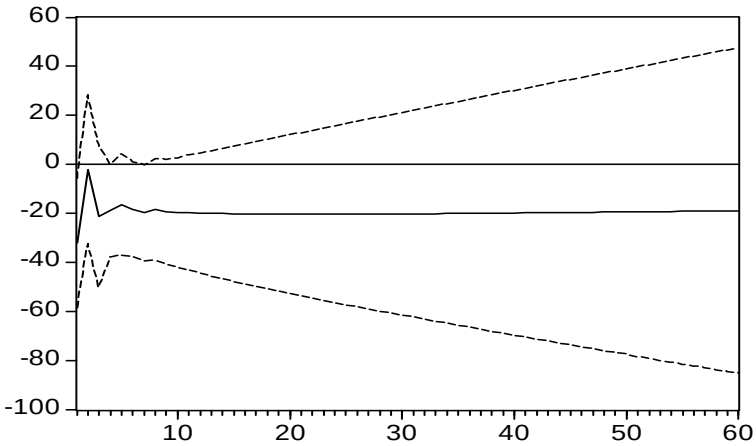

Figure 5. Response of SCA_SA to Cholesky one S.D. SN_R_SA Innovation.

Source: Authors' Computations.

In order to analyze the decomposition of the variance we choose a Cholesky type decomposition in which the order is given the following – the real net wages, the current account deficit. The decomposition was done for a period of 60 months. The table 2 presents the results.

Table 2
Variance Decomposition

Perioada	SN_R_SA	SCA_SA
1	4.896223	95.10378
2	4.576728	95.42327
3	6.192783	93.80722
4	6.423682	93.57632
5	6.933720	93.06628
6	7.706311	92.29369
7	8.419894	91.58011
8	9.069456	90.93054
9	9.828817	90.17118
10	10.56022	89.43978
11	11.27908	88.72092
12	12.01552	87.98448
24	20.04569	79.95431
36	26.23181	73.76819
48	30.88923	69.11077
60	34.47127	65.52873

Source: *Authors' Computations.*

We can notice that in the first months the net wages have an explanative power of under 5% of the total variation in the current account variations. As the time horizon enlarges, its explanative role increseases. Thus, toward a 5 years horizon, the net wages fluctuations reach an explanative power of 35%. However, the variation of the current account remains explained mostly through its own fluctuations.

Model B.

The second VAR is also a bivariate model which contains as endogenous variables the real gross wages and the current account deficit. We used the SIC and LR informational criteria to choose a three lags VAR. As exogenous variables we included again several dummy variables, that model different unexpected shocks as described in the first VAR. As in the first model, the estimation was done for the January 1996-December 2005 period.

SB_R_SA = 1.042*SB_R_SA(-1) + 0.034*SB_R_SA(-2) - 0.085*SB_R_SA(-3) + 0.0001*SCA_SA(-1) - 0.0001*SCA_SA(-2) + 5.543624937e-06*SCA_SA(-3) + 0.0431 - 0.315*D9612 - 0.117*D9702 - 0.069*D0408 + 0.279*D0409

SCA_SA = 130.439*SB_R_SA(-1) - 311.113*SB_R_SA(-2) + 152.775*SB_R_SA(-3) + 0.299*SCA_SA(-1) + 0.133*SCA_SA(-2) + 0.387*SCA_SA(-3) + 71.509 - 591.303*D9612 - 136.185*D9702 - 1251.134*D0408 - 495.744*D0409

The gross real wages have an effect of increasing the current account deficit: the sum of the coefficients of the gross wages variables in the equation of the current account is a negative number.

In order to analyze the differences between shocks at the level of gross wages and shocks at the level of net wages, we extended the analysis of the VAR by using again the impulse response functions and the variance decomposition techniques.

The impulse response function illustrates the negative response of the current account to a shock in the (Fig. 6) gross wages. The worsening effect stabilizes after a semester and it has afterwards a tendency to diminish slitghly. The fact that there is a long run tendency to diminish comes from the fact that the gross wages also contain a fiscality component which has only a temporary effect.

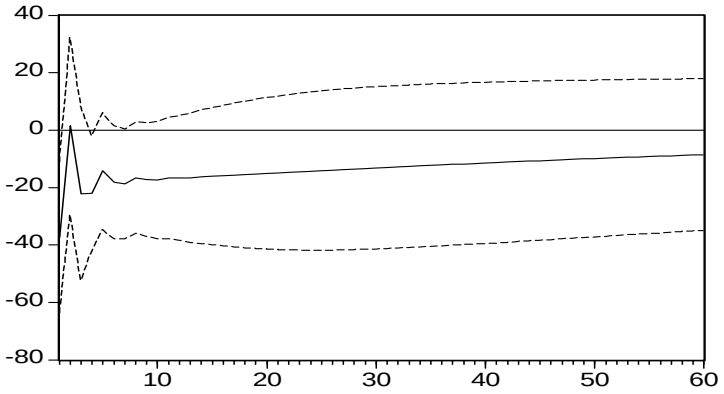

Figure 6. Response of SCA_SA to Cholesky
One S.D. SB_R_SA Innovation.

Source: *Authors' Computations.*

We analyze now the decomposition of the variance by choosing again a Cholesky type decomposition in which the first variable is the gross wage and the second one the current account deficit. We choose again a 60 periods time horizon (Table 3).

In the medium and long run, the level of gross wages does not have a significant explanative power. The explanative power of the gross wages increases in the long run so that it gets to a 25% of the total variations of the current account deficit. The explanative power of the gross wages is lower than that of the net wages, mainly due to the effect of the fiscality which is included in the current account deficit.

Table 3

Variance Decomposition

Perioada	SB_SA	SCA_SA
1	6.715663	93.28434
2	6.206637	93.79336
3	7.819866	92.18013
4	8.209090	91.79091
5	8.354077	91.64592
6	8.990873	91.00913
7	9.511578	90.48842
8	9.927574	90.07243
9	10.44593	89.55407
10	10.95168	89.04832
11	11.42705	88.57295
12	11.91845	88.08155
24	17.13320	82.86680
36	20.81388	79.18612
48	23.24864	76.75136
60	24.86299	75.13701

Source: *Authors' Computations.*

4. Conclusion

Based on annual date, the VAR model suggests that the variation of the current account deficit in GDP is explained mostly by its own fluctuations (their explanative power decreasing in time toward 55%) and by consumption, keeping in mind that the savings rate as an explaining source of variations of current account grows in the long run up to only 30%.

Monthly data confirm that the appreciation of the leu relative to the euro has a negative impact on the current account, suggesting that other tools should be found to stop the tendency of worsening of the current account in the Romanian economy.

From the point of view of the wage policy, the data from the models reveal the fact that the changes in the wages affect the current account deficit. This draws attention to the fact that in order to the stabilize the current account in the long run, the wage policy should be used as a determinant tool.

For a country like Romania whose GDP is sustained mostly through increases of consumption, the fiscal instrument can be extremely efficient

for maintaining sustainable levels of current account deficit. The use of fiscal instrument must also take into account the negative impact that the growth in consumption taxes has on inflation, especially when the inflation objective is extremely important in reaching the level of convergence imposed by the future integration in EMU.

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WORLD ECONOMIC PROSPECTS IN THE CONTEXT OF AN ONGOING GLOBAL CRISIS

Anda GHEORGHIU and Anca GHEORGHIU*

Abstract. *The current financial crisis which started in 2007 and is still ongoing in 2010, was triggered by a liquidity shortfall in the United States banking system and has been considered the worst financial crisis since the Great Depression of the 1930s, since it affected drastically most countries in the world, big corporations and contributed to declines in consumer wealth and a noteworthy downward spiral in the economic activity.*
In these times of global depression, most countries and companies are affected, some more than others. The financial crisis is turning out to be much deeper and broader than expected. This paper underlines what is the outcome of the financial crisis on the global economy and synthesises the main opportunities for companies in these unstable years.

Keywords: *crisis, unemployment, happiness index, oil demand.*

1. Introduction

The collapse of a global housing bubble caused the values of securities tied to real estate pricing to drop thereafter, having a negative impact over the financial institutions worldwide. The financial crisis had its starting point in the U.S. housing market and was restrained to slowing growth prospects in the U.S., Canada and Europe for almost two years (2007 and 2008). At the crisis' early stages, economists considered that developing economies would be invulnerable (the so-called "decoupling hypothesis"). Now we can conclude that this theory was at least naïve. In the era of globalization, the emerging markets, especially China, Brazil or India cannot be kept away from the downturn of the global economy.

The advanced economies severe decline caused demand for emerging economies exports to drop and the crisis became truly global, much deeper and broader than expected. The black series of bankruptcies has shattered the trust of people in the key financial institutions, in the rating agencies,

* Hyperion University of Bucharest, 169 Calea Călăraşilor, St., Bucharest, Romania.

even in the markets ability to normalize their own irregularities. The case of Lehman Brothers, once the fourth-largest US investment bank, scared the world-it filed for bankruptcy protection on September 15, 2008. The bankruptcy of Lehman Brothers was the largest bankruptcy filing in U.S. history with Lehman holding over $600 billion in assets.

Credit rating agencies failed to accurately evaluate the risk involved with mortgage-related financial products and governments did not adjust their regulatory practices to address contemporary financial markets

However, it should not be any surprise, since even the free-market symbol, Adam Smith warned that markets and the invisible hand did not always produce socially-desirable effects and that there was a responsibility for governments in monitoring and channeling the mechanisms of markets.

Even the Marxian theory, although considered obsolete by many critics, warned that a "conjuncture" in a "chaotic" capitalist development, will if no countervailing action is taken, mark the transition to a recession or depression.

The truth is that many causes have led to the global economic melt-down: the easy credit conditions, the escalation of the housing bubble, the sub-prime lending, the complexity of the markets and financial instruments or, why not, the failure of top world economists and leaders to anticipate or to take steps in order to avoid a systemic crisis.

After September 2008, the advanced economies severe decline caused demand for emerging economies' exports to drop and the crisis became truly global, much deeper and broader than expected.

In this era of global depression, most countries and companies are affected, some more than others. The financial crisis has turned out to be much deeper and broader than expected. Managers, researchers, politicians keep asking themselves: how deep will the recession be and how long will it last?

2. Effects of the financial crisis

Many people praised, at the beginning of the new millennium, the benefits of the globalization phenomenon: growth of the living standards express thanks to the specialization, pursuit of comparative advantage, intense trade between countries or advance of the technology. Yet, even before this crisis, globalization was already being challenged-critics argued that globalization favoured capital rather than labour and the wealthy rather

than the poor. The crisis has accentuated the differences between have and have-nots. For example, tiny Iceland is emerging as the biggest casualty of the global financial crisis[1]. Relative to the size of its economy and population (only 304.000 people), Iceland's banking collapse, which involved all the three major banks is the largest suffered by any country in history.

Right away after the shocking avalanche of bankruptcies from September 2008, the world governments started to inject capitals in their economies, while banks cut their interest rates in order to help borrowers and remain profitable. The U.S. alone executed two stimulus packages, totaling nearly $1 trillion during 2008 and 2009. Many people have criticised these measures, considering them as a waste of money, while others have applauded the intervention of the states in the economy.

On the occasion of the speech held by Barack Obama, the American President, in favour of the $787bn economic stimulus plan of 2009, he said "we have a once-in-a-generation chance to act boldly and turn adversity into opportunity and to use this crisis as a chance to transform our economy for the twenty-first century"[2].

Rumours concerning bank solvency, turn down in credit availability and lack of investor confidence had a severe impact on global stock markets, where securities suffered huge losses during late 2008 and early 2009.

The rich industrialized countries entered in 2008 a recessionary period; export-dependent nations such as Japan, Germany, South Korea and China are suffering from the contraction in global demand and have turned to their domestic markets. Even the Arab world, once a flourishing group of states, reported losses in 2009, as a result of failed investments in foreign markets and the drop in oil prices.

Some developing countries that had seen strong economic growth saw significant slowdowns. The emerging countries, which grew on average 7 to 8% during the past few years, slow to an average of 3% in 2009. The most vulnerable remain the countries that depend on foreign capital (such as Hungary, the Baltic states, Turkey, Central Asia) and those that have big current account deficits.

No wonder that the foreign investments flows to the developing countries have sharply declined during the years of crisis, as shown in figure 1. Overall, net private capital flows to developing countries in 2009

[1] Capell Kerry, *The Stunning Collapse of Iceland,* Businessweek, October 9, 2008.
[2] BBC News, *US Congress passes stimulus plan,* 14 February 2009.

are estimated to have fallen by $795 billion (relative to their high in 2007), or by almost 70 percent. Even with recovery on the horizon, projected flows in 2010 are only $517 billion, or 3.2 percent of GDP.

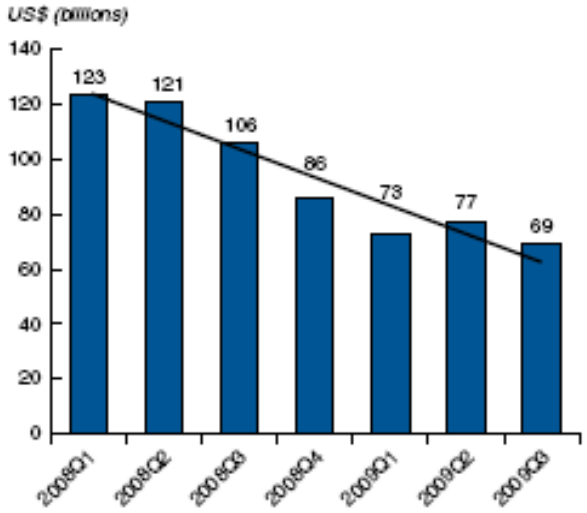

Figure 1. FDI flows to developing countries.

Source: International Bank for Reconstruction and Development / The World Bank Global Economic Prospects/Crisis, Finance, and Growth-2010, p. 38.

A good example of what the financial crisis has meant for a developing country is **Romania**, whose rating has been downgraded by Standard & Poor's agency in the fall of 2008 to junk level, meaning a dangerous exposure of the banking system, because of a high rhythm of loan agreements, a system unable to face a profound crisis of liquidities at global scale.

On March 24, 2009, Romania has reached an agreement for a total funding of 19.95 billion Euros, of which 12.95 billion Euro from IMF, 5 billion Euro from the European Commission, EUR 1 billion Euro from World Bank and a one billion Euros from the European Bank for Reconstruction and Development (EBRD). The main conditions for receiving installments under that agreement are related mainly to reduce public spending is badly needed: wages decrease, reforming the public pension system, adoption of fiscal accountability law, which creates a framework of state budget on a medium term of 3-4 years. Fortunately, in this situation that seems dramatic to Romania, one of ray of hope regarding financing comes from the structural funds, financial instruments created by European Union, in order to assist member states post-accession modernizing process. These funds, in a total amount of 32 billion Euro, can be

accessed until 2013. Structural funds are therefore a possible answer to the Romanian economic crisis. Of the total Structural Funds is 5.77 billion Euro direct contribution to competitive programs and 15.8 billion Euros, an indirect contribution to regional development programs, human resources, environment and transport.

3. Unemployment – the most disagreeable outcome of the economic crisis

An indicator that painfully shows of how much the crisis really hurts is the unemployment rate. It has increased significantly over the past 18 months, across all sectors. Unemployment among OECD member countries alone has increased by 25.5 million since the start of the crisis and some estimates suggest that globally the increase could total over 50 million in 2010. Jobs are not created as fast as they are lost and any prolonged period of high unemployment will have undesirable effect on consumption.

Very few countries succeeded to maintain a decent level of unemployment rate. In Germany, for instance, unemployment has so far increased only marginally (by 0.3%, from 7.2% in October 2007 to 7.5 in October 2009), compared to an increase of 4.4 percentage points over the same time period in the US (from 5.8% to 10.2 %) or over 8 percentage points in Spain (from 11.4% to 19.3%). Germany has also taken steps to shorten working hours, rather than cutting jobs and to maintain people in employment, if only part-time.

One aspect, common to both the developed and developing world, is that unemployment has an excessively large impact on youth and the effects of poor job opportunities early on in the working life have, usually, negative effects for earning power and development over the rest of an individual's career and life. Moreover, people are forced now to accept part-time jobs or under their level of skills.

To worsen things, according to the International Labour Organization only 20% of the world has adequate social protection, 50% of the world has any coverage at all, while in developing countries that figure falls to less than 10% of their population.

In a recently disclosed report[3], the International Labour Office presents the case study of Brazil, a very suggestive one, because is

[3] International Labour Office, *Global Employment Trends,* January 2010, page 32.

conclusive for many emergent countries, which have roughly followed a similar scenario in the past 12 months.

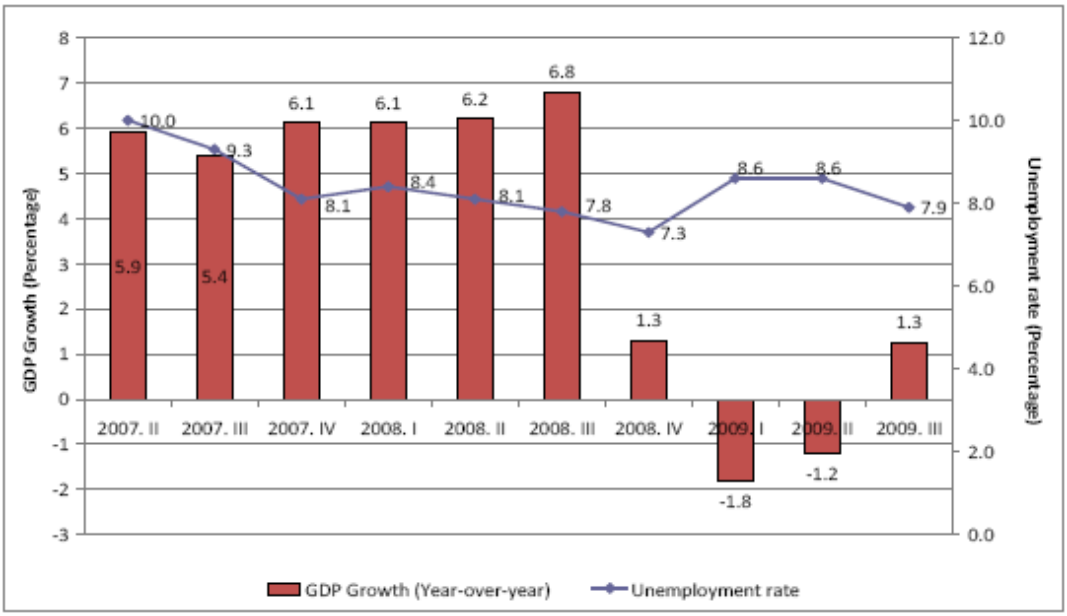

Figure 2. Brazil: GDP growth rate and unemployment rate, by quarter (percentage).

Source: Central Bank; IBGE.

Before the start of the economic crisis in Brazil in September 2008, the economic growth had been steady, with 4 years of robust growth, with a peak in the third quarter of 2008 as figure 2 depicts. Furthermore, there was a significant recovery of wage levels and an increase in employment, particularly formal employment. Yet, the international crisis halted economic growth and had an instant and sharp impact on employment. The GDP growth in the fourth quarter of 2008 decreased to 1.3 per cent and there was a net job loss of 634,000 formal jobs in the quarter, compared with a net gain of 10,400 formal jobs in the fourth quarter of 2007.

Only in the third quarter of 2009, economic growth had resumed and the unemployment rate had returned to near pre-crisis levels (in October 2009 the unemployment rate of 7.5 per cent was equivalent to the rate for October 2008).

Some researchers succeeded to obtain a transatlantic comparison of the so-called ‘happiness index’, which combine consumption and unemployment. From this standpoint, during the crisis, Europe does only to some extent better than the US. The difference is small because unemployment is usually much more stable in Europe. However, strong

differences exist within the euro area, with a clear hierarchy: Germany is better off than all the others, with little deterioration in its index while Spain is at the other extreme. If we look at figure 3, we can clearly notice that 2009 is by far one of the darkest years of the last decades, a year of despair, characterized by high unemployment rates, plunge of consumption and lack of hope.

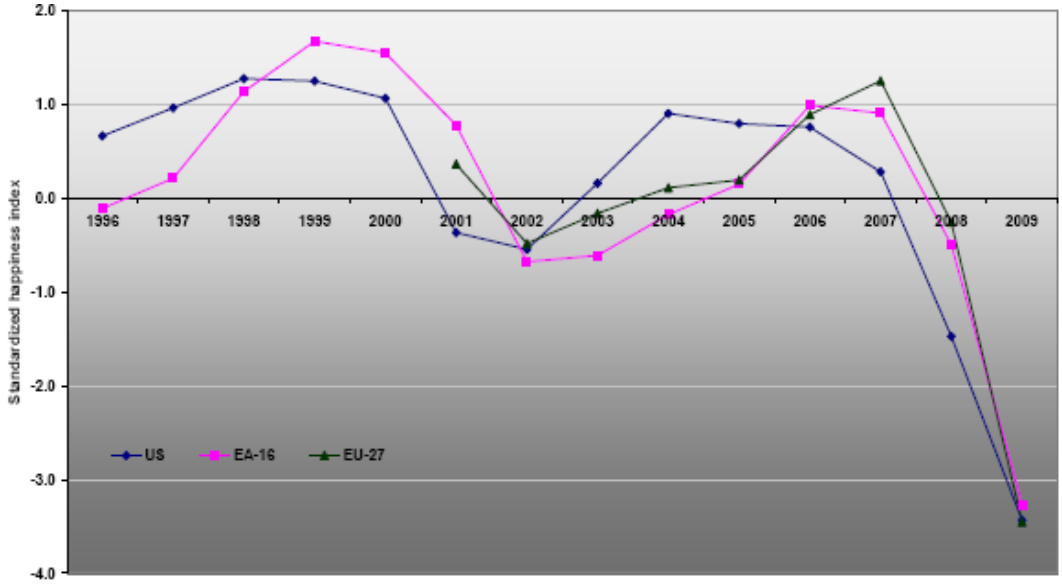

Figure 3. Standardised 'happiness index': the US and Europe.

Source: Daniel Gros and Cinzia Alcidi The Impact of the Crisis on the Real Economy, page 5, Centre for European Policy Studies, CEPS Policy Brief, nr. 201/2010.

4. The upside and downside of the economic crisis over the environment

Definitely, current economic crisis determine companies to produce and trade less, people to drive or fly less, consume less energy, hence lowering expectations for greenhouse-gas emissions, which is the bright side of the crisis.

Unfortunately, less consumption undeniably leads to a serious decrease of worldwide production, but also to a decrease of using raw materials. As oil consumption declines, the price of oil is also dropping, thus discouraging investment in expensive "green" projects. It will not worth to poor money into expensive eco-friendly technologies, since alternative energy costs will be much higher than those related to classical sources of energy. If the prices for oil and gas keep falling, the incentive

for utilities and consumers to buy expensive renewable energy will shrink. That is what happened in the 1980s when a decade of advances for alternative energy collapsed amid falling prices for conventional fuels.

The world oil demand has dropped significantly in the second half of the year 2008 and in the first half of the year 2009 (see Fig. 4). The price of oil has plunged dramatically, from $147.50 in July 2008 to $40 a barrel in January 2009.

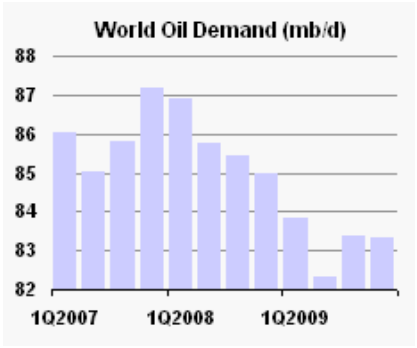

Figure 4. Oil Market Report-Highlights of the latest OMR, dated 14 May 2009.

Source: International Energy Agency.

As the International Energy Agency makes public in its Oil Market Report-Highlights of the latest OMR, dated 15 January 2010[4], the forecast global oil demand remains virtually unchanged –86.3 mb/d in 2010 (+1.7% or +1.4 mb/d versus the previous year). Growth is driven by non-OECD countries, most notably in Asia. In the last months of 2009, the world oil demand rose, but still remained under the levels of 2008 (see Fig. 5).

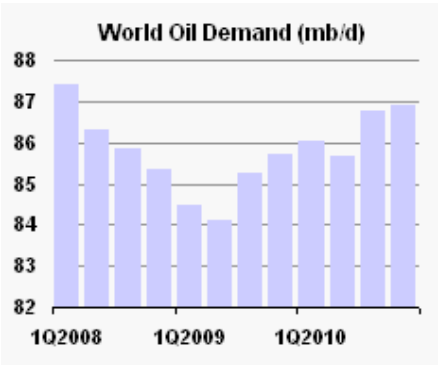

Figure 5. Oil Market Report-Highlights of the latest OMR, dated 15 January 2010.

Source: International Energy Agency.

[4] http://omrpublic.iea.or.

The economic crisis has scared the politicians. Leaders of some European Union countries are calling for a slowdown in efforts to curb emissions of greenhouse gases due to the growing economic crisis. Under huge pressure to shield German industry from the cost of going green, however, Angela Merkel, the German Chancellor, fights to reverse key goals that she once championed. Under a plan adopted by the EU in 2007, member countries pledged to reduce such emissions by 20% below 1990 levels by 2020, which is far more ambitious than the Kyoto Protocol. Merkel was then the "Iron Lady" who pushed through tough climate change targets to show that Europe could lead the world in beating global warming. However, in December 2008, she demanded free carbon credits for 90 to 100 per cent of German factories until 2020 – blowing a hole in a key climate change scheme[5]. Prime Minister Silvio Berlusconi of Italy and the leaders of some Eastern European countries, like Poland, pointed out as well that due to the crisis, they were no longer able to finance the high costs of attaining the 2020 goal and so weren't prepared to adopt a detailed plan.

5. Temperate confidence for the future years

A recent study[6] conducted for Deloitte Touche Tohmatsu by Forbes Insights reveals that economic optimism reached its highest level in the past 12 months among surveyed executives only in December 2009. The analysis discloses that in the last month of the year 2009, more than one-third of the executives surveyed (35%) believe the worst of the economic crisis is behind us-the highest level of economic confidence since the survey began in January 2009 (Fig. 6). The data comes from a survey of 335 senior executives and talent managers from large companies (annual sales $500+ million), across a range of many industries and the three major economic regions, the Americas, Asia Pacific (APAC), and Europe, the Middle East, and Africa (EMEA).

[5] The Times-December 11, 2008, Angela Merkel turns her back on green dream of EU.

[6] Deloitte Development LLC – Managing talent in a turbulent economy, January 2010.

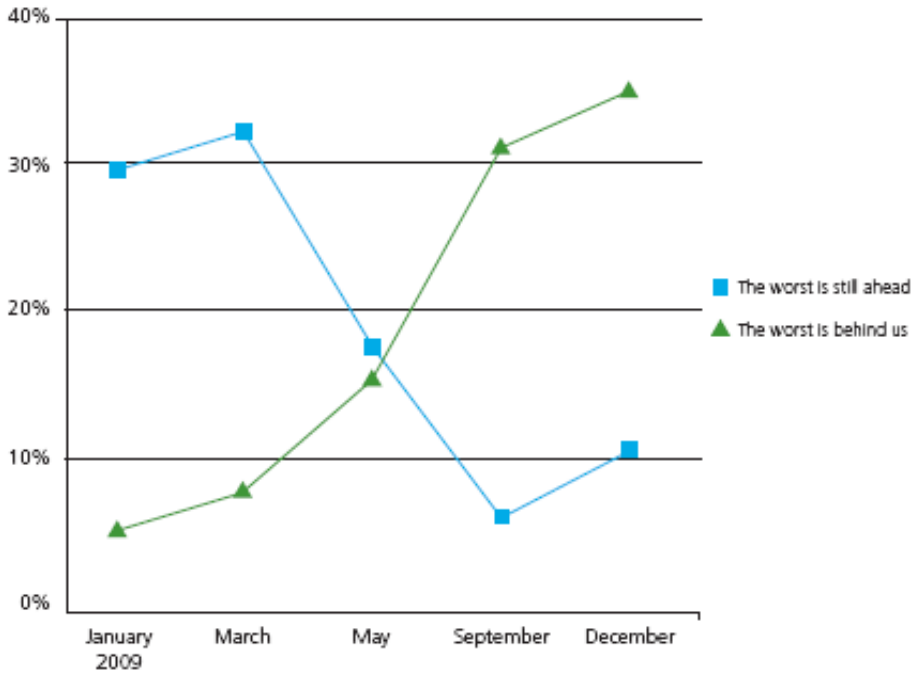

Figure 6. Executive outlook on the economy (December 2009).

Source: Deloitte Development LLC.

Indeed, the forecast of IMF suggests the same positive trend will follow the major economic indexes. The world trade volume is expected to rise in 2010 at 5.8 per cent (Table 1) compared with a dramatic –12.3 per cent in 2009. The oil prices is predicted to get much higher in 2010 (22.6 per cent in 2010 compared to a sharp drop of –36.1 in 2009). Projections are good for 2011 as well.

Without doubt, the progress of the last months of 2009 gives hope to worldwide entrepreneurs, since the pace of economic contraction is slowing and the financial markets are recovering from decline. However, household spending remains constrained by job losses, lower housing wealth and tight credit. Most reports suggest that unemployment will fall faster in the US than in Europe. The difference is attributable to the flexibility in US labour markets but, even with this, the US will be affected by widespread plant closures and continuing bankruptcies among small and medium size enterprises.

Coming out of the crisis, the world has a historical chance to reshape its policies, architecture and institutions and support balanced global growth and financial stability. People seem to fail to remember about the probability of crisis outbreak in times of prosperity and fail to take quick crisis management actions. Especially the emerging economies should

avoid macroeconomic imbalances and to follow a sustainable growth trend backed by structural reforms. The current financial crisis has highlighted the need for up-to-date and transparent information by type of instrument, currency, creditors, and debtors.

Table 1

Overview of the World Economic Outlook Projections

Indicators	Projections (%)			
	2008	2009	2010	2011
World trade volume (goods and services)	2.8	–12.3	5.8	6.3
Imports				
Advanced economies	0.5	–12.2	5.5	5.5
Emerging and developing economies	8.9	–13.5	6.5	7.7
Exports				
Advanced economies	1.8	–12.1	5.9	5.6
Emerging and developing economies	4.4	–11.7	5.4	7.8
Commodity prices (U.S. dollars)				
Oil	36.4	–36.1	22.6	7.9
Nonfuel (average based on world				
commodity export weights)	7.5	–18.9	5.8	1.6
Consumer prices				
Advanced economies	3.4	0.1	1.3	1.5
Emerging and developing economies	9.2	5.2	6.2	4.6

Source: International Monetary Fund[7].

Many companies are rethinking the way they address social issues, especially in emerging markets. An online survey of McKinsey[8], May 21, 2009 – June 3, 2009, received responses from 2,245 senior executives from around the world. The results demonstrate that for managers the most important drivers of economic growth in developing and emerging economies over the next 10 years are:

1. education (21%)
2. trade and economic integration (18%)
3. private-sector development (16%).

[7] http://www.imf.org/external/pubs/ft/weo/2009/update/01/pdf/table1.pdf.

[8] https://www.mckinseyquarterly.com/Strategy/Strategy_in_Practice/Rethinking_how_companies_address_social_issues_McKinsey_Global_Survey_results_2514.

But the crises do not bring out only losers; there are opportunities for savvy companies able to involve the entire staff in supporting new market entry strategies, guidelines for increased efficiency, by minimizing risks and cutting costs in key areas.

The attempt to enter new markets has always been a risky entrepreneurial act, but also a rewarding one, in the case of success. Producing profits from selling or producing abroad are great achievements for firms trying to expand their market share in foreign countries.

Well-capitalized companies, with robust financial positions and with liquidities to invest, have now a unique chance to make strategic acquisitions and to buy previously unaffordable assets. Of course, it takes audacity to act in a risky climate, but as more and more targets become available, taking advantage of this occasion will help daring companies to have success in the years of boost after the crisis.

In a survey realised by us between September15-December 31, 2009, we scrutinized the greatest risks taken into account by 40 managers, economists and analysts, which could have affected the prospective for development of the companies they were working for. The results showed that most of them feared a shrinking in the market share (40%), followed by default or incapacity to pay debts (32%) and other risks with lesser significance: asset price collapse (15%), oil and gas prices volatility (6%) and pandemic risk (7%) (see Fig. 7).

Many analysts come out with new ideas and models for the so called "new economy" and the "new financial order". For instance, a new world order for a stable society[9] would entail, among others, that the current practice of crediting both the production and the consumption, in other words facilitating at the same time the initiative of both "making and taking", and financing companies and individuals at the same or comparable amount should fade away. A producer could develop its business 100% on credit whereas an end user may do the same thing, but the burden is actually over the people who had the power to spare and hence had financed the banking system. This model, where consumers unable to spare even a cent hope and even succeed to finance a living standard far beyond their possibilities and where the social-economic development is based exclusively on other people's money, well, this model should disappear.

[9] Mihail Brînzea, *The New Financial Order and Redefining Power According the Saving Capacity. The Crisis Opens new Respects to New Models*, http://mihailbrinzea.finantare.ro, 9 February 2009.

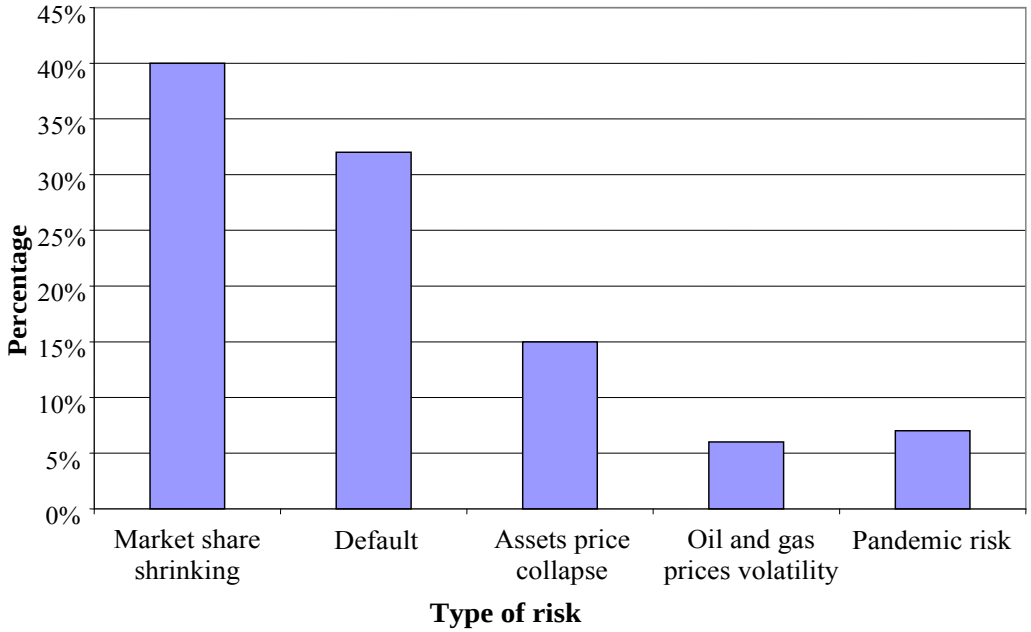

Figure 7. Managers viewpoint on the highest risks most likely to affect their companies (December 2009 survey).

Source: Anda Gheorghiu, a survey realised between September 15-December 31, 2009[10].

6. Conclusions

How will this crisis be remembered in the history books? As a systemic crisis and a turning point in the economic paradigm of capitalism, or as a transitory, soon reabsorbed accident?

In a nutshell, the crisis has burst due to a number of specific technical problems in the functioning and regulation of financial markets and it has been exacerbated by a number of mistakes made during the management of the crisis.

The abolition of Glass-Steagall Act by the US in 1999 had the consequence of inducing the banks to play the markets for quick profit. The repeal of the Glass-Steagall Act of 1933 in fact removed the separation that up to that time existed between Wall Street investment banks and depository banks and has been blamed by some for exacerbating the damage caused by the collapse of the subprime mortgage market.

[10] Anda Gheorghiu, a Poll realised on http://polls.linkedin.com/p/56818/gokpq (What is the greatest risk for your company in 2010?), 40 answers.

Other roots of the deep economic downturn that are truly significant are: the bonus-driven culture, the regulatory failure in the financial sector, the promotion of a false belief that banks or financial institutions are too big to fail and the oligopolistic nature of rating agencies (only three agencies dominated the market in the past decade – Standard&Poor, Moody's, Fitch).

If companies and states will be able to learn from these mistakes and manage the recovery from the crisis well, the economy will be back to a better shape, with less excesses and more stability.

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[10] The Times-December 11, 2008, Angela Merkel turns her back on green dream of EU.

RISK MANAGEMENT AND BASEL 2

Wolfgang ECKER-LALA[*]

Abstract. *Economic life changed in the past years. In order to increase the opportunities of business enterprises have to get external money. On the other side banks have to decrease the risk of losing money which they gave as loans and credits to enterprises. Therefore it is necessary that both sides understand the business of risk management and the rules of Basel2. This paper presents an introduction in the rules of Basel2 and an overview of necessary topics which have to be considered in risk management.*

Keywords: *operational risk, risk management, Basel 2, rating methods, statistical methods, financial rating.*

1. Introduction

In the previous paper[1], we have been introduced some considerations about risk causes and risk management in general. In this paper we present an overview about risk management, Basel 2 and risk management for financial institutions.

Before "the period of Basel 2" banks have not really been aware about risks. They gave loans to almost everyone in order to make money. They did a lot of "strange" deals in order to get "quick money". And they did not really consider the value of collaterals.

So we can say that there was almost no risk management in banks before "Basel 2".

2. Basel 2

If a bank gives a loan to a customer who will be not able or not willing to pay back the complete loan (including all fees) the bank will lose money. If a bank will make deals on the money market and the expected profit of the deal will not be reached the bank might lose money. In daily business it is normal that not each loan will be paid off by a customer or a deal will not result in the expected profit. In general it will be no problem if the own capital of a bank is big enough. The real problem is that all these events will be future events and have to be predicted.

[*] MATH-UP.COM, Landesstrasse 58, A-3441 Ranzelsdorf, Austria

[1] W. Ecker-Lala, *Risk management for Enterprises*, in this Proceedings of ENEC- 2010, pp. 165-171.

The “Basler Ausschuss für Bankenaufsicht” (= regulators for banks and financial institutions) created a set of regulations and rules for bank's own capital (own funds) in order to stabilize the financial market and prevent it from some kind of collapse.

Originally this set of regulations and rules have been initiated by the USA. The USA did not follow this regulations and rules in the same strict way as the European Union did. Since 1st of January 2007 all financial institutions have to fulfil this regulations.

Basel 2 regulations and rules have been based on Basel 1 regulations and rules. Basel 1 caused following criticism:

- **misallocation**
  There have not been any considerations about the credit rating on a customer. All considerations have been done on customer segmentations. So banks had a very big interest to give loans to “bad” customers because of receiving higher interest rates for such loans.
- **no operational risks**
  Basel1 considered the amounts of own capital and control mechanisms which have to be done be the national regulators. Any kind of operational risk has not been considered – e.g. most of the main activities are done by a single trader (Nick Leeson).
- **no international standard**
  Basel1 did not define common standards in control and reporting for the national regulators and even no reporting standards for the financial institutions.
  So Basel 2 was supposed to repair the open issues of Basel 1.

3. Basics of Basel 2

The idea of Basel 2 is based on three pillars (Fig. 1):

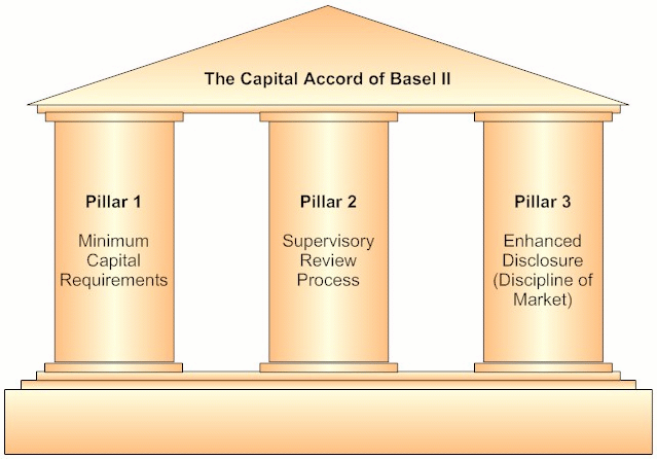

Figure 1.

- **Minimum Capital Requirement**
  Aim of these pillar is to consider risks in accordance to the own capital. Three risk categories have to be considered:
  - *risk of loan defaults*
    The risk is defined by a rating which can be calculated by an external agency or by the bank (**I**nternal **R**ating **B**ased).
  - *risk of market rates*
    This risk is caused by unexpected changes of exchange rates, interest rates and all other prices on the money market which give a negative input on the bank's profit.
  - *operational risk*
    Even errors and defaults caused by systems and staff members (e.g. unavailability of a server, wrong decision of an employee of a bank) are risks in daily business.
- **Control process of regulators**
  The national regulator has to check if all rating methods, risk controlling methods and reports are done according to the Basel 2 regulations.
- **Market Discipline**
  This means that reporting has to fulfil all necessary requirements in order to provide all relevant information to externals. The publications have to provide information about:
  - structure of the own capital
  - identified risks and risk rating
  - amount of the own capital.

Summing it up the ratio of own capital of a bank has to be at least 8% of the sum of all risk weighted assets.

Sum of all risk weighted assets:

= 1.06 * (Sum of risk weighted assets of loans);

+ 12.5 * (requested own capital out of market risks);

+ 12.5 * (requested own capital out of operational risks).

4. Ratings. Rating Methods

One of the most important information within Basel 2 is the rating of risks. As mentioned in previous chapter the rating can be done by external agencies (standard approach) or by the bank itself (**I**nternal **R**ating **B**ased).

The term **rating** has to meanings:

- The possibility of being able to pay future claims (based in future profit or income). It shows the degree of credit worthiness.
- The economic situation of a company or person.

The calculated rating is the base for all conditions for a loan or credit (duration, amount of a periodical payment, interest rate).

As mentioned in previous chapter the rating result shows the degree of credit worthiness. In order to be able to calculate the rating several rating methods have to be developed.

Three categories of rating methods can be found:

- **heuristic methods**
  These methods are based on experiences, knowledge and observation of the past:
  - *check list*
    A list of all relevant questions to estimate the rating based on the past experiences of credit experts.
  - *expert systems*
    A kind of check list system which gives more flexibility in the estimation of different risk factors.
  - *knowledge based systems*
    These systems are automated expert systems – in general available in form of software. It gives more flexibility and performance in combining risk factors.
- **statistical methods**
  These methods are based on historical data and use statistical methods:
  - *discriminant analysis*
    This method analyses differences within groups or classes (e.g. *Z*-Scores by Altman).
  - *regression*
    This method calculates the probability of a customer to be member in a specific rating class. It is based on a set of significant figures.
  - *neuronal networks*
    These methods try to simulate a biological workflow of information processing (like signal processing of a brain).

- *data mining*
  Data mining is a very new discipline for banks. The importance is increasing within the next years. Data mining tries to detect patterns in data in order to get a base for a decision whether the loan can be paid off by the customer or not.

- **causal analytical methods**
  These methods are based on economic theories:
  - *option price model*
    It considers the value and volatility of foreign capital of an enterprise/company.
  - *cash-flow simulation model*
    This model performs an analysis of the cash-flow under different situations.

5. IRB-Approach

In the Internal Rating Based (IRB) approach banks can calculate the ratings by their own. Therefore they have to collect all necessary and appropriate data, develop rating models and validate these models. It has to be approved by the national regulator that all the prerequisites are fulfilled and the complete process is done according to the Basel2 regulations and rules.

The bank can choose if the IRB will be done by following ways:

- **IRB-Base**

Here following figures has to be calculated or defined and constraints have to be fulfilled:

- *sufficient data history* (even for defaults)
  databases has to be implemented.
- *probability of defaults have to be estimated*
  This is the probability of a customer being unable to pay the assets.
- *LGD* (loss given default)
  is assumed as 45% for unsecured assets and 75% for subordinated assets.
- *Collateralization*
  can be done by financial collaterals or physical collaterals which have to be accepted by the market (e.g. house, flat, real estate).
- *Maturity*
  is assumed as 2.5 years.

- **IRB-Advanced**

This approach is an enhancement of the IRB-Base approach. In addition following has to be calculated:

  - *EAD* (exposure at default)
    This is the amount value of the exposure in case of a default.
  - *Collateralization*
    unlimited, netting can be done.
  - *maturity* (remaining)
    can be calculated by the bank but has to be in the range between 1 and 5 years.

6. Financial Rating

A very important parameter is the financial rating based on balances. Banks developed their own financial rating methods based on the available data of the past.

A very well known method is the Z-Score developed by Edward I. Altman. It is a discriminant analysis based on financial statements.

Altman chose a sample of 33 companies which got bankrupt. Each of these companies had a total assets amount between 1 and 26 million US$. He compared it with "good" companies having similar business and assets amounts. Using the paired-sample method he developed following formula:

$$Z = 0{,}012 \cdot X_1 + 0{,}014 \cdot X_2 + 0{,}033 \cdot X_3 + 0{,}0006 \cdot X_4 + 0{,}999 \cdot X_5$$

where:

X_1 – working capital / total assets amount;
X_2 – retained earnings / total assets amount;
X_3 – earnings before interest and taxes (EBIT) / total assets amount;
X_4 – market price of own capital / foreign capital;
X_5 – total revenue / total assets amount.

He found out that all companies having $Z < 1.81$ went to bankruptcy one year later and all companies having $Z > 2.99$ have been "good" one year later.

7. Rating Validation

If a bank is allowed to calculate the rating according to IRB approaches it is obligatory to validate the models every year.

Measures for the quality of the rating models are summarized under the term ***rating accuracy***.

Rating accuracy distinguishes between:

- *discriminative power*
  This is the measure for the quality of the separation effect of the methods.
- *calibrating power*
  This is the measure for the exactness of the methods to predict future hazard rates within rating classes.

Even the accuracy of the implemented and used rating systems has to be checked.

8. Conclusion

Daily business is conducted by a lot of risks even in the sector of financial institutions. In order to be able to survive difficult economic situations and of course crises risk management and risk management methods has to be used.

Basel 2 provides a set of recommendations, regulations and rules to financial institutions in order to implement appropriate risk management systems. So financial damages can be avoided or at least minimized.

But in any case – risk can also be seen as the possibility of getting a chance. So let us looking forward in a more positive way for the future.

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THE NEW "NORMALITY" AND ITS EFFECT ON SME`S

Ana-Maria GRIGORE*

Abstract. *A strong turbulence it is the new normality. That is the new challenge of the leaders in economy and politics. They have to accept this new situation, to assess it, and than imagine new strategies and approaches to face it, to get things done through the years that follow.*
This paper presents issues regarding the impact of the economic and financial crisis on the SME`s.

Keywords: *crisis, small and medium enterprises, new "normality", entrepreneurs, turbulence, economic crisis.*

1. Introduction

World nowadays it`s in a quite new economical stage. We cannot speak anymore of independent national economies; there are complex connections and subtle interdependencies.

Trade takes place on the basis of information flows that move at lightning speed via Internet and mobile phones. This new status confers extraordinary benefits for lowering costs, accelerating production and delivery of goods and services. But it comes with a dark side, which raises a substantial degree of risk and uncertainty for producers and consumers. An event or a circumstancial change in a single country – whether it comes to the bankruptcy of a bank, a stock market or real estate crash or a political assassination or a currency severe depreciation – can spread in many countries and create a giant wave of turbulence, pushing the entire system to a totally unexpected result [7].

Turbulences and especially severe turbulences, with its concrete consequences – chaos, risk and uncertainty – are now the normal status in industries, markets and companies. Turbulence is the new normal, interrupted by periodic and intermittent bursts of prosperity and decline – including prolonged periods of decline, which equates to recession and

* Hyperion University of Bucharest, 169 Calea Călăraşilor, St., Bucharest, Romania, E-mail: anagrig27@gmail.com.

even depression. And turbulence has two major effects. One is vulnerability, against which companies need defensive armor. The other is the opportunity to be exploited. Hard times are hostile for many and favorable for some. The opportunity arises when a powerful company can take another company`s customers or even buy cheap a weak competitor. The opportunity is present when your company doesn`t reduce the important costs, but all of your opponents see themselves compelled to reduce them.

Today, and for the foreseeable future, the new economy means more than normal periods of economic fluctuations upward and downward, which, after all, have conferred a degree of predictability in macroeconomic activity. Today we can expect more big shocks and dramatic disturbances, resulting in a generally high level of risk and uncertainty for companies, both at macroeconomic and microeconomic level.

Companies must understand that they cannot operate in the past anymore, with some scenarios for normal market conditions and periods of economic boom, and others for the conditions and periods of recession.

Traders now have to develop capabilities, systems, processes and disciplines needed to rapidly detect and predict turbulence in their operating environment, and to identify vulnerabilities and opportunities that make chaos a profitable product.

2. About crises

Written in Chinese, the word “crisis” is composed of two characters. One represents danger and the other opportunity.

From what the others told us and from what we are currently experiencing, we know that the moment called crisis it’s in the same time an implosion and an explosion event of the highest intensity, which includes an unmatched variety of economic phenomena and processes, and which has the largest geographical spreading and the highest temporal concentration. It is in its nature not to pass unnoticed. It is disturbing, it determines standpoints, it changes matrixes or governments, it revises and updates discourse, etc., in a word, and it requires study and examination [9]. And that is what it gets. About the cause of the current crisis Bartlett [2] said that the crisis was started with the downfall of US subprime mortgage industry ,and the intensity of this collapse was significant; “Mark-to-market losses on mortgage-backed securities, collateralized debt obligations, and related assets through March 2008 were approximate $945 billion”. He further stated that it is “The largest financial loss in history”,

as compared to Japan's banking crisis in 1990 about $780 billion, losses stemming from the Asian crisis of 1997-98 approx $420 billion and the $380 billion savings and loan crisis of U.S itself in 1986-95. Other specialists [12] believe that it was series of events which caused the crisis; it begins with the collapse of currencies in East Asia in 1997 and became edgy due to the financial crisis of Russia in 1998. Next, in USA was the "dot-com" stock collapse in 2001, and the final stroke was again in USA, when after a swift decline in housing prices and "rapid contraction in credit", it fell into recession.

There is one hope-giving piece of information coming from crises history, namely that they are transitory; they come, they create serious trouble or disorder and they leave. A new cycle begins when they leave the scene. Regardless of its nature and duration (whether it is annual, decennial or centennial), a cycle always reaches a peak-crisis. What happens today, comparable only to what history witnessed from 1929 to 1933, belongs to the long centennial Kondratieff cycle. Should we be tempted, which is only natural, to compare the current crisis with the one that occurred at the beginning of the 20th century, we have every reason to believe, at least out of inertia, that this crisis also has a beginning and an ending [9].

How long the crisis will prevail? It is indeed very difficult to answer this question. Warne [14] believes that it's the matter of confidence of investors, as long as it is restored, crisis will be over; but it cannot be done when we daily hear news about the abandonment of financial institutions, it needs some financial stability. Yalmaz [16] acknowledged that the worst part of the crisis is already over and the markets are suffering from what can be called 'the after shocks'. Sha Zukang [17] says that normalization of economic activities need "global and symentic" solutions, he stated that current "global Economic Governance System" is derisory for the prevention of such crisis.

What governments are doing? Governments are providing support and doing whatsoever they can to prevent their economical structure; US government injected $800 billion in the economy to support the structure, UK government has announced a package of $692 billion. To fight the crisis effects, the European Council adopted, in December 2008, the European Economic Recovery Plan worth EUR 200 billion, or 1.5% of the EU's GDP (EUR 170 billion provided by the member states and EUR 30 billion from the European Investment Bank), plus funds from the Community budget.

3. SME`s and crises

It is a painful reality that small businesses are most affected by the economic crisis. Battered by contracting markets and frozen credit, many businesses today are fighting for survival. Indeed, the current global financial crisis provides a mandate for restructuring. But survival is not the end goal, says Harvard Business School professor Lynda M. Applegate. Think of the economic crisis as a disrupter to the status quo and look for areas of pain. In fact, cost cutting and restructuring are simply the first steps in repositioning and leading your company and industry through the crisis and in defining how business will be conducted in the future [1].

In these turbulent financial times, SME`s need to spend as much time as they can focusing on what really matters: boosting their turnover and reducing their overheads.

SME`s, considered the most sensitive and the most affected by the economic climate, were among the first hit by the effects of the world financial crisis. The financial crisis adversely impacts most of the SME`s, reducing the development rate and increasing the number of bankruptcies. Startups in particular are most vulnerable, lacking the resources to survive the downturn. Nevertheless, for a small number of SME`s, i.e. those that identify the changes in the market and react promptly, this period may prove favorable. In times of crisis, some SME`s, unlike the big companies, have the advantage of greater flexibility, being able to implement new services and launch new products more easily. Not bound by strategies devised at higher echelons and by the need to get approvals, SME`s can make decisions more easily and thus become much more efficient based on prompt action and solutions adjusted to market circumstances [6].

4. Can entepreneurs lead us out of this crisis?

As an entrepreneur is a key to economic growth, differences in the quality of entrepreneurial behavior between and among societies may account for different rates of growth, productivity and development. Those societies that include individuals willing and eager to perform an entrepreneurial function can accelerate their growth and development process while those societies lacking such individuals lag behind.

On the other hand, the quality of entrepreneurship is determined by many factors such as the core values of the surrounding overall economic

system, the entrepreneur's personal and environmental characteristics, the nature of the micro business environment, the entrepreneur's personal set of goals and the existence of a viable business idea. Considering the role of Entrepreneurship in the crisis, Won [15] states that due to its ability of innovation and growth of investment, entrepreneurship is able to play a vital role in the current financial scenario by creating job opportunities and economic growth. Barlett [2] states that economic crisis and "downturns" provides good opportunities for medium sized enterprises; they can "undertake counter-cyclical moves that strengthen their competitive position; lean enterprise campaigns; strategic acquisitions; hiring of talented employees released by downsizing companies" and etc; He further stated that current crisis offers the same opportunities.

We agree with Tom Hayes and Michael Malone [5] in their belief that "Entrepreneurs Can Lead Us Out of the Crisis". They notice "Only entrepreneurs have the flexibility, the freedom and the risk-everything ambition to find the path back to prosperity in a rapidly changing, technology-driven global economy" and "These are the people who gave us everything – from Wal-Mart to iPhones, from microprocessors to Twitter – that is still strong in our economy. Without entrepreneurs, we will never get out of our current predicament". And they outline about a half dozen ways the administration can help them.

Entrepreneurs have the agility, flexibility, and grit to make change happen. Innovation is the chief tool of the entrepreneur.

In a report on innovation, summer 2009, Ernst & Young wrote, "Experience shows that entrepreneurs should not give up on start-ups in a down economy".

Many companies with billion-dollar market capitalizations were started during a recession, the report said, including Starbucks.

Research from Kauffman in June found that more than half of the companies on the Fortune 500 list in 2009 and nearly half of the companies on the Inc. magazine 2008 list were founded during a recession or bear market.

5. The economic crisis and its effects on Romanian SME`s.

Approximately 90% of the more than 600,000 SME`s in Romania are affected by current economic and financial crisis.

The main challenges most SME`s in Romania have to cope with as a result of the economic-financial crisis are the sudden rises in the prices of

raw materials, energy and food, liquidity and credit related problems, a marked decline in the demand for products and services, considerable variations in the exchange rate, and inflation. This phenomenon is spreading quite rapidly to a growing number of companies. The adverse effects of the financial crisis are visible particularly in the case of SME`s in sectors like commerce, constructions and real estate. Declining exports, diminished investment, and the liquidity blockage are the main effects of the financial crisis, with repercussions on companies [6].

In the first half of the year 2009, the number of SME`s going bankrupt has doubled over the same period the previous year. This is due to the fact that the credits for SME`s have declined by 30%, which has precluded their development and reduced their solvency.

A study done on a sample of 228 SME's by The Romanian National Council of SME's in november 2009, analyze the impact of the factors generating the decrease of the companies activity level, as it follows: 35% are due the state/government policies, 25% are due the instability of the political environment, 22% are generated by bank policies and only 18% are due the global crise. So, it's shown the low ability of the state to manage the economic crise and we can say that Romanian entreprises are most affecred by the economic crise due to the failure of the state policies.

The study shows that 60% of the SME's had a decrease on sales comparing to 2008 and only 17% of subject registered an increase on sales. The main problems companies are facing are the low rate of cashing the accounts receivable (68,9%), the decrease of demand (52,6%), the depreciation of the national currency (45,2%), the lack of liquidities (32,9%), the lack of capital (21,5%) and inflation (16,7%).

Trying to evaluate the general situation of Romanian SME's in the first semester of 2009, The Romanian National Council of SME's calculated an "entrepreneurial**"** index pondering 3 indexes: the business environment index, the index of SME's evolution and the index of entrepreneurs opinion regarding the situation of their own companies. This new indecs shows a very dissatisfactory situation of the business environment for SME's compared to the same period in 2008.

The representatives of the National Association of Romanian Employers believe several measures are needed to save the SME`s and they identified ones of the most important measures: resuming credits, VAT payment by companies on collecting, deduction of excise duty on gas, electricity and fuel, facilitation of government guaranteed loans, regulation of the price of raw materials by the Competition Council, reorientation of

the business to more profitable activities, deduction of social contributions, financing from banks and access to funds from CEC Bank and Eximbank.

6. Conclusions

To prosper in a turbulent economy, you need more than shere luck or guts intuition. It requires a new way to judge things, a serious planning and appropriate strategies.

The most effective way to face the new reality is a perfectly pragmatic and disciplined approach – a way to attack consists of well-defined systems, designed around a robust management model able to respond quickly to stimuli; that is the basis of a solid operational structure.

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THE EUROPEAN ENVIRONMENT POLICY'S INSTRUMENTS AND THE GLOBALISATION

Romeo IONESCU*

Abstract. *The environment can not be ignored nowadays. As a result, the EU developed legislative, technical and economical instruments and specific supporting instruments which are able to answer to the new environment tendencies and strategies.*

This paper realises a comparative analysis of these instruments, including the Eco-Management and Audit Scheme. A distinct part of the paper deals with the financial instruments connected to the environment protection and analyses the situation in the Member States. We talk about the environment preservation, the innovative projects and the technical assistance projects in the third countries, as well.

Keywords: *European environment policy, eco-management, audit scheme, environment protection, LIFE program, European Comission.*

1. Introduction

The is paper realises the distinction between the specific instruments, as LIFE+, the Structural Funds, the Cohesion Fund, the credit system of the European Investment Bank and the program NATURA, as well.

Nowadays, 16.5% of the ERDF and 50% of the Cohesion Fund finance directly the environment programs. We realised a comparative analysis of every structural fund and of its effects on the environment protection.

The NATURA 2000 is analysed distinctly because its sites cover 18% from the EU's area. As a new member of the EU, Romania has specific objectives and deadlines according to the European environment policy. These objectives cover 2004-2016 periods.

The last part of the paper deals with the environmental policy in Romania under the 2007-2013 National Development Plan. We talked about the Sector Operational Program Environment and the National Reference Strategic Framework, as well. Of course, we analysed the six priority axis of the Romanian environment policy.

* Dunărea de Jos University, 47 Domnească, St., 800008, Galatz, Romania.

The main conclusion of the paper is that the environment protection represents a challenge not only for the EU, but for the whole world, which can support or decelerate the socio-economic development.

The paper is based on the latest statistical database of Eurostat and the WTO.

2. The environment policy objectives and instruments

The evolution of the environment policy and its changes in time are reflected by its objectives, priorities and its numerous implementing instruments. There are three kinds of instruments: legislative, technical and economic-financial, which are supported by "help instruments", which are connected to the new environment protection tendencies and strategies.

One of the main functions of the environment action programs was the elaboration and the systematization of an efficient system of instruments in order to achieve the environment objectives. These instruments are subordinated to the European Environment Program and they are systematized by the European Commission as: regulation instruments, market instruments and technical instruments.

The regulation instruments establish the common legal framework and cover 200 components of the community acquis (regulations, directives decisions) which translate under the legislative framework European strategies, programs and action plans. The most frequent used instrument by the Member States is directive.

The market instruments cover all economic, technical and financial instruments which have impact on the costs and the profits of the economic agents, in order to modify the production and consumption behaviours according to the environment objectives. These instruments are based on the social market economy doctrine, which considers that markets are imperfect and the governmental intervention has to correct these imperfections. Under our approach, these imperfections are environment externalities. The main advantage of the market instruments is the adapting of the environment policy to the needs of the market economy. Under the market instruments, the European Commission is focused on: ecologic compatibility insurance, identification of the obstacles in economic instruments' implementation, environment taxes, environment responsibility, environment voluntary agreements, fiscal instruments for environment protection[1].

[1] European Council, Decision no. 2179/1998, Brussels.

In 1993, the EU implemented Eco-Management and Audit Scheme (EMAS), in order to support companies to adopt an ecologic management, by integration environment protection to the companies' strategies. Still 2001, EMAS was extended to all economic sectors, including public administration and European Commission. An essential role is the correct price establishment. This price has to cover the environment costs, as well. Under the European Commission point of view, the public administration has the responsibility to imply itself in the evaluation of this cost, in order to orient the companies to take into consideration the environment impact.

The technical instruments cover EU Eco-Labelling Board, environment voluntary accords, IPPC system, PIP system, environment inspection criteria for the Member States, Best Available Technologies and so on.

The Eco-Labelling Board is a system which supports the social responsibility of the companies and those goods which have a little impact on environment.

The environment voluntary accords were implemented until 2002 and they added a regulation framework to the community environment agreements[2].

The IPPC system supports the pollution decrease in energy, metallurgy, chemistry and offals management. The specific measures are focused on the emissions decrease in water, soil and air and offals management, in order to ensure a high environment protection.

The PIP system was implemented until 2003 and supports the eco-markets[3]. The system is focused on two main directions: general conditions for the ecologic integration improvement to the goods life cycle and the goods with highest ecologic potential.

The system follows three steps: implementation of the polluter-paid principle on the prices level, consumer option and goods ecologically production.

The environment inspection criteria for the Member States were created in order to ensure the conformity with the European environment legislation and to apply uniformly it. Criteria represent minimal conditions for environment inspections' management and evaluation.

The standards and emission limits are parts of the environment legislation limit environment pollution and identify great polluters.

Best Available Technologies (BAT) is presented in special guides on distinct industries and is obligatory for all companies.

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[2] European Commission, COM no. 412/2002 final, Brussels.

[3] European Commission, Building on Environment Life-Cycle Thinking, Brussels, June 2003.

3. Community Financial Instruments for the environment protection

3.1. LIFE Program

The EU has specific financial instruments which support the environment policy: LIFE Program, Structural Funds, Cohesion Fund, European Investment Bank's credits, NATURA 2000 Program and NGOs environment promoting.

The Community Financial Instrument for the Environment (LIFE) was created in 1992. It is used exclusively to the European Environment Program's implementation and covers three thematic areas: environment, nature and third countries. The objectives of the program are the following:

- definition and promoting of the production and consumption models according to the sustainable development principles;
- good practice examples promoting;
- supporting the pilot projects, horizontal information, education and training;
- development and improvement of the administrative structures competences;
- implementation of the environment in other policies.

LIFE program is divided into three thematic components: LIFE-Nature, LIFE-Environment and LIFE-Third countries. Every component has its own budget and specific priorities. Accompanying measures is a subcategory of the components and it supports with materials, studies and information the implementation of the three components, dissemination and good practice exchanges. All components have to be co-financed by the eligible countries, excepting the accompanying measures, which benefit only by European financing (see Table 1).

Table 1

LIFE budget

	LIFE -Nature	LIFE – Environment	LIFE – Third countries	Accompanying measures
Budget	47% of LIFE total budget	47% of LIFE total budget	6% of LIFE total budget	5% of disposable funds

The projects financed by LIFE have to be under community interest and to support the LIFE objectives, to be implemented by serious financial and technical partners and to be feasible as cost-efficiency and budget.

LIFE-Nature finances 50%-70% of eligible expenditures for natural habitat, wild fauna and flora preservation projects. The main such projects of the Member States are presented in table 2.

Table 2

Nature preserving projects under LIFE-Nature program

Country	Projects
Belgium	Land acquisition to protect special areas.
Denmark	Rebuilding of the rivers banks and swamp habitats; Reinsertion of the animal to grass.
Germany	Rebuilding of the swamp lands.
Estonia	Preservation of the boreal Baltic coast glades.
Greece	Protection of the endangered species, as Mediterranean monk seal.
Spain	Protection of the swamp lands, dunes, lagoons and maritime and coast areas; Protection of the endangered species, as brown bear, European back eagle, European otter and bat.
France	Contracts with the farmers for land ecologic management.
Ireland	Prominence of the Irish natural patrimony, especially by supporting eco-tourism.
Italy	Protection of specific animals (wolfs, bears, bats) or specific habitats (swamps, rivers, springs).
Latvia	Restoration and protection of large natural areas.
Luxembourg	Restoration of the biodiversity which was destroyed by agriculture.
Hungary	Protection of wolf and lynx from the North-East.
Netherland	Reinsertion of the spontaneous processes in order to recreate the natural sites.
Austria	Build of a "green bridge" above a speedway, in order to allow the passing of the brown bears in Alps and to grow the bear population.
Portugal	Management plans for „Nature 2000" sites.
Romania	National action plan for the protection of the dolphins from the Black Sea.
Slovenia	Protection of the swamps.
Finland	Monitoring of some specific butterflies which are used as indicators of the environment situation.
Swedish	Restoration of large swamp and glade areas on the Baltic Sea coasts.
UK	Protection of the birds which nest on the soil, especially in the Hebrides Islands.

Source: European Commission, DG Environment (http://europa.eu.int/comm/environment-/life/life/nature.htm).

LIFE-Environment finances 30%-50% of the eligible expenditures for the implementation of the community environment policy and legislation in the Member States and in candidate states, as well. The main objective

of this program is to support the development of methods and innovator techniques of the environment protection. The program has five eligible domains: land use development and planning, water management, decrease of the economic activities' impact on environment, waste management and decrease the impact on the environment using an integrate production framework.

The main projects implemented by the Member States under LIFE-Environment program are presented in table 3.

Table 3

Innovator projects in the Member States

Country	Innovator projects
Belgium	Systems of environment integrated management for major socio-cultural events (fairs, festivals).
Denmark	Decontamination of the treated wood waste; Ecologic denomination for retail sector.
Germany	Recycling of demolition waste and oils; Improvement of water quality; Environment local management plans.
Greece	Environment management plan for Olympic Games (2004, Athens); Olive oil production without impact on environment.
Spain	Integrate initiatives connected to sustainable development and tourism supporting.
France	Design of the cars' components in order to improve their environmental performances; Innovator treatment for residual waters.
Ireland	Regional environment management; Electronic equipment recycling.
Italy	Local initiatives for sustainable tourism promoting; Fight against greenhouse effect and air pollution.
Luxembourg	Use of simulation and monitoring soft for wastewater treatment.
Netherland	Integrated management for cities' water; Ecologic building supporting.
Austria	Sustainable development strategies for rural and urban areas; Promoting of bio-fuels and recycled building materials.
Portugal	Air quality monitoring; Decreasing the impact of the pig farms on environment.
Romania	Selective system of household waste collecting.
Finland	Integrated management for costal rivers and river basins.
Swedish	Waste ecologic treatment; Forest sustainable management.
UK	Collection, redistribution and reuse of the IT waste.

Source: http://europa.eu.int/comm/environment/life/life/environment.htm.

LIFE-Third countries finances technical assistance (70% of the eligible expenditures) for the sustainable development in the third countries. This program is focused on the initiation of the administrative capacities and structures for the environment policy and action programs development in the Member States, in some candidate states and in third countries beside Mediterranean and Baltic Seas. The project proposals have to be of community interest, to promote international, national or regional sustainable development and to propose solutions to solve the major environment problems.

The technical assistance projects from the third countries are presented in table 4.

Table 4

Technical assistance projects in the third countries

Country	Technical assistance projects
Albania	Traffic sustainable development in Tirana;
Algeria	Implementation of an environmental information and forming centre.
Bosnia-Herzegovina.	Action environment plan for swampy areas Bardaca; Assistance for environment management for local and regional authorities; Decreasing the industrial activities impact on the environment; Assistance for the initiation of the legislation connected to the pollution decrease.
Croatia	Introduction of national amendments to air pollution and offals.
Gaza and West Coast	Integrated management to the rural environment.
Jordanian	Implementation of a natural touristic park in Jerash; Environmental aspects.
Lebanon	Decreasing of the industrial pollution and offals; Fight against forest arsons.
Russia	Environment technical assistance for the city of Kaliningrad; Administrative assistance for Baltic Sea shores' protection.
Syria	Implementation of the environment management systems, especially EMAS, to the Syrian business environment.
Tunisia	Creation of monitoring pilot systems to the desert advancing (together with Morocco).
Turkey	Improvement of the air and water quality and the offals; Elimination of the odorous emissions.

Source: http://europa.eu.int/comm/environment/life/life/third countries.htm.

LIFE – Environment covers 30%-50% of the expenditures to innovator techniques and methods which are able to support the decrease of the negative impact on environment.

LIFE – Nature financed 50%-70% of the biodiversity preservation and amelioration projects, including the support to the Nature 2000 network. LIFE-Third countries program covers 70% of the financing connected to the administrative structures creation and the environment policy implementation in countries from Mediterranean and Baltic areas.

The financial perspectives 2007-2013 [COM (2004)101] support the environment dimension of the specific community financing. The environment objectives are included to the priority domains and are financed under the thematic areas "Sustainable growth", "Sustainable management and natural resources protection" and "EU as global partner".

The European Commission proposed a new program LIFE+ – "Financial instrument for environment: promotion of a sustainable EU", in order to support the development, applying, monitoring, evaluation and communication in the environment community policy and law. The program supported PAM 6 by financing those activities which are able to create added value to the community and to generate multiplication effects, under to priority axis: Ecologic Implementation and Governance" and "Information and Communication"[4].

LIFE+ started in 2007 and is divided into three components: LIFE+ Nature and biodiversity, LIFE+ Environment policy and governance and LIFE+ Information and communication.

During 2007-2013, the budget of this financial instrument is 2.143 billion Euros. LIFE+ can finance public and/or private actors and institutes.

LIFE+ Nature and Biodiversity program is focused on the following objectives:

- implementation of the community policy and legislation regarding nature and biodiversity, especially of the Directives no. 79/409/EEC and 92/43/EEC at local and regional levels, in order to support the future development and the implementation of the Nature 2000 network, including costal and marine habitats and species;
- consolidation of the knowledge basis for the preliminary evaluation, monitoring and final evaluation of the common policy and legislation regarding nature and biodiversity;

[4] CEE (2004), Proposal for a Regulation of the European Parliament and of the Council concerning the financial instrument for the environment (life +), Com (2004) 621 final.

- elaboration and applying of the monitoring and evaluation policies and instruments to nature and biodiversity;
- a better environment governance.

LIFE+ Environment Policy and Governance program supports:

- development of innovator policies, technologies, methods and instruments;
- consolidation of the knowledge basis for the environment policy and legislation;
- elaboration and applying of the monitoring and preliminary evaluation policies connected to the environment protection;
- supporting the regional and local applying environment policy;
- supporting better environment governance.

LIFE+ Information and communication is focused on: information diffusion and forest fires preventing, and complementary measures.

3.2. Other EU financial programmes for environment protection

Another EU specific financial instrument which supports the environment policy is Structural Funds system. This system covers 35% of common budget. Nowadays, 16.5% of European Regional Development Fund and 50% of Cohesion Fund finance directly environment programs.

The environment protection represents an important criterion to select the projects financed by the European Investments Bank (EIB). EIB can cover 50% of the investment cost in: water and air quality improvement, urban transport networks, healthcare, energy and offals management.

Nature 2000 program covers 18000 protected areas with high ecologic value. This network consists of Special Areas of Conservation and Special Protected Areas.

Romanian legislation specifies these elements into Law no. 462/2001. Romania has the most bio-geographic regions: alpine, continental, Pannonian, veldt and Pontic. Nature 2000 implementation in Romania represents a condition to the Romania's integration into EU. As a result, Romania had to achieve the following objectives:

- 2004 – transposal of the Birds and Habitats Directives into national legislation;
- 2007 – elaboration of the list of potential Sites of Community Importance (pSCIs);

• 2009 – bio-geographic seminars for the Sites of Community Importance's list negotiation;

• 2010 – endorsement of the Sites of Community Importance's list;

• 2016 – the Sites of Community Importance will become Special Conservation Areas and it will be created a functional system of protected areas Nature 2000.

The environment NGOs promoting program supports the initiatives of the civil society connected to the European environment policy implementation. EU finances 70% of these initiatives (80% for the candidate countries).

4. Conclusions

The dynamic analysis of the environment instruments system reflects the EU concern to adapt the environment policy to the market economy principles. This means the movement of the accent from the control and command instruments to those which are based on market, using special actions, in order to integrate the ecologic components to the production and consumption behaviour.

The environment protection represents a challenge not only for the EU, but for the whole world, which can support or decelerate the socio-economic development.

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[8] http://europa.eu.int/comm/environment/life/life/environment.htm

[9] http://europa.eu.int/comm/environment/life/life/third countries.htm