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ECONOPHYSICS Section

THE NEOCLASSICAL THEORY OF A FIRM; CORRECTIONS FOR ITS ERRORS

Matti ESTOLA *

***Abstract.** The static neoclassical theory of a firm is logically inconsistent, and it has not got any support in empirical tests. In spite of this, the theory is dominating in mainstream textbooks. The main logical inconsistencies in the neoclassical theory are: 1) Assuming that a firm produces at a constant positive profit maximizing flow of production does not allow its growth or the possible bankruptcy of the firm, which are common events in firms' behavior. 2) The theory does not explain how firms find their equilibrium; only optimal behavior is modeled. 3) The dynamic neoclassical theory of a firm obtained by dynamic optimization is inconsistent with the static one. The main empirical shortcomings of the theory are: 1) most data of production flows obeys a unit root which implies that the time series has a linear or a more complicated time trend; business cycles are also common in production data. These observations question the assumption that firms produce at a constant flow of production. 2) In the neoclassical theory, price explains the flow of production but price and the flow of production do not always correlate positively. 3) The existence of a profit maximizing flow of production requires decreasing returns to scale in production, but increasing returns have been observed in various studies. 4) The assumed duality in the neoclassical theory has been rejected in empirical tests. As a solution to these problems, we present a dynamic theory of a firm that corrects the shortcomings in the neoclassical theory. We define the "economic force" that acts upon the production of a firm and show that firms' profit-seeking adjustment of production may be stable or unstable. Economic growth, business cycles, and bankruptcies of firms are modeled by using a single framework, and the static neoclassical theory is obtained as a special case in this framework: the zero-force situation. (JEL D21, O12)*

***Keywords:** Errors in the neoclassical theory, Dynamics of production, Economic force, Causes for firms' bankruptcies.*

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1. Introduction

Static neoclassical theory of a firm is the dominating one in economics textbooks. However, by static analysis we cannot explain the observed evolutionary behavior of economies. MasColell et al. [1 p. 620] state the problems of the neo-classical framework as follows: “*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 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 cost then production will expand. ... The difficulty is in transforming these informal principles into precise dynamic laws.*”

The definition of “*precise dynamic economic laws*” requires a dynamic framework for modeling economic behavior, and we introduce here such. *We believe that the willingness of economic agents (entrepreneurs, consumers, workers etc.) to better their situation in a competitive environment is the fundamental cause of economic dynamics.* The assumption that economic units behave in an optimal way prohibits understanding economic dynamics because no economic unit likes to change its optimal behavior. *The error in the neoclassical framework is the same as if in physics it were assumed that the initial position of a particle is in its point of minimum potential energy where it has “no willingness” to move anywhere.* Thus to understand economic dynamics we need to assume that economic units are not in their optimum, for example, after a price change that has shifted the equilibrium point. Economic units like to improve their welfare and optimal behavior results when no improvement is possible, see [2].

We start by presenting the neoclassical theory of a firm to point out its theoretical weaknesses. Next we give empirical evidence that is in contrast with the assumptions made in the neoclassical framework. Then we introduce a theory that corrects the weaknesses in the neoclassical framework and gives the static neoclassical theory as a special case: the

zero-force situation. Finally, we give examples of dynamic behavior that can be explained by using the proposed framework.

2. The neoclassical theory of a firm and its weaknesses

Let the flow of production of a firm be $q(\text{unit}/y)$, where y is a time unit e.g. a week or a month. The unit price of the product of the firm is denoted by $p(\text{€}/\text{unit})$, $p(q)$ is the sales or inverse demand function, $C(q)(\text{€}/y)$ the cost function, and $\Pi(p, q)(\text{€}/y)$ the profit of the firm,

$$\Pi(p, q) = p(q)q - C(q), \quad C'(q) > 0, \quad C''(q) < 0.$$

In the neoclassical framework it is assumed that the firm produces at its profit maximizing flow:

$$\frac{\partial \Pi}{\partial q} = 0 \Leftrightarrow p(q) + p'(q)q = C'(q) \Leftrightarrow q^* = f(p),$$

where $p(q) + p'(q)q$ is marginal revenue, $C'(q)$ marginal cost, and q^* the optimal flow of production of the firm. The essential weaknesses of the theory are:

- 1) In the theory time is abstracted away and thus q^* depends on a fixed price p . This is in contrast with the observed growth of firms, business cycles, and firms' bankruptcies.
- 2) The theory assumes that price determines the flow of production, but in the theory it is not explained mathematically how the firm reaches its new optimum after a price change. Only equilibrium situations are modeled.
- 3) The static and the dynamic neoclassical theory obtained by dynamic optimization are inconsistent with each other, see [3].
- 4) The interactions between firms' production decisions are not taken account properly in modeling the behavior of a single firm, see [4].
- 5) The theory does not explain the motivation for firms to develop their production technology or the quality of their products that are essential elements in firms' competition.

In Figure 7 in Appendix are graphed annual industrial flows of production and price levels of Finnish manufacturing industries: DA: Food products, beverages and tobacco, DB+DC: Textiles, textile products,

leather and leather products, DD: Wood and wood products, DE: Pulp, paper and paper products, publishing and printing, DF: Refined petroleum products, coke and nuclear fuel, DG: Chemicals and chemical products, DH: Rubber and plastic products, DI: Other non-metallic mineral products, DJ: Basic metals and fabricated metal products, DK: Machinery and equipment, DL: Electrical and optical equipment, DM: Transport equipment, DN: Other manufacturing and recycling. The industrial prices are computed as $p_t q_t / (p_0 q_t) = p_t / p_0$, i.e. current value time series $p_t q_t$ are divided by fixed price series $p_0 q_t$.

The following observations of the data are in contrast with the neoclassical framework:

- 1) All industrial flows of production and prices obey a unit root (Table 1 in Appendix; the power values of all Augmented Dickey-Fuller tests are greater than 0.01). Thus a linear or a more complicated time trend exists in the series, and fluctuating behavior is also visible. These observations question the omitting of time in the neoclassical framework.
- 2) According to the T -tests of the correlations (Table 1), two of the industrial prices do not correlate significantly with the flows of production, and two of the correlations are significantly negative. Thus only in 9 cases of 13 a significant positive correlation is observed between the flow of production and the price in an industry.
- 3) The theory assumes decreasing returns to scale ($C''(q) < 0$), but increasing returns have been observed in various studies, see e.g. [5, 6].
- 4) In [7] the duality theory of a firm fails in empirical testing because the estimated parameters of production and cost functions turned out to differ significantly. The reason for this may be that some of the following assumptions in the neoclassical framework are erroneous: cost minimizing behavior, perfect competition, static framework, and no uncertainties in modeling.

Due to these theoretical and empirical weaknesses of the neoclassical theory, we introduce a dynamic theory of a firm that corrects them. This theory is similar to the Newtonian one in physics, and it is based on a force that is acting upon the production of a profit-seeking firm. This framework

has been presented earlier in refs [8, 9], but here we give some new results and data that support the theory. In [8] is described how uncertainties can be handled in the theory, and in [9] it is shown that the Newtonian theory to be presented here outperforms the neoclassical one in every studied industry. Thus we have evidence of the superiority of the theory to be introduced next.

3. Kinematics of production

The accumulated production of a firm till time moment t (the accumulated kilometers a car has driven) denoted by $Q(t)(unit)$ (a marginal change in time ds is measured in time units y) is

$$Q(t) = Q(t_0) + \int_{t_0}^t q(s)ds, \quad Q'(t) = q(t), \quad Q''(t) = q'(t),$$

where $Q(t_0)$ is the accumulated production of the firm from its foundation till moment t_0 , $Q'(t)$ with unit $unit/y$ the momentous velocity of accumulated production, and $Q''(t) = q'(t)$ with unit $unit/y^2$ the momentous acceleration of accumulated production. This kinematics of production is a necessary prelude for production dynamics analogous to Newtonian mechanics.

4. A dynamic theory of production

A common way to transform the neoclassical theory into dynamic form is to use dynamic optimization. The applications of this technique e.g. [10] use time dependent profit functions in contrast with the static theory, however, and thus the two theories are inconsistent. The dynamic optimization problem of a firm gives the same result as the static problem if identical profit functions are applied, see [3]. Dynamic optimization as a mathematical technique then does not solve the problem, and we omit here the dynamic optimization technique.

The decision-making concerning the dynamics of production of the firm – the cause of this dynamics – can be studied by assuming that the decision-makers are planning whether to increase the accumulated production of the firm by a certain amount or not, or whether to change the velocity of accumulated production of the firm measured from the last week, month, or year by a certain quantity. We study here only the latter

alternative; for the former see [8]. The function, that expresses the maximum unit price $p(t)$ (€/unit) by which the firm can sell the quantity $q(t)$ (unit/y) of products during time unit y , the inverse demand or the sales function of the firm, is

$$p(t) = f(q(t), t), \frac{\partial f}{\partial q} \leq 0.$$

Our modeling covers a monopoly firm and a firm in monopolistically and also in “roughly perfectly” competing market. We assume here that the product is heterogeneous with those of other firms to avoid taking account other firms’ production decisions in the production decision of the studied firm, see [4]. Including time in function $f(\cdot)$ allows that the sales of the firm may change with time due to changes in customers’ habits or due to marketing the good.

The costs of firms can be divided in four categories: 1) costs from starting production (buying or renting the necessary buildings, machines and tools), 2) fixed costs in a given time unit independent of the level of activity (monthly rents, salaries, heating costs etc.), 3) costs in a given time unit that depend on the level of activity (costs from working hours, raw materials etc.), and 4) costs from maintaining and expanding the production capacity (gross and net investments). Here we do not treat starting costs and investment decisions, and so these costs are omitted in the following.

Without losing generality we can write the cost function as

$$C(q(t), t) = h(t) + g(q(t), t)q(t).$$

We denote by $C(\cdot)$ (€/y) the costs of the firm during time unit y at moment t realized at the velocity of production $q(t)$, by $h(t)$, (€/y) fixed costs during time unit y independent of the velocity of production, and unit costs $g(\cdot)$ (€/unit) may depend on the velocity of production and time. Technological development, for example, may decrease unit costs with time.

The profit Π with unit €/y is then

$$\Pi(q(t), t) = f(q(t), t)q(t) - h(t) - g(q(t), t)q(t), \frac{\partial f}{\partial q} \leq 0.$$

Taking the time derivative of the profit function gives

$$\begin{aligned}
\Pi'(t) &= \frac{\partial \Pi}{\partial q} q'(t) + \frac{\partial \Pi}{\partial t} \\
&= \left(\left(\frac{\partial f}{\partial q} - \frac{\partial g}{\partial q} \right) q(t) + f(q(t), t) - g(q(t), t) \right) q'(t) + \left(\frac{\partial f}{\partial t} - \frac{\partial g}{\partial t} \right) q(t) \\
&\quad - h'(t).
\end{aligned} \tag{1}$$

The second additive term in the first form of Eq. (1) shows that time affects profit via functions $f(\cdot)$, $g(\cdot)$, and $h(\cdot)$ independently on the firm's production decisions, which motivates the firm to do marketing and develop its technology. The firm's leaders like to increase the profit of the firm with time, and then they change $q(t)$ as follows:

$$q'(t) > 0 \text{ if } \frac{\partial \Pi}{\partial q} > 0, \quad q'(t) < 0 \text{ if } \frac{\partial \Pi}{\partial q} < 0, \quad \text{and} \quad q'(t) = 0 \text{ if } \frac{\partial \Pi}{\partial q} = 0. \tag{2}$$

These rules make the first additive term in the first form of Eq. (1) non-negative, i.e. the rules increase the profit with time. The last rule implies that there is no reason to change the velocity of production if it does not affect profit. These rules are in accordance with the intuitive dynamic rules stated in [1] referred earlier, and [11 p. 387] writes about the behavior of a firm in a perfectly competed market as: "... if $p - \Delta C / \Delta q > 0$, then the firm can increase its profits by producing more". Thus also in mainstream textbooks adjustment rules (2) have been accepted.

Imitating Newtonian mechanics we identify $\partial \Pi / \partial q$ – the reason for the acceleration of production – as the "*force acting upon the production of the firm*". A relation that fulfills rules (2) is

$$q'(t) = F\left(\frac{\partial \Pi}{\partial q}\right), \quad F'\left(\frac{\partial \Pi}{\partial q}\right) > 0, \quad F(0) = 0, \tag{3}$$

where $F : \mathbb{R} \rightarrow \mathbb{R}$. In Eq. (3), the firm adjusts its velocity of production according to the deviation between marginal revenue and cost (this assumption is made in [12] too). Taking the Taylor series approximation of

function F in the neighborhood of point $\partial\Pi/\partial q = 0$, and assuming the error term to be zero, we can approximate function F by a linear one,

$$mq'(t) = \frac{\partial\Pi}{\partial q}. \quad (4)$$

Constant $m > 0$ with unit $(\text{€} \times y^2)/\text{unit}^2$ is the ratio of force and acceleration; its magnitude measures the inertia in the firm's adjustment of production: rigid technology, bottlenecks in the production process, fear of decreasing product price etc. Following Newton we call m the “*inertial mass of the velocity of production*”, and Eq. (4) the *Newtonian theory of a firm adjusting its velocity of production*. Neoclassical theory corresponds to zero-force in Eq. (4): $\partial\Pi/\partial q = 0 \Leftrightarrow q'(t) = 0$.

We can also introduce the concept of static friction into economics. Static friction is a force component resisting all changes. By reflecting on this concept we can explain that many times firms (and people) do not change their behavior unless the reasons become compelling enough, i.e. the acting force component exceeds a limit. This can be formulated as

$$mq'(t) = \frac{\partial\Pi}{\partial q} + F_f, \quad (5)$$

where the static friction force with unit $\text{€}/\text{unit}$ is denoted by F_f ; it is zero when $\partial\Pi/\partial q = 0$, its direction is opposite to that of $\partial\Pi/\partial q$, and $|F_f| \leq |\partial\Pi/\partial q|$. The absolute value of F_f increases with that of $\partial\Pi/\partial q$ and it keeps the total force zero until $\partial\Pi/\partial q$ exceeds a limit. Static friction could be added in all examples we study later but is omitted for simplicity.

Case 1: A dynamic extension to the neoclassical theory

Let the sales and unit cost functions be

$$f(q(t)) = a - \frac{b}{2}q(t), \quad g(q(t)) = A,$$

where $q(t)$ is as before and a, b, A positive constants with units: $\text{€}/\text{unit}$, $(\text{€} \times y)/\text{unit}^2$, and $\text{€}/\text{unit}$, respectively. Parameter a measures the maximum unit price at which the first produced unit during time unit y

can be sold, and b the relation between unit price and the sales of the firm. Taking account the problems in the definition of perfect competition (see [4]), the more competition there exists the closer to zero b is; monopolistic competition and a monopoly firm correspond to $b > 0$. Parameter $A > 0$ measures unit costs from the first produced unit during time unit y . Assuming the fixed costs during time unit y to be constant h_0 , the profit function $\Pi(\text{€}/y)$ becomes

$$\Pi(t) = f(q(t))q(t) - h_0 - g(q(t))q(t) = aq(t) - \frac{b}{2}q^2(t) - h_0 - Aq(t).$$

Assuming no static friction in production, the Newtonian equation is:

$$\frac{\partial \Pi}{\partial q} = mq'(t) \Leftrightarrow a - A - bq(t) = mq'(t). \quad (6)$$

Eq. (6) shows that the firm increases its flow of production ($q'(t) > 0$) if $q(t) < (a - A)/b = q^*$, and decreases its flow of production if $q(t) > q^*$, where q^* is the profit maximizing flow of production. The solution of differential equation (6) is

$$q(t) = \frac{a - A}{b} + C_0 e^{-\frac{b}{m}t}, \quad (7)$$

where $C_0(\text{unit}/y)$ is the constant of integration and $(b/m)t$ is a dimensionless quantity because time t has unit y . According to Eq. (7), $q(t) \rightarrow q^* = (a - A)/b$ with time which situation corresponds to zero force. Setting $t = 0$ in Eq. (7) gives $q(0) = (a - A)/b + C_0 \Rightarrow C_0 = q(0) - (a - A)/b$. Thus $q(t)$ increases (decreases) with time if C_0 is negative (positive), that is, whether $q(0)$ is smaller or greater than q^* . The neoclassical theory corresponds to $q(0) = (a - A)/b = q^*$, and then the firm produces at the constant optimal flow of production. This example adds dynamics in the neoclassical theory and shows how the firm reaches its optimum with time if it does not be in it; see Figures 1, 2 where $q^* = 10$.

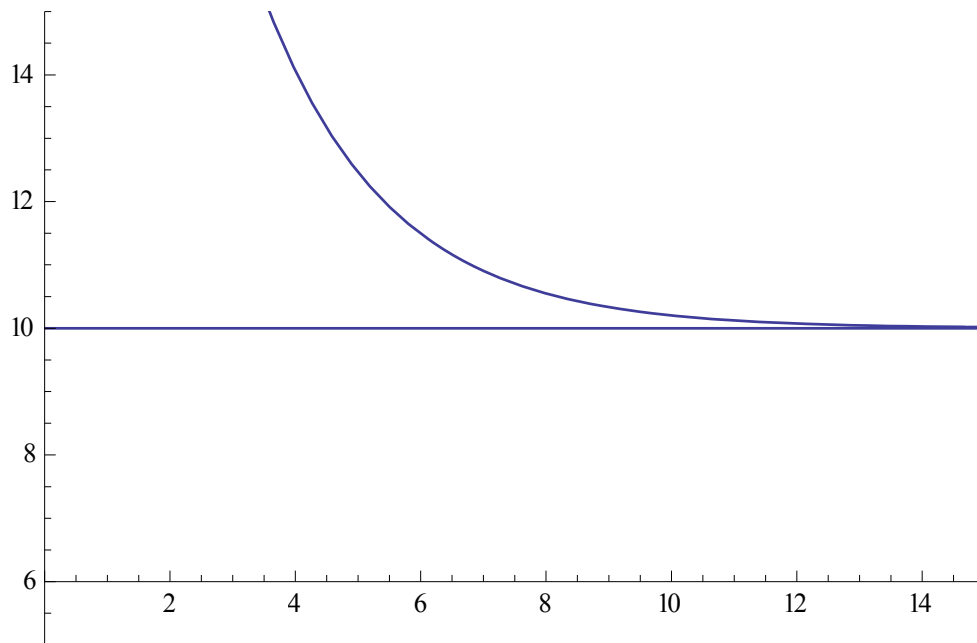


Figure 1. Eq. (7) with the following values:

$$m = 2, a = 20, A = 10, b = 1, C_0 = -40.$$

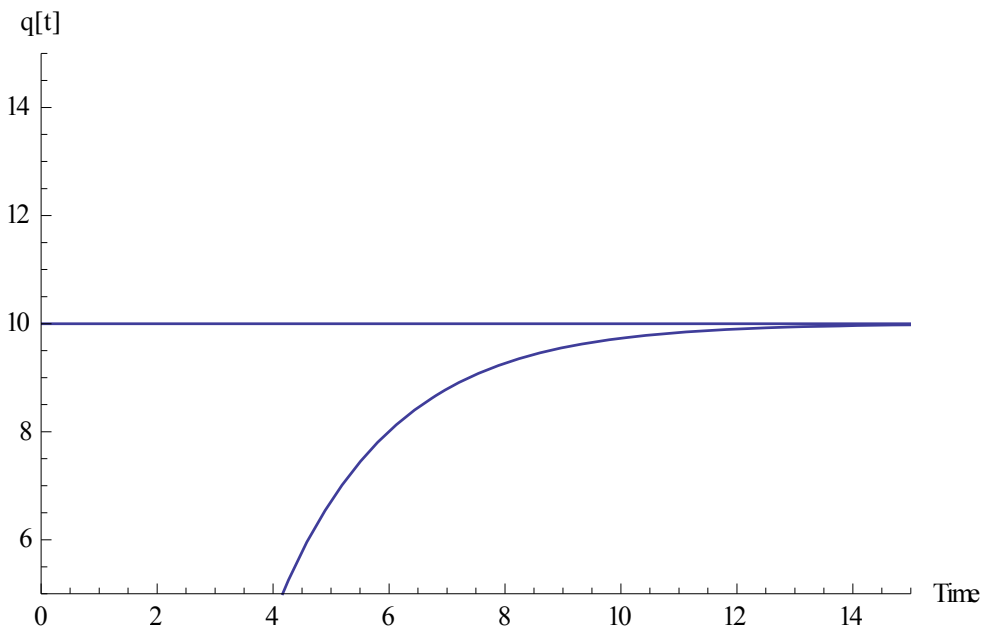


Figure 2. Eq. (7) with the following values:

$$m = 2, a = 20, A = 10, b = 1, C_0 = 30.$$

Case 2: Growth in production, business cycles, and the bankruptcy of the firm

Let the sales function be

$$f(q(t),t) = a - \frac{b}{2}q(t) + ct + k_1\text{Sin}(h_1 + w_1t) + k_2\text{Sin}(h_2 + w_2t),$$

where parameter c with unit $\text{€}/(\text{unit} \times y)$ measures changes in sales with time due to changes in consumers' preferences or wealth (c may be positive or negative), the amplitude parameters k_i of the sine functions have unit $\text{€}/\text{unit}$, the frequency parameters w_i have unit $1/y$, and the phase parameters h_i are pure numbers, $i=1,2$; the other terms are as before. Parameters k_i are needed for the dimensional consistency of the function, and the unit of the frequency parameters w_i makes the arguments of the sine functions dimensionless as they should be (a system of measurement units for economics is given in [13] and also in [14]). The sine functions represent business cycles and seasonal fluctuations that affect the sales of the firm with different phase and frequency.

Let the unit costs be:

$$g(q(t),t) = A + \frac{B}{2}q(t) - Ct, \quad (8)$$

where A, B, C are dimensional constants with units $\text{€}/\text{unit}$, $(\text{€} \times y)/\text{unit}^2$, and $(\text{€} \times y)/\text{unit}$, respectively. Parameter B measures either decreasing ($B > 0$) or increasing ($B < 0$) returns to scale, and parameter C measures the development in technology that decreases unit costs with time if ($C > 0$). Assuming fixed costs to be constant h_0 the profit Π during time unit y becomes:

$$\begin{aligned} \Pi(t) = & \left(a - \frac{b}{2}q(t) + ct + k_1\text{Sin}(h_1 + w_1t) + k_2\text{Sin}(h_2 + w_2t) \right) q(t) \\ & - \left(A + \frac{B}{2}q(t) - Ct \right) q(t) - h_0. \end{aligned} \quad (9)$$

The Newtonian equation is then:

$$mq'(t) = z_0 - z_1q(t) + z_2t + k_1\text{Sin}(h_1 + w_1t) + k_2\text{Sin}(h_2 + w_2t), \quad (10)$$

where $z_0 = a - A$, $z_1 = b + B$, and $z_2 = c + C$. If the unit price by which the firm can sell its first produced unit during time unit y exceeds the unit costs of the first unit, then $z_0 > 0$. The second term in the force consists of possible linear relations unit price and unit costs may have with $q(t)$. It always holds $b \geq 0$, and decreasing returns to scale corresponds to $B > 0$, and increasing returns to scale to $B < 0$. We obtain different behavior depending on the sign of z_1 , that is, whether the increasing returns to scale effect ($B < 0$) dominates the negative demand effect ($b > 0$). Constant z_2 shows that changes in consumers' preferences or wealth and technological development create an identical linear time trend in the force; Eq. (10) thus does not distinguish between demand and supply based growth. Notice that z_2 may be negative, too, which corresponds to situations where consumers substitute this product by others or the unit costs of the firm increase with time.

The solution of Eq. (10) is:

$$q(t) = a_0 + a_1 t + a_2 \sin(w_2 t) + a_3 \cos(w_2 t) + a_4 \sin(h_1 + w_1 t) + a_5 \cos(h_1 + w_2 t) + a_6 e^{-\left(\frac{z_1}{m}\right)t}, \quad (11)$$

where:

$$a_0 = \frac{(z_0 z_1 - m z_2)(z_1^2 + m^2 w_1^2)}{z_1^4 + m^2 z_1^2 w_1^2}, a_1 = \frac{(z_1 z_2)(z_1^2 + m^2 w_1^2)}{z_1^4 + m^2 z_1^2 w_1^2},$$

$$a_2 = \frac{k_2(z_1 \cos(h_2) + m w_2 \sin(h_2))}{z_1^2 + m^2 w_2^2}, a_3 = \frac{k_2(z_1 \sin(h_2) - m w_2 \cos(h_2))}{z_1^2 + m^2 w_2^2},$$

$$a_4 = \frac{k_1 z_1^3}{z_1^4 + m^2 w_1^2 z_1^2}, a_5 = -\frac{m k_1 w_1 z_1^2}{z_1^2 + m^2 w_1^2 z_1^2},$$

and a_6 (unit / y) is the constant of integration. In Eq. (11), $q(t)$ has a linear and an exponential time trend together with cyclical behavior. The time trends are caused by returns to scale and time dependent sales and cost functions. A profit maximizing flow of production exists only if $z_0, z_1 > 0$ and $z_2 = k_1 = k_2 = 0$. Then Eq. (7) results and the firm will end into the neoclassical optimum. Setting different values for the constants we get varying realizations of Eq. (11), see Figures 3-6.

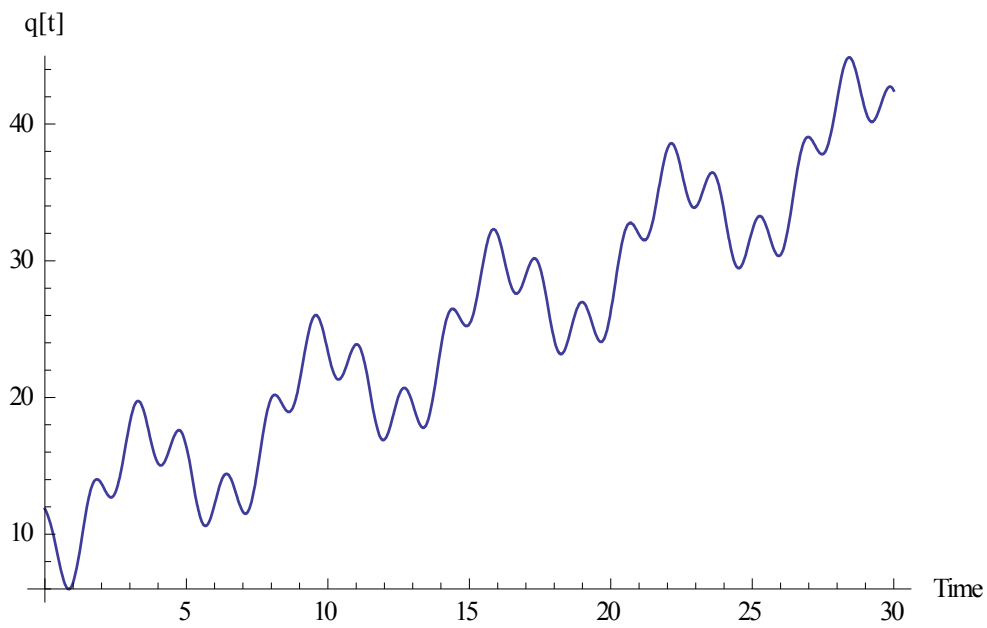


Figure 3. Eq. (11) with $m = 1, w_1 = 1, w_2 = 4,$
 $h_1 = 10, z_1 = 2, a_0 = 10, a_1 = 1, a_2 = 1, a_3 = 2, a_4 = 3, a_5 = 3, a_6 = 4.$

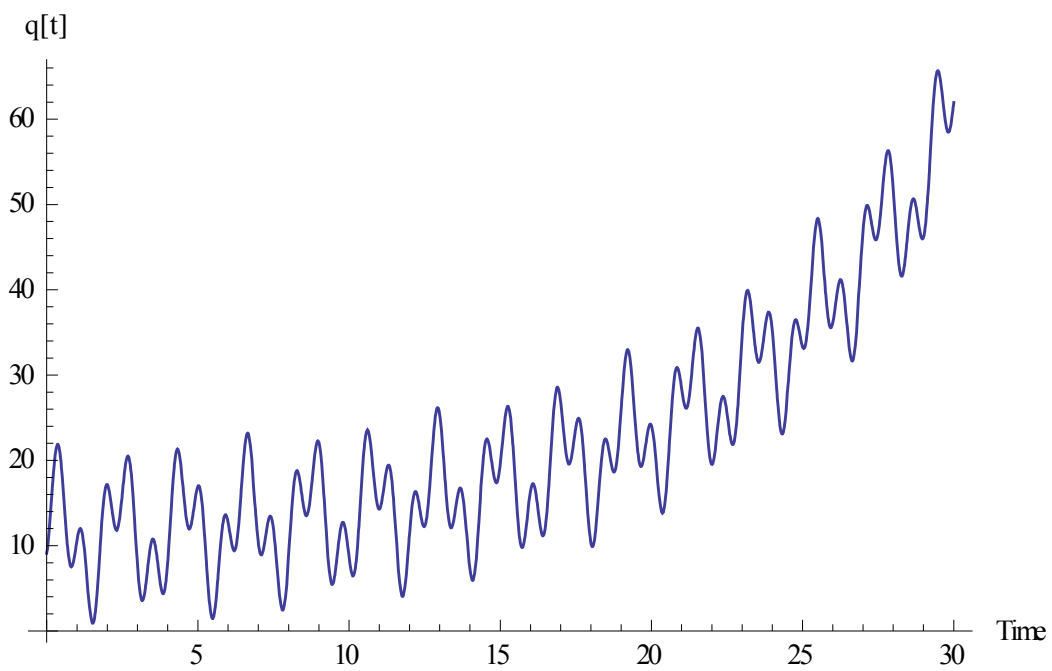


Figure 4. Eq. (11) with $m = 1, w_1 = 1, w_2 = 4,$
 $h_1 = 4, z_1 = -0.13, a_0 = 10, a_1 = 0, a_2 = 5, a_3 = 3, a_4 = 3, a_5 = 4, a_6 = 1.$

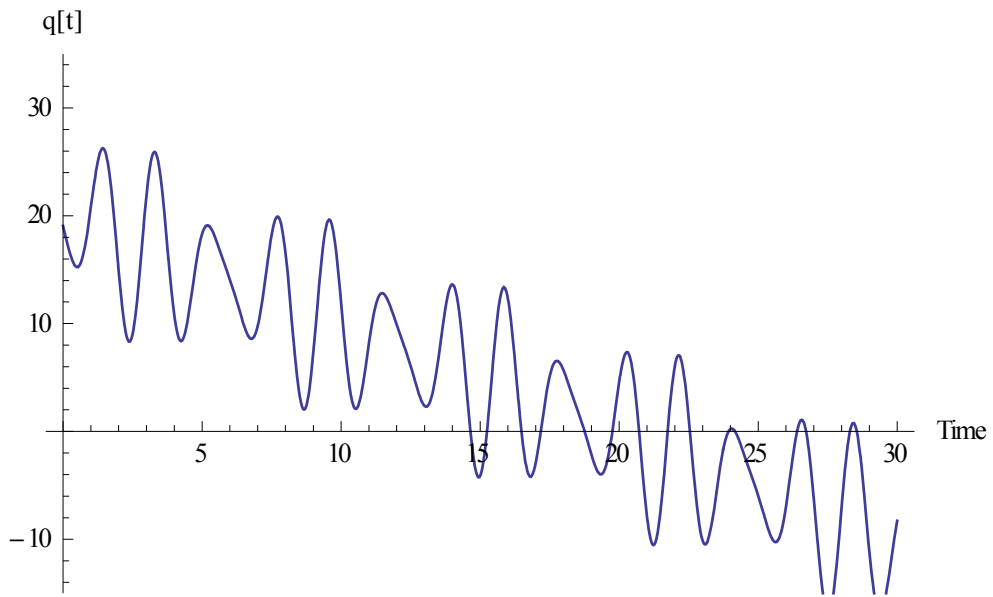


Figure 5. Eq. (11) with $m = 1, w_1 = 3, w_2 = 4,$
 $h_1 = 10, z_1 = 2, a_0 = 20, a_1 = -1, a_2 = 1, a_3 = 3, a_4 = 6, a_5 = 2, a_6 = 1.$

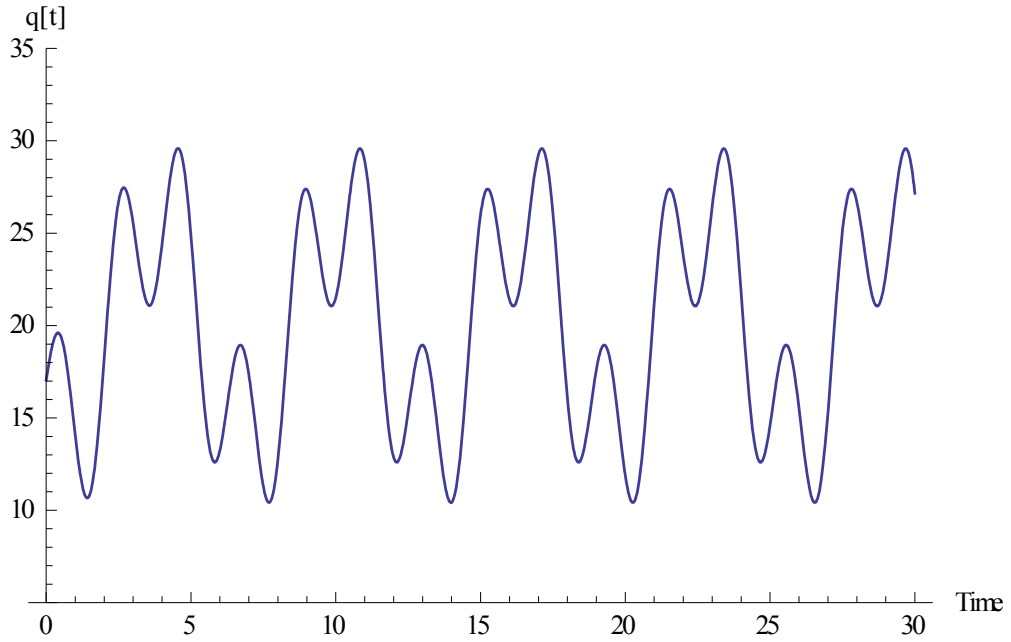


Figure 6. Eq. (11) with $m = 1, w_1 = 1, w_2 = 3,$
 $h_1 = 10, z_1 = 1, a_0 = 20, a_1 = 0, a_2 = 5, a_3 = 1, a_4 = 6, a_5 = 2, a_6 = 1.$

Figure 3 shows a growing flow of production with business cycles and seasonal fluctuations due to increasing sales or decreasing unit costs with time. Figure 4 shows exponential growth with fluctuations due to increasing returns to scale. In Figure 5, the firm ends up into bankruptcy due to decreasing sales or increasing unit costs with time, and Figure 6 shows that decreasing returns to scale and no time dependencies in sales and unit costs lead to stationary fluctuations.

We can remark here that our assumption of linear time relations in demand and unit costs are unrealistic. They were made only to get a simple Newtonian equation for production and more complicated functions would give more realistic results. However, the numerical value of z_2 can be chosen small enough that the growth rate obtained is e.g. 2%/year, which is a common growth rate of real GDP in industrialized countries. In Figure 7, the time paths of flows of production have a linear or an exponential time trend together with cyclical behavior. From this we have evidence at firm level too. For example, the average growth rate of the turnover of Nokia Corporation was 25.1%/year, during 1979-88, -2.5%/year, during 1989-92, and 28.5%/year, during 1993-8. This demonstrates the non-steady-state nature of the production process.

4. Conclusions

We introduced a dynamic framework for modeling firms' behavior that can explain firms' growth, business cycles, and bankruptcies. The "economic force" acting upon the production of a profit-seeking firm was defined, and the model was shown to give the neo-classical theory as a special case: the zero-force situation. The studied force fields were "time and velocity dependent". Physics too operates with velocity dependent forces, and engineering operates with time-dependent forces e.g. when the motion of a body is controlled by a force. The defined forces allow us to analyze the production of a firm as a controllable system. In this study the controller was the decision-maker of the firm, but the analysis can be extended to economic policy-making too; e.g. tax policy can be studied by assuming that government controls by tax parameters the productions of firms.

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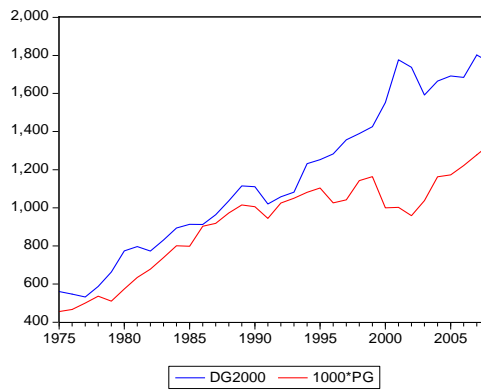
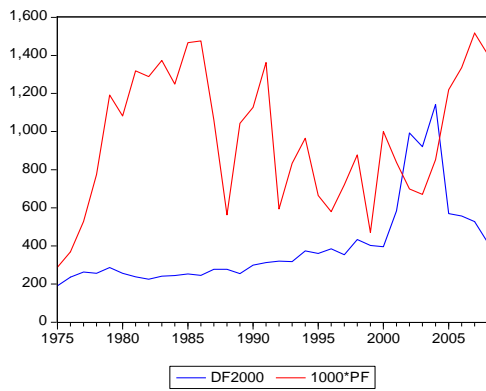
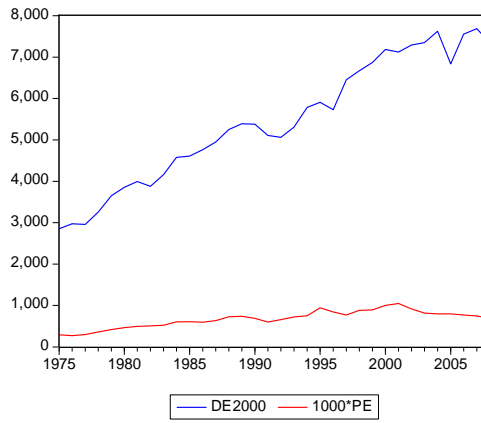
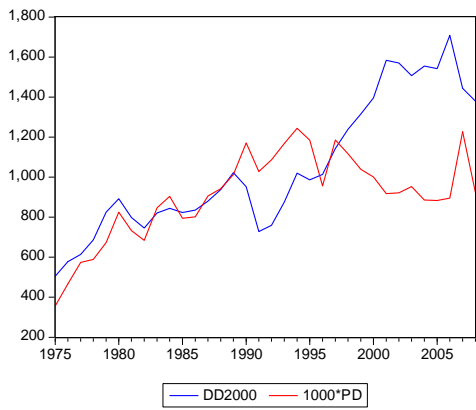
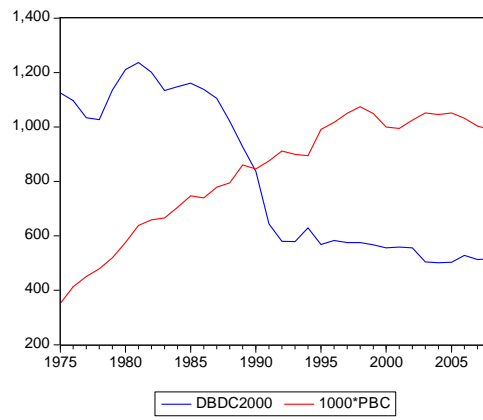
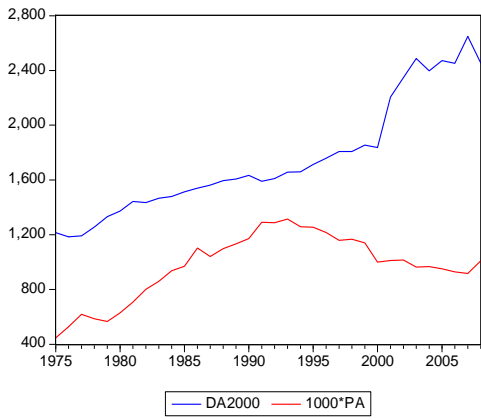
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APPENDIX

Table 1.

Unit root and correlation tests of industrial flows of production and prices

Industry	ADF, volume (Prob.)	ADF, price (Prob.)	Correlations, (T-test)
DA	0.9 (0.99)	-2.6 (0.10)	$r = 0.34(2.03)$
DB+DC	-0.6 (0.86)	-3.6 (0.01)	$r = -0.87(-9.85)$
DD	-0.6 (0.85)	-2.7 (0.09)	$r = 0.45(2.86)$
DE	-1.2 (0.65)	-2.0 (0.30)	$r = 0.88(10.51)$
DF	2.3 (0.99)	-1.9 (0.32)	$r = -0.11(-0.64)$
DG	-0.5 (0.89)	-1.0 (0.76)	$r = 0.88(10.42)$
DH	-0.4 (0.89)	-1.4 (0.59)	$r = 0.94(14.94)$
DI	-0.7 (0.83)	-2.2 (0.21)	$r = 0.79(7.29)$
DJ	1.9 (0.99)	-2.9 (0.06)	$r = 0.86(9.58)$
DK	1.2 (0.99)	-2.1 (0.23)	$r = 0.72(5.93)$
DL	1.5 (0.99)	-0.1 (0.94)	$r = -0.75(-6.48)$
DM	-3.2 (0.03)	-1.5 (0.51)	$r = 0.13(0.75)$
DN	-1.0 (0.73)	-2.5 (0.12)	$r = 0.77(6.82)$



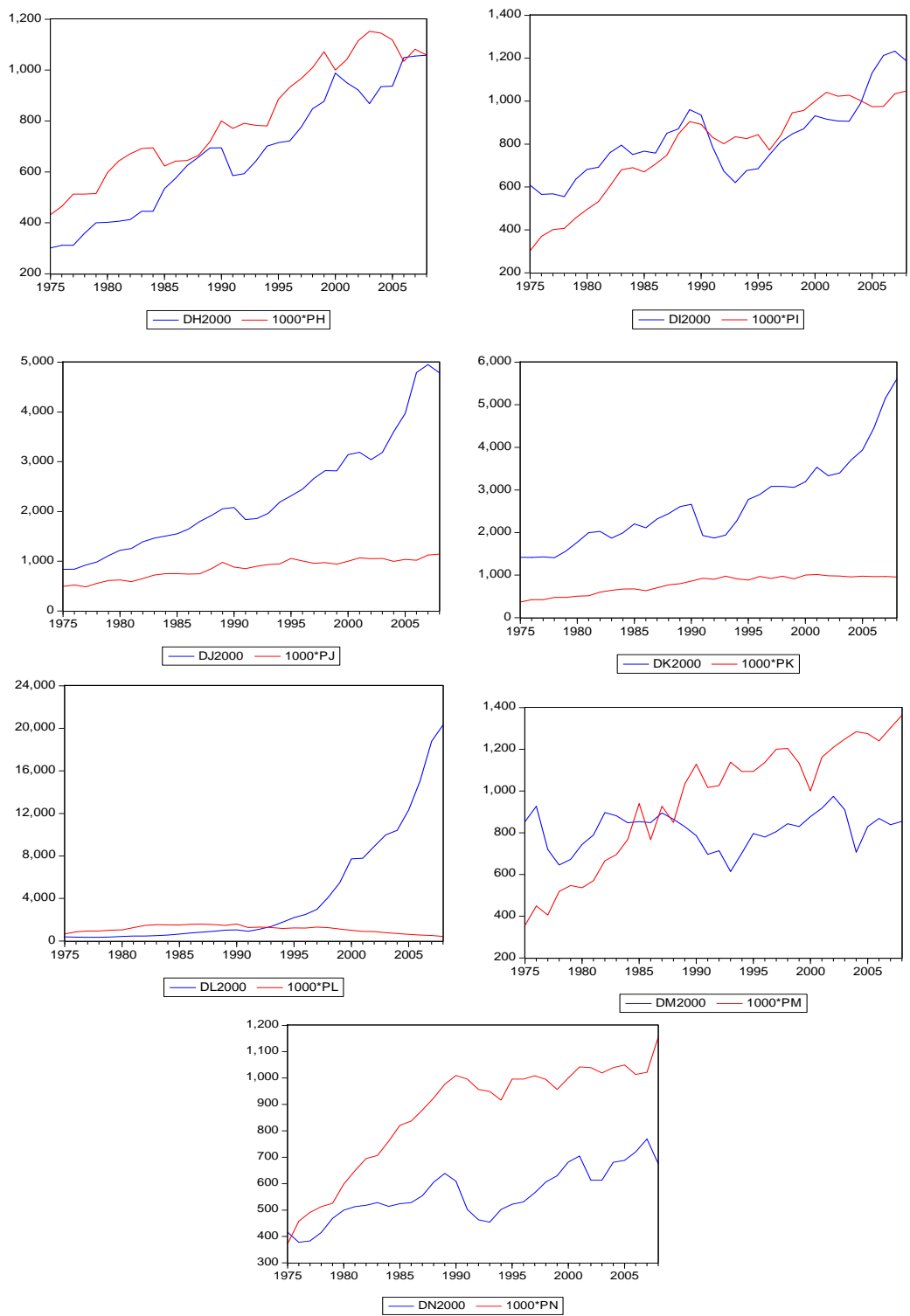


Figure 7. Industrial flows of production and prices in Finnish manufacturing.

INNOVATION MANAGEMENT *FROM* FRACTAL INFINITE PATHS INTEGRAL POINT OF VIEW

Alain Le MÉHAUTÉ^{*}, Dmitrii TAYURSKII^{*},
Rui MENEZES^{**}, Serge RAYNAL^{***}

Abstract. *While a mastery of management innovation is crucial for the future of the economy, to date, there is no theory able to base with objectivity the management of creativity and entrepreneurship. This absence is not due to the lack of methods but to ignorance of mathematical foundations which justify the paradigmatic transgression. These foundations exist nevertheless. It can be mentioned the fractal geometry and the role played by the singularities and correlations over long distances. In the set theory, let us mention Cohen's forcing methods and its engineering consequences through CK theory. In the categories theory, we can mention the principles of Kan extension herein applied by the mean of holomorphic analysis and the analytical extensions. All these methods are based on the recognition of the incompleteness of any structure axiomatically closed (Goedel). At the junction between the physics and the economy, the goal of the present work is to show that the lack of recognition of the role of singularities in this science must be searched in mental biases and the paradigms that affect our concept of equilibrium. We show that this concept must be generalized. If the criticism of the concept of equilibrium in economics is already known, it does not lead, quite as much, to a theory of innovation. We would like to address the issue of creativity by backing the reasoning by the questioning of the concept of equilibrium, using an analogy coming from the physics in fractal structures. The idea is to consider the equilibrium as some steady state limit of a fractional dynamics. The fractional dynamics is a dynamics controlled by non integer fractional equation. These equations will be considered in the Fourier space and by the means of their hyperbolic geodesics. Due to the intrinsic incompleteness of the fractality and of its cardinality, the thickening of the infinite will be used to show that there is no even physical balance but only pseudo-equilibria. The practical use of this observation leads to the design of a dynamic model of creativity, named DQPI (Dual Quality Planning), giving a topologic content to the innovation process. New principles of management of innovation emerge in naturally.*

Keywords: *Creativity, Innovation, Management, Fractal and Hyperbolic Geometry, Path Integrals, Categories theory.*

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1. Introduction

All human societies are organized to pursue the general interest while maximizing everyone's utility [1]. Nevertheless this dual objective is rationally impossible to be reached. As it has been shown by Arrow, -after Condorcet in 1785-, (Condorcet, Arrow's impossibility theorem), there is no aggregation function, except dictatorial [2,3], able to validate the hypothesis of Pareto optimality (also a competitive steady state). Global equilibrium [4-7] cannot meet the independence of individual choices [8,9]. The transfer of transitivity of these individual choices to the transitivity of overall social choice is highly problematic [10-13]. If the set, which has to be optimized, contains many agents – game and economic theory-, the overall equilibrium often leads a local, sub-optimality [7,14]. Because of the multiplicity of individual choices, even embedded in an overall equilibrium (considered as a smooth Euclidean manifold E characterized by state variables), the local metric between agents defines almost surely a hyperbolic structure F for their internal relationships [15]. For instance, insurances at disposal leads the society to an increase for taking risks and the hyperbolic set of risks leads to chaotic and fractal behaviors [16,17]. Fortunately, according to a Nash's theorem, we can assert the existence of an isometric application between E and F , which can then live together almost in harmony [18,19]. Might this isometric application and embedding, explain the emergence of overall laws of behavior? The absence of demonstration of this hypothesis involves that the emergence of an equilibrium, and macroscopic laws for the overall of numerous complex system, remains mainly misunderstood [20] and also far from individual interest.

Conversely, compared to the above distribution (E overall, and F local) the innovation management requires the consideration of a dual interdependency [17]. The overall manifold must now be associated with the hyperbolic metric F^* (global chaos with a growth) and a local state, associated with a Euclidean class of space E^* (local steady state). Thus, according to the Nash theorem, it must be a paradoxical isometric application embedding the overall into the local (Voronin's universal theorem). The closure of the system may then lead to the scaling properties [21]. Due to overall correlations (and of the memory), the system is then in an over-optimal state (creative and innovative) and new matters, devices and organizations are able to emerge. The diagram shown in Figure 1 can illustrate our hypothesis.

Dedicated to the management of the creativity the above approach is the symmetric of the traditional approach of complex systems. It is characterized by intrinsic local irreversibility no more due to traditional statistical effects but to the will of the engineers. Initially designed for batteries optimization, this approach has been generalized in physics [22] using the concept of transfer of energy upon fractal interface (TEISI model) and transfer function $Z(s)$.

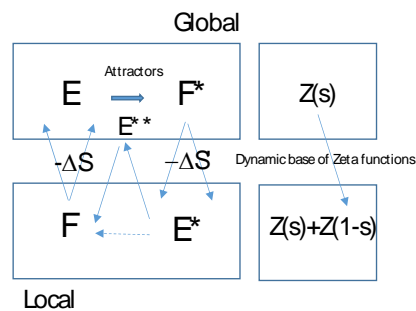


Figure 1. Diagram showing the relationship between local and global metric depending on ‘equilibrium’ location and attractor fields. $Z(s)$ points out the integer or fractional geodesics of the dynamics related to reciprocal applications (arrows).

This analysis was later extended to econophysics via a model of Dual Quality Planning (DQPI model). This model was practically applied [23] for the development of the pedagogy of the innovation and sustainable development. Playing with the balance of negentropy production this tool uses the lever of a paradoxical and singular 'pseudo-equilibrium' E^{**} (Figure 1), as a source of the innovative processes and of the economic growth.

Let us observe that the fractal geometry plays an important role in the models especially through a theory of the measurement [24]. The very general presence of scaling properties in the metric of discrete set of relationship characterized by a 1D order, -that is to say identical to N -, finds their origins in a couple of constraints: (i) the addition (+) of some agent must be considered as a constructivist action, while (ii) the deconstruction or the partition of a set, must be related to the arithmetical division (/). Because this partition cannot be done without a remainder in general situation, the only solution to remove it and to close the system, is to introduce scaling properties [21]. This categorical requirement explains the universality of the fractal geometry of nature [16].

2. Constraints for steady states

Games and economic theories: we cannot consider in details herein the multiplicity of the specific cases, described within games and economic theories [7]. In games, the gain-factor is an ‘arbitral variable’ while in economy the optimality is based on a ‘utility function’ [25, 26]. The Sisyphean task required by the analysis of the multiplicity of the possible axioms and of the maturity issues, leads to the question of the very relative universality of the assumptions and, therefore, of the rational conclusions, that can be inferred [7,27]. In both cases the assumption of an income obtained by a rational player taking an added value sourced in risks taking, leads to a misfit between the optimization of the collective interests (judging criteria isomorph to the natural numbers N), and the requirements of individual interest, (infinite set of choices characterized by an higher cardinality than N). This contradiction renders out of order the simplest idea of a set of choices distributed as $N...$ except as if, a drastic reduction of the problematic is clearly announced and performed by the econometric models. The inability to merge without drastic reduction, the main set of choices (local and overall) leads scientists to release some constraints for obtaining plausible mathematical solutions. These last are certainly globally ‘optimal’ but locally ‘under-optimal’ leading even to social disasters (mass unemployment, dictatorship, social partition ...). One of the constraints that it is the most amazing to have been released is the rationality of the choices [27-29]. In many games one can show that the rationality can be clearly cons-productive [6].

Steady state, attractors and quality planning: the surprise with regard to the *impossibility theorems* (to reach equilibriums) can be overcome by noting that the dynamic attraction fields (attractor) to the zeroes of a non-monotone function (a zero mimics mathematically a states of equilibrium) have the fractal structure of a Julia sets F . The convergence to a steady state E given by a zero (Newton-Raphson method) is highly dependent on initial conditions (boundary) and on the space-time scale accuracy. This point of view is not natural and requires a mathematical analysis to be clearly understood.

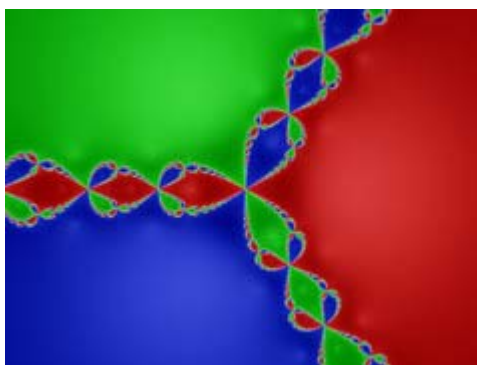


Figure 2. Classical example of Julia attractor for the automorphism $z \rightarrow z^3 - 1$ in the complex plan. We observe that the field of attraction for the cubic root of the unit has a very complex boundary that mixes together the different domains according to a fractal structure. The Euclidean roots are related to hyperbolic structure of the attractor. This type of property is general.

The surjection from E (zeroes) into F (attractors), that controls the dynamics, may be related to the Nash's theorem [18], asserting that there exists an isometric application between the Riemannian manifold (associated to the individual set of choices or location in F) and embedding Euclidean space (optimum E). Despite this recognition of the role of the fractality, the libertarians, who think in the frame of a linear simple rationality, ignore the theoretical constraint of the epimorphism (surjection). For them, the base of measure of the set of instability is nil. At an upper level of cognition and faced to chaos, libertarians think that a complex system can be reduced to its statistical components (invisible hand of the market) without singular extremum or black swan. It is now well known that this hypothesis is almost surely untrue [16,30,31]. In spite of an exceptional deepness, the Schumpeterian concept of 'creative-destruction' [32] is written in the same 'language'. Despite the need for a step of divergence in all creative process (destruction) it is clear that this process must be strongly rooted in the environment and in the history with which it must resonate. Creation and thermodynamic self-organization, can clearly find their origin in the entropy production, but the associated mess must be fractal. It must contain memory and correlations which partly change the stochastic standards: Fractional Brownian Motion, non-Gaussian Distribution, Levy flight etc.

Dynamics, path integrals and fractional differential equations: Some recent works in statistical thermodynamics can be used to illustrate the assumption of a debt with regard to the ancients (memory). One can borrow in [33] the model of the 'Equilibrium with Growth' and

Morishima's reserves concerning the Schumpeterian hypothesis of 'destruction' in the model of innovation.

The Badioli's concepts concerning the 'Thermodynamic Paths Integrals', may be used to enlighten the Morishima's issues. Badioli's model [34] is based upon a local irreversible transition. As developed by Feynman, he sums this transition all along the infinite number of possible paths leading from state A ($t = 0$) to state B ($t = 1$). In spite of very singular way of access to thermodynamic solutions, under the condition of the existence of a concept of energy (Noether theorems) and using a standard statistical analysis, he obtains, from very simple computations, a diffusive type of behavior (Fokker Planck and/or Smoluchowski). This conclusion reminds the result of the computation of the Black and Sholes equations. His model founds easily the quantum mechanics, that is to say, the existence of the set of steady states, which explain the stability of molecules, atoms, etc (zeroes of an universal wave function). At this step, his main idea concerns the concept of fluctuations of closed paths ($A = B$). The global steady state is the set of paths for which the internal energy (introduced into the system) is equal to the average energy of closed paths between the time $t = 0$ and $t = 1$. This point of view introduces a conceptual breakthrough concerning the idea of what is the equilibrium. In certain conditions, there is no thermodynamic state. The equilibrium must be 'forced' [35] by the experimentalist. Obviously, a homotopy interpretation is implicitly involved: all closed paths that do not round a singularity, -i.e. a steady state-, are strictly equivalent and aside with regards to the zeroes.

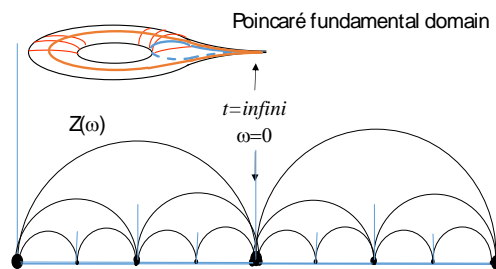


Figure 3. Poincaré traditional fundamental domain. This figure is based upon the canonical first order transfer function in Fourier space. The semi-circle parameterized with frequency is considered herein as the boundary of a fundamental domain of a complex plan whose diagonal is an ordered discrete set. This N set at infinity, represent the equilibrium states of a discrete 1D space. The automorphism points out the unicity of this equilibrium E. The topology of this automorphism is given by the punctuated torus. The angle at cusp is nil because the automorphism is related to integer differential equations. The fractionality modifies this situation (Figure 4 and 5).

This equivalence can be represented for instance using Poincaré's fundamental domains where the hyperbolic boundary may canonically be given by a first order dynamical transfer function (semi-circle in Fourier space). The singularities are then located at the boundaries of an automorph dynamic groups controlled only by one parameter: the time (frequency in Fourier space). We can consider the research of equilibria as equivalent to the integral path-loops upon hyperbolic space determined by the folding of the fundamental domain (punctuated torus in Figure 3) as the sum of all level of approximation of the horizontal axis [15].

The hyperbolic space is the complementary of the space of zeroes (of a function of utility ie of energy). As the attractors (Julia set) of the Euclidean geometry E , the hyperbolic space is characterized by a Fractal geometry F^* (scaling properties) and there exist a dual relationship between the set of equilibrium (E) and the stationary dynamics inside of the fractality. The isometric transformation F (integrals of paths) in E (all stable states) is associated to the interferential interaction between the paths, and equally that of E in F^* (the interference of the paths using the phase, when we withdraw all zeroes in the loops).

As suggested above, this analysis allows us to reverse the terms of the problem (Figure 1). The hyperbolic metric, F^* may be attributed to the overall structure characterized by a chaos in evolution (growth). By duality, a Euclidean metric must be attributed at a hypothetical local (individual) level E^* . For instance, the Zipf law encourages to explore this inversion; equally the Fermi distribution in quantum mechanics. Nevertheless, the definition of the status of E^* is extremely problematic. Due to the infinite development of the automorphism, E^* is likely to be think like an abstract an artificial reference, required just for justify the mathematical symmetries! Except in a very specific case E^* ($d = 1$) is not related to any type of equilibrium. More generally, it cannot possess any simple physical status! The problem is identical for performing the CK model of innovation [36,37]. The status of the extended concept C^* (conceptual extension) is never defined in his documents. To unveil this 'status', we have to consider the intermediation of an E^{**} equivalent to E starting from a standard dynamic situation. As shown in Figure 1, E^{**} may then appear like a specifically designed equilibrium (it is design like E). It is qualified pseudo equilibrium because the dynamic within correlated chaos, is not able to possess any type of equilibrium. It is for example affected by strong fluctuations during its asymptotic position. This intermediate 'state' is what Husserl named, a Zeit Objekt [38]. Explaining the dynamic status of E^{**} shall allow us to qualify E^{**} as a 'weak-equilibrium'.

3. Fractional dynamics and fractality

Implicitly, the TEISI model, developed 30 years ago [22,17] takes place in the class of models of path integrals (sum of state at different frequency). Its foundation takes into account not only the interface (equivalent to a full path F) but all interfaces at all scales (that is to say the whole full paths F^*). The fractal set F^* must consider a steady states, that can no longer be written in N but in a set of upper cardinality than N (like Fractal structures). This extension must have physical consequences; among these consequences: the presence of a phase angle at infinity and therefore the role of interferences which veils the presence of what should be the natural level of equilibrium E^* .

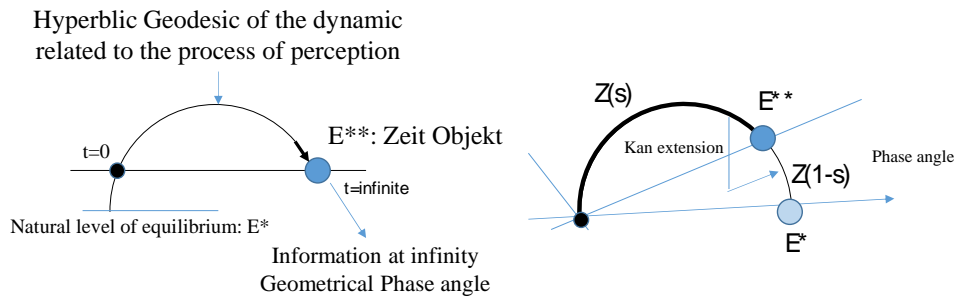


Figure 4. The main conclusion of the TEISI model, is herein interpreted in terms of perception of pseudo steady states. It points out these states at thick infinite time (nil frequency). If the structure is hyperbolic (for instance fractal) the model proves the presence of a remainder information at infinity (phase angle for fractal geometry). A rotation of the axis of representation discloses the need for complex time and the meaning of the Kan extension with respect to E^* and E^{**} .

Beyond mere physical, and especially for social sciences, it is important to unveil the hidden meaning of E^* (as pseudo equilibrium). We will not repeat herein the analysis leading to formalize the fractal-transfer by using of non-integer differential equations, by cons we emphasize the fact that in Fourier space, the dynamics is then represented by a hyperbolic geodesic which is nothing more than a circular arc whose Euclidean extension is related to the fractal dimension, that is to say, the correlations within the chaos. We note that the nil frequency, usually equivalent to steady state (here infinite time, but herein in the absence of convergence) defines what is named above a Zeit Objekt (tempo object). The end point of the geodesic defines an object because it defines physically its

phenomenological perception (through experiences) via an irreversible process. Nevertheless this object is a Zeit Objekt, because even if the frequency is nil (the time is at infinity), the spectrum of frequencies, i.e. the set of its 'qualities', leaves aside a remainder. The Zeit Objekt is an object but this object is not really in equilibrium. Due to a geometrical phase at infinity this object carries with its a transcendental momentum (living, social and in general complex systems [39]). Let us observe that, without additional conditions, it is unable to define an equilibrium except for $d = 1$. Fortunately when $d = 2$ even if E^{**} is not at equilibrium, some useful symmetries appear and the process is well known to be related with a statistical object (for instance, the Fermi distribution). This observation can serve as a guide for asserting that, even below the physical horizon, E^* should play the same role as a connected set of steady states used as reference. How to overcome, at this step, the apparent paradox of the transgression of the traditional paradigm asserting that a steady state, is a state without evolution, while the series which define our object, does not converge? To do so we have to follow a new idea:

If the dynamics is fractal the arc defining the Zeit Objekt matches (geometrically and partly) an underlying deterministic process ($d = 1$) whose the virtual steady state E^* is located under the experimental horizon of F^* (Figure 4). $E = E^*$ for $d = 1$. We then have to distinguish two cases: (i) simple $d = 2$ with symmetries (ii) the requisite extension $1 < d < 2$.

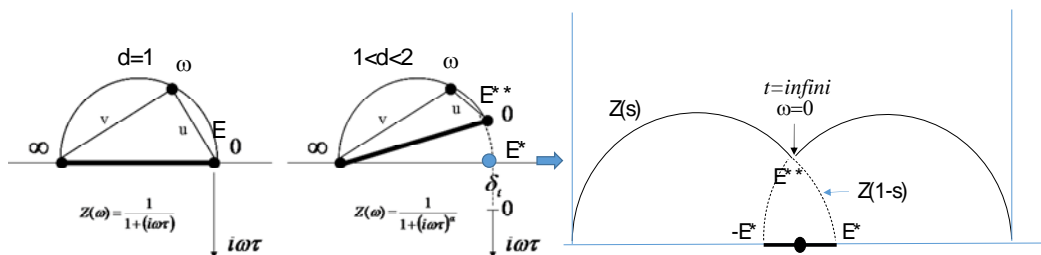


Figure 5. Transformation of the first order transfer function $Z(s)$ into fractional canonical transfer function. Geometrical phase angle appears. Equilibrium E is split in into E^* and E^{**} . The linear hyperbolic distance (u/v) vs standard time relationship turns into a power law. Noether homogeneity is recovered by embedding time in the complex space. Poincaré fundamental domain is modified and the limit equilibrium is replaced by a group of symmetry [40]. The equilibrium becomes a dynamic process requiring Kan extension and therefore producing negentropic effects.

As far as the metric of the interface is given by $d = 2$, we can construct a very simple morphism between time and space (external algebra). Due to a degeneration shown in the figure 5 there exists a difféomorphisme (Laplacian) between deterministic process ($d=1$) and a fractional $\frac{1}{2}$ stochastic process. In practice, the average distance of this elementary hyperbolic process, is a linear form of the square root of the time variable. This characteristic, -associable to the diffusion and to a solvable Galois group-, gives access to equilibrium states. Similar to an optimization principle, the equilibrium emerges naturally from stochastic phenomenon such as those assumed for the free market [26].

Initially under the experimental horizon, steady state can be found, like a solution of an *ad hoc* automorphism. We can read this automorphism as a curvature of the dynamics that is carried by the Zeit Objekt $d = 1/2$ on the axis-states (Figure 6). This operation is represented by fundamental Poincaré's group of the torus (Euclidean) with a nil angle at cusp (hyperbolicity at infinity).

One observes that in this case it is also possible to combine the Zeit Objekt to a homotopy class, which asserts to the absence of singularity other than equilibrium states projected onto the line at infinity.

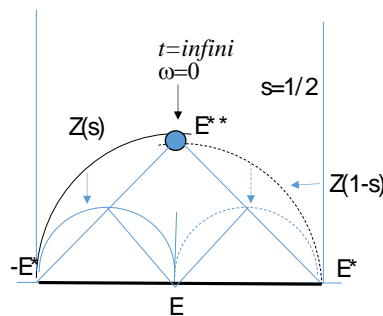


Figure 6. Degeneration of the fractal dynamic when $d=2$ and $a=1/d$. The generalized Poincaré fundamental domain pointed out in figure 3 and 5 disappears herein. Nevertheless the structure of the diagram authorizes a couple of projections (Nash theorem) leading an isometric relationship of E^{**} and E . The reconstruction of the automorphism according to external algebra and the Laplacian operators is then very simple. As it is well known diffusion equation can easily be built from first order equation as seen in the figure after Nash theorem application.

Even if the economists measure the limitations of their models and attempt to introduce amendments, the statistical and dynamical constraints related to degeneration involved by the geometry are never considered and the Peano geometric structure for F^* stays implicitly the basis of the

general theories of economy, therefore their limits. As shown above this situation contains many underlying hypotheses and some confusions due to the equivalence of $Z(s)$ and $Z(1-s)$ when $s = 1/d+i$ with in this case $d = 2$.

It is no longer the same if d is fractional. Instead of two data for defining the partial arc of semi-circle, the dynamic then requires 3 data. Therefore, the parameterization must be expressed using a complex time. The final state can never be reduced to the initial state and the definition of the application via a homotopic simple loop is impossible. In this case the hyperbolic curvature splits the infinity into a couple of non-symmetric parts $E \rightarrow E^* + E^{**}$ and the simplicity of the diffeomorphism obtained for $d = 2$, between Euclidean process E^* and hyperbolic one F^* is broken. The Nash's morphism, strictly non-linear, non-differential and non-convergent, causes a shift from the ordinality of the problem toward its cardinality. The line at infinity becomes thick. The standard state becomes a string. The information at infinity cannot be put aside. The associated Galois groups are almost certainly not solvable. We cannot find the zeroes, and thus the traditional steady states. Nevertheless, due to geodesic structures of the dynamics, their virtual equivalents E^* located under the experimental horizon continue to exist. But it is no longer able to be easily reduced by automorphism and compactification, unlike the case $d = 2$. Transposed in the field of economy, the irreducible curvature at infinity prohibits the existence of a Pareto optimality and an impossibility theorem appears naturally. The concept of connex derivation is then required. It combines the global fractal character F^* (chaotic) and the behavior locally smooth E^{**} (individual stability). At this step, the assertions concerning the link between fractional differential dynamics and Riemann Zeta universal functions can play an extremely useful heuristic role. We shall see that these functions are naturally associated to the model de creativity whose acronym is DQPI (dynamic model for innovation). The acronym DQPI (d  cupler in French) means increase, amplify, extend, and overcome etc., in other words: creation.

4. Zeta functions and DQPI model

Let us recall herein the surprising relationship between (i) the well-known Riemann zeta function $Z(s)$ with $s = a + it$, (ii) the concept of fractal path integrals related with statistical thermodynamic [34] and (iii) the 'fractional dynamics' related to d -fractal geometry [39,40]. In the frame of these relationships, with $a=1/d$, Riemann's hypothesis (that is to say $a = 1/2$) ensures the existence of a close link between the set of the zeroes of the

zeta function; the duality between (i) addition, multiplication and fractality [21]; (ii) the spectral relevance of stochastic analysis; (iii) the existence of a linear time (subject to the assumption of the existence of a Noetherian energy invariance); and (iv) the quantum mechanics (*i.e.*, its steady states). As this universal function possesses a set of zeroes if and only if $a=1/2$ (related with the set of primes), we can assert that the constraint $d = 2$ plays a central role in the establishment of an overall steady state for all type of complex system, which depends of a $1/2$ fractional dynamic. But, let us ask, what happens in the other physical situations, for instance for a general type hyperbolic dynamic? The local $1/2$ fractal chaos of associated with primes, leads to the emergence of overall deterministic and/or stochastic laws. What become these rules when d is not integer [42] (Tayurskii *et al.*, 2012). Obviously, the rule which must be revisited is the rule of the equilibrium! An analogy with the problematic above, suggests a main distinction between (i) the status of equilibrium for local games or economies, precisely characterized by steady states (or a set of zeroes of a situation that looks like a stochastic situation), and (ii) the fractional case for $1/2 < a < 1$, where the absence of zero for the zeta function does not lead to a simple definition of the equilibrium but to a more fundamental concept (equilibrium becomes a specific case). The analogy with zeta function may therefore enlighten the problematic of a concept of a generalized equilibrium even for the economy. The concept is derived from the properties of the Riemann function but under its more general form, that is to say when the value of 'a' is not the half of the unit. In this case, the absence of zeroes indicates that without adding any additional criterion, there does not exist a steady state in general for fractional complex systems.

The DQPI model addresses the issue of these criteria. Indeed, like for the set of attractors of the zeroes of a non-monotonic function, the analysis of the set $\{Z(s), Z(1-s)\}$ allows us to imagine a generalization of the surjection from $Z(s)$ into $Z(s-1)$. This surjection can be interpreted as a Kan extension in categories theory. This extension is similar to a 'local factorization' in distributions theory, -rather than a traditional factorization of a function (using zeroes) -. This generalized factorization comes just before any path integration in Fourier space. The integrated set is then obviously not factorable (path integral). We named this new situation, 'spectral equilibrium'. The Cohen's forcing of the 'spectral equilibrium' taking into account E^* in the context of an absence of steady state for E^{**} , can be well understood, in this frame. The 'forcing' and Kan extension takes the same meaning. Thus complete information on this complex

system requires a new type of merging between $Z(s)$ and $Z(1-s)$. As shown by the DQPI model the topology authorizes this merging by gluing.

This operation consisting to 'fill up' increases the cardinal of the set of the given data and leads to a mixing of information and therefore to an exponential growth of entropy. The topologic DQPI model, is specifically designed to understand how the mixing entropic term is reversed into a negentropy term when playing with the incompleteness of the circle (here the circle may represents the knowledge). The opening of the circle represents the incompleteness, while the gluing the lips of the open sector, compels the system to take into account the incompleteness, in achieving an operational gluing. Doing so, the gluing performs a 'Cohen forcing' and solves the paradox of the use of the incompleteness as a lever of a performance (action on innovation).

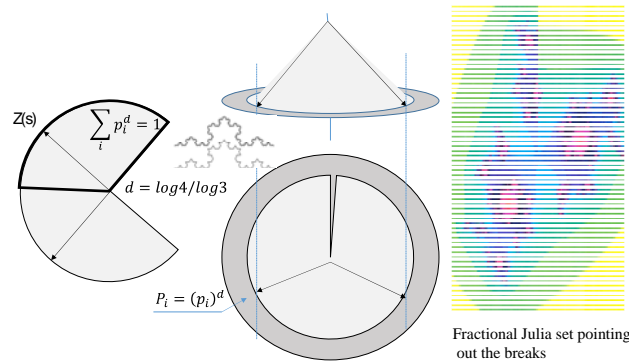


Figure 7. Development of fractional dynamics into DQPI model. The circle is deprived of a sector (uncompleteness). It shows (i) the partial arc of semi-circle pointing out the relation with a fractional dynamic, (ii) the splitting between different types of statistics. The relation with the fractal geometry is given. The gluing raises a new axis: the axis of innovation. The analysis of the fractional attractors points out cuts and attractor slips within the Julia set when, far from integer, the fractionality is involved.

The function $Z(s)$ and the distribution $Z(s) + Z(1-s)$ can be associated to couple of arcs of circles (enlarged dynamics) whose the open sector would have been first recognized like relevant. It is removed to compel the action. The comparison of both structures -before and after gluing- discloses the presence of two classes of competing probability. The resolution of that competition in the frame of a conceptual synthesis is precisely related to the negentropic process named: innovation. By gluing, the innovation appears geometrically as the emergence of an orthogonal direction with regard to the complex plan of the initial knowledge (the plan

of the circles). The 3D representation points out the fact that the incompleteness is precisely a variable of the problem of innovation.

The emergence of a third dimension tells us that the merging of the two classes of probabilities is constructive. Assuming that the circle whose a sector is removed, schematizes a knowledge which includes the existence of an incompleteness (full circle excludes this incompleteness), the ability to freely assume the incompleteness, that is to say, to take into account a transcendental equilibrium E^* related to this incompleteness, leads to think the physical environment by taking into account this abstract object. This posture leads to design new steady states $E' = f(E^*, E^{**})$, ie new objects. Unexpected in the field of initial knowledge these new objects require, for being achieved, a transitory situation named Zeit Objekt (it is an object in mind). The new object originates from the entropic mess, is created precisely through a Kan extension. The structure of the uncompleted circle is related to the d value in fractional dynamics. If we consider otherwise the automorphism associated with fractional operators, like a fields of attractors, -fractal Julia attractors-, the fractionarity involves the emergence of many lines of cutting (Figure 7) which are continuous and derivable into the traditional Julia diagram. The generalized Julia set, points out, the presence of new deterministic correlations, between close attractors. These lines, also characterized by scaling properties of the attractor fields, are the proof that creative process is partly chaotic and partly determined by a capability of new coupling, inside the chaos. Obviously these new correlations are naturally and probably implicitly used by the innovators and the entrepreneurs. The new concepts of fractal equilibria can help us to overcome the traditional way of thinking the management and therefore summons the closure of the methods of management based upon short term accountancy and reporting.

5. Conclusion: the paradoxical management of innovation

Highlighting (i) the strange character of an equilibrium that is no more a state but a transformation group ($(E^{**}, E^*, -E^*)$ ie a stationary loop), and (ii) the need to express this extension by using a temporal singularity, the TEISI model and then the DQPI model provide a mathematic content to the concept of Kairos as a singular reaction to an external excitation. Both model lead to think the 'Equilibrium Growth' as a tangible reality, and not as a paradox. Both concepts lead to enlarge the

Schumpeterian concept the destructive-creation. Associated with distributions with long tails (long range correlations), the entanglement between local and overall states, which naturally characterizes the majority of the incomplete complex situations, explains the conceptual deficiencies which render inefficient the performances of the traditional management, when it is based upon the only consideration of the transitivity of collective choices (1D ordered set as instrument of the accountancy). The topological operation of gluing in the DQPI model is equivalent to an overcoming of the managerial tradition that always assumes a perfectly defined initial ordered knowledge within an unknown environment. In the traditional managerial framework, the state of the knowledge may be tested and structured but, except marginal progresses, the creative process is then almost prohibited. This situation is qualified as an academism. As pointed out by Mandelbrot in his memories [43], the management of innovation must be based upon different methodologies. Taking into account the scaling correlations, the knowledge must be recognized as always uncompleted. It can be 'forced' through and far from its boundaries using the incompleteness as a lever. The goal of the DQPI strategy is not to fill the incompleteness but to overcome it. The multiplicative factor introduced by the lever is a negentropic term. The gluing is the expression of this lever. The gluing is performed from the upper level of cognition (the brain for the will; the leader for social structure; the macrostructure in living systems). It is able to integrate all the local chaotic paths and the multiple fields of attractors into a sole vision and a singular motion. Born from a path-integral point of view, this posture is clearly holistic and merges, like for the zeta function, the concept constructivist (the addition) and the concept of partition (the division). Fractal geometry then emerges naturally as the underlying geometry for solving the paradoxes. The concept of quality is no more in its detail. The reference factor for innovating is the merging between detail and overall point of view. For doing so, the main reference is the 'differance' emerging from the correlations between different levels of approximation of the reality, or between the qualities used to define them. The quality, which has not to be forgotten, is clearly the incompleteness. Due to this forgot, the traditional constraint of maximization of individual choices always is proved suboptimal. Conversely, as shown the role of motivation, the choice to abandon the search for a Pareto optimum by the acceptance of freedom axis , is often

revealed as creative on-optimal choice; equally, the choice of move the accountancy rationality into a fractional dynamic rationality using Kan extension methods.

Let us recall herein how the great economist Arrow, was accused of political anarchy. The accusation was not gratuitous and the DQPI model, gives a mathematical foundation of his position. What is the meaning of the word, 'anarchy' in our model? To finish our analysis we would like to match this word with the word 'chaos' for giving a weak to it definition. Starting from the physical meaning of DQPI model, the 'weak-chaos' puts in conjunction -not in competition- at least a couple of fields of Julia attractors. In this frame the lever of the innovation management is the understanding of what means the concept of forcing in set theory, or the concept of extension in categories theory. All procedure of creativity that, explicitly, matches fractional divergent dynamics, operates implicitly by controlling the extensions of the set of knowledge into its own incompleteness. This incompleteness bases the weak chaos. In practice, the uncertainty associated with non-integer states, is expressed among others by the need to make (policy) choices in a situation where a possible equilibrium should be located below the physical horizon. The lever for creativity is then associated to an embedment in an enlarged set, characterized by an upper cardinality of the set of the basic and sure knowledge. The main question is precisely to define what means the word sure! The understanding of the paradoxes involved by the embedding a sure knowledge into an uncompleted set, is solved within the topological DQPI because it matches a fractal dynamic. Its physical meaning is given by TEISI through energy exchange upon fractal structure. It is characterized precisely by the presence of an upper cardinality with respect to the traditional N order used by the simple accounting. Its ability to take into account the remainder of the knowledge at boundary and the existence of Zeit Objekt, help us for grasping the meaning of the pseudo-equilibriums. Doing so, the DQPI model also improves the effectiveness of management and, on the way, the capability for innovating. It is exactly what is perceived by the greatest among the economists who try to improve their models unfortunately in the frame of a vision given by integer numbers. We show herein, that the fractionality and its underlying fractality might be a way to reach the same objective with a great economy of means, indeed to generalize their models.

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COULD ECONOPHYSICS COMPLEMENT THE CHARACTERIZATION OF DIFFICULT NEO-CLASSICAL ECONOMICS' SOLUTION CONCEPTS?

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***Abstract.** This paper considers three compelling reasons for collaboration between economists and econophysicists. That is: 1) Increasing returns to scale in production theory is common in everyday life and ubiquitous in aggregate data; 2) the problem of maximization over the infinite horizon in the presence of increasing returns to scale is complex, and; 3) the application of the physics of complex systems sheds light on that complexity and, with noiseless data, could falsify many of the stylized facts of the standard economic theory. But, market imperfections generate irremediably noisy economic observables. Hence, our recommendation is that both groups should focus more on the general and enduring patterns thrown-off by the complex system rather than on endogenously noisy data.*

***Keywords:** Increasing returns to scale, Quasiconcave technology, Complexity, Strange Attractors, High-dimensional chaos.*

JEL Classification C13, C62, D5, D9.

1. Introduction

The dominant Neo-classical School of economics seeks direction from elegant models based on premises such as rapid transition to equilibrium under the competitive actions of small, representative, rational, and farsighted agents. If these were the characteristics of actual economies, economic and financial outcomes would then be efficient (optimal) and follow log-normal distributions. This is not what the available data show, and that may account (to a large extent) for the emergence of econophysics.

Econophysics (a term coined by Eugene Stanley [1] in the mid-1990s) is an emerging discipline. Its adherents argue that in real economies big and small agents are intricately interconnected. Thus,

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heterogeneity, autonomy, and intricate network inter-connections combine to make the impacts of individual actions on the whole unpredictable. This type of complexity is a property of dynamic systems that depends on inputs' behavior and on a multitude of feedbacks and feed-forwards; and the more so if heterogeneous agents can learn and adapt to new situations. In modern economies it is easy to find examples where big agents deliberately manipulate flows so as to create bogus excess demands that they can easily exploit given their 'market power'. To cope, the smaller ones must adapt or devise countervailing survival strategies. That is to say, behavior and intricate inter-connections may send the dynamic system into a subset of parameter space corresponding to high-dimensional chaos. Econophysicists then believe that it would be wiser to determine empirically the nature of the invariant set of the system first and then use proven methods of physics to search for laws of complexity (if any) before attempting to build elegant models.

Econophysicists' thinking is motivated by the following. Despite the data limitation, econophysicists have already stumbled on many empirical facts that the dominant theory cannot explain. For example, the distribution of income of the one percent richest individuals is different from that of the ninety percent. Using financial data, Mandelbrot [2] has found a fat tail in the distribution of absolute returns. Such a fact better fits the 'Omory Law' of earthquake aftershocks rather than log-normality. The occurrence of persistent and abnormal returns cannot really be explained by new information if the latter is accessible to all. The autocorrelation of asset returns is found to decay at a geometric rate, while those of absolute and squared returns decay to zero as a power law over many time lags. The long market memory observed by Mandelbrot, a phenomenon known as 'clustered volatility', is a quantitative manifestation of long range dependence (LRD). A log-normal distribution may generate a fat tail depending on the scale parameter, but returns cannot assume negative values. Admittedly, LRD is a property of self-similar processes, but the economic process is not a Brownian motion (B_m), because the time derivative of B_m is everywhere infinite and its increments are independent; besides B_m is more a mathematical construct than a real world phenomenon. On the other hand, it is not an α -stable Levy process because the latter can display self-similarity but without LRD. It is neither a Poisson process nor a pure Gaussian; LRD is incompatible with a Poisson process, and a Gaussian process can display LRD without self-similarity etc. Mandelbrot and van Ness succeeded in connecting self-similarity and LRD

in stationary time series via fractional Brownian motion (fBm), but with a unique self-similarity exponent; indeed, there are many reasons to believe that exponents of the economic process are dependent on input behavior. Determining the true nature of the economic process is difficult as it contains bits of many other processes. However, toward the end of this paper we will suggest an indexed hybrid of self-similar and Gaussian processes with scales determined by the behavior of inputs that seems to do the trick.

In the meantime, some orthodox economists view the incongruities discovered by econophysicists as an intrusion on their turf. They argue that many principles of physics were used in economics, but to no avail, or that extant methods of physics are unable to prove the existence of complexity in economics because, there, uncertainty is fuzzy and ‘Knightian’. Such criticism not only appears unjustified but they negate the contributions of the early econophysicists such Bernoulli, Walras, Edgeworth, Pareto, and Tinbergen, Georgescu Roegen, just to name a few. After all, ‘science is science’. Its methods may vary depending on fields of study, but conclusions must be ‘consilient’ regardless of fields.

The main purpose of this paper is precisely to show, via examples, that many solution concepts of economics do reflect complexity. But, orthodox economists, being so fascinated with elegant solutions, are more willing to coerce solutions into steady states rather than dealing with that complexity. Thus, Part II briefly examines the problematic of maximizing in the presence of increasing returns to scale (IRTS) via two solution concepts that are conform to the premises of the neoclassical theory but in which complexity is unavoidable. Part III dwells on the nature of that complexity and examines how econophysics could improve on the characterization of the solution. Our conclusion and recommendation are discussed in Part IV.

2. The problem

A detailed literature review is unnecessary for the present purpose. However, readers interested in studies relative to complexity in economics are directed to references [2-8], while those more interested in the contributions of econophysics are referred to [9-16] and references thereof.

In essence, the difficulty in selecting optimal time paths of capital accumulation in continuous-time infinite horizon models with non concave

technology stems from the apparent violation of the Magasarian's Theorem [17] on the sufficiency of the Pontryagin's conditions. Indeed, earlier studies of the stability of time paths in regions of IRTS¹ have arrived at mixed results. For example, if no stringent additional conditions are imposed as in [18], a marginally stable fixed-point obtains. Skiba [19] appeals on a convexo-concave technology to produce a solution dependent on a discount rate being less than the average product and on cutoff points for the trajectories of a neo-classical concave function g_1 together with a producer's power function g_2 that is an input in g_1 . In a more recent study (Sorger [20]), the concavity assumption of the Hamiltonian must first be replaced by a concave homeomorphic transformation. Then if a symmetric matrix Q with negative curvature can be found, and if the Hessian matrix is negative semi definite when evaluated at the transformed variable, then a unique optimal asymptotically stable state exists for bounded solutions of the Hamiltonian dynamic system. The result of Sorger crucially depends on that Q matrix whose existence in turn depends on the existence of a hyperbolic attractor for the system. However, the major road blocks here are: finding such a Q -matrix, and a hyperbolic attractor, when the latter is not found in the natural world. In recent times, the emphasis seems to be on developing a Turnpike Theorem for stochastic balanced path of capital-labor ratio, derived from a martingale and its corresponding Golden Rule [21]. This last vintage is an extension of previous works based capital accumulation in stochastic neo-classical growth models under the assumptions of underlying uncertainty driven Brownian motion shocks and production technology being concave with constant returns to scale. Hence, to deal with the complexity of IRTS, we must return to works done in earlier periods, in particular the work of Benhabib and Nishimura [22] who appealed to the Hopf bifurcation Theorem to prove that the attractor of the economic system is a limit cycle (sic).

2.1. The First Solution Concept

The problem is presented as an optimal control problem of maximization of national income V in a convex feasible set C . The problem is to maximize $V(\mathbf{x}, \dot{\mathbf{x}})$ with a discount rate ρ and given initial

¹ For a function $\mathbf{f}: \mathfrak{R}^n \rightarrow \mathfrak{R}$, where $\mathbf{f}(\cdot)$ is continuous on \mathfrak{R}_+ , C^2 on \mathfrak{R}_{++} , $\mathbf{f}(\mathbf{0}) = \mathbf{0}$, the phenomenon of IRTS is given as $\mathbf{f}(\alpha \mathbf{x}) > \alpha \mathbf{f}(\mathbf{x})$, $\forall \alpha > 1$, $\forall \mathbf{x} \in \mathfrak{R}^n$

condition $\mathbf{x}(0) = \mathbf{0}$. Using the Maximum Principle, the Hamiltonian canonical form is: $H(\mathbf{x}, \mathbf{p}) = \max! [V(\mathbf{x}, \mathbf{p}) + \mathbf{p} \dot{\mathbf{x}}]$, s. t. $(\mathbf{x}, \dot{\mathbf{x}}) \in C$. The Hamiltonian is assumed to be concave in $\mathbf{x} \in n$ and convex in $\mathbf{p} \in n$, where \mathbf{x} is the aggregate capital stock and \mathbf{p} is the shadow price vector of national income. The equations of motion are then: $\dot{\mathbf{x}} = \partial H(\mathbf{x}, \mathbf{p}) / \partial \mathbf{p}$, and $\dot{\mathbf{p}} = -\partial H(\cdot) / \partial \mathbf{x} + \rho \mathbf{p}$. Linearization around the steady state yields, after some manipulations, a Jacobian matrix \mathbf{J} ,

$$\mathbf{J} = \begin{pmatrix} \mathbf{H}_1 & \mathbf{H}_2 \\ \mathbf{H}_3 & -\mathbf{H}_1^T \end{pmatrix},$$

where $\mathbf{H}_1 = \partial^2 H(\cdot) / \partial \mathbf{x} \partial \mathbf{p}$, $\mathbf{H}_2 = \partial^2 H(\cdot) / \partial^2 \mathbf{p}$, $\mathbf{H}_3 = -\partial^2 H(\cdot) / \partial^2 \mathbf{x}$.

If perfect competition prevails and a discount rate $\rho = 0$, we somehow arrive at a saddle-point (due to the assumed hyperbolicity) and at a stable manifold of dim n (see definition below). It is then claimed that since the stable manifold is of the same dimension as the control vector, the optimal control program will steer the system toward the turnpike, thereby guaranteeing convergence as asserted by the Turnpike Theorem. However, if $\rho > 0$, this may not be true; because, as asserted by Benhabib and Nichimura, a pair of eigenvalues may cross the imaginary axis and thereby making the system complex.

For the moment, it suffices to say that complexity exists in an n -dimensional diffeomorphisms ($n \geq 1$) whenever the real part of the dominant eigenvalue is positive. Whenever economists encounter such a situation, they automatically call for additional conditions. Thus, when $\rho > 0$, they call on a special symmetry: $\mathbf{H}_3 = \mathbf{H}_2^T$, together with α -concavity and β -convexity properties, defined as: $H(\cdot) + 2^{-1}\alpha \|\mathbf{x}\|^2$ and $H(\cdot) + 2^{-1}\beta \|\mathbf{p}\|^2$. The idea here is for $H(\cdot)$ to remain concave in \mathbf{x} (for $\forall \mathbf{p}$, $\alpha > 0$) and convex in \mathbf{p} (for $\forall \mathbf{x}$, $\beta > 0$), while maintaining an upper bound (determined by both α and β) on the discount rate. Under these stringent conditions, the Turnpike Theorem can lead one to the globally stable manifold of the invariant set, which is thought to be a limit cycle.

It is recalled here that whether $\rho \geq 0$, the settings must be perfectly competitive (which does not exist). If markets are imperfect (the most likely scenario), we know of no general Turnpike Theorem to which one can appeal.

2.2. The Second Solution Concept

The second solution concept does not require stringent conditions. But to make it even more realistic, we will include adjustment costs in the sense of Treadway [23] and Lucas [24]. Simply put, the problem refers to a dynamic context in which a single firm-economy faces adjustment costs while attempting to solve the problem of present-value maximization with a quasiconcave² technology using n quasi-fixed factors $\mathbf{x}(t)$ and n variable factors $\mathbf{v}(t)$, where t stands for time. Thus, the production technology is strictly concave in $\mathbf{v}(t)$ and strictly convex in $\mathbf{x}(t)$ causing the scale elasticity to exceed unity. We will show that even this more sensible economic representation leads directly into a complex situation, and how econophysics can shed more light on it.

2.1.1. Preliminaries

Consider a one firm-economy producing an output q sold at a price $p = 1$, using quasi-fixed factors $x_i(t)$, ($i \in n$), and variable factors $v_j(t)$, ($j \in n$). Variable input price p_j are given by the market and are assumed to remain constant for all future periods, but the market for quasi-fixed factors is imperfect. That is, $x_i(t)$ are varied at a cost $c_i(\dot{x}_i(t))$, where the dot refers to time differentiation, and $c_i(x_i(t))$ is the sum of purchase and internal adjustment costs. If adjustment costs were negligible, then $c_i(\dot{x}_i(t))$ would be equal to $p_i(x_i(t))$; $c_i'(\cdot)$ would equal p_i , and $c_i''(\cdot)$ would be 0. Otherwise, $c_i(0) = 0$, $c_i'(\dot{x}_i(t)) > 0$, and $c_i''(\dot{x}_i(t)) > 0$, where the prime denotes the first derivative of the cost function.

The technology of the firm is $q = \mathbf{f}[\mathbf{x}(t), \mathbf{v}(t)]$, where $\mathbf{x} \in \mathcal{R}_+^n$, $\mathbf{v} \in \mathcal{R}_+^n$ and \mathbf{f} belongs to the class of quasiconcave homogeneous functions of degree $r > 1$. Hence, $\mathbf{f}: \mathcal{R}_+^{2n} \rightarrow \mathcal{R}_+$ is continuous on \mathcal{R}_+^{2n} , C^2 on \mathcal{R}_+^{2n} , and $\mathbf{f}(\mathbf{0}) = \mathbf{0}$. Here IRTS is then $\mathbf{f}(\alpha\mathbf{x}, \mathbf{v}) > \alpha \mathbf{f}(\mathbf{x}, \mathbf{v})$, $\forall \alpha > 1$, and the constant rate of investment is (ρ) . Then the present-value (PV) maximization problem consists in selecting Euler time paths $\mathbf{x}(t)$, $\mathbf{v}(t)$ at $t \geq 0$ so as to maximize the sum of discounted net cash flows (V) as $t \rightarrow \infty$. Thus, the definite integral within the limits $(0, \infty)$ is:

$$V(\cdot) = \int \exp(-\rho t) \{ \mathbf{f}[\mathbf{x}(t), \mathbf{v}(t)] - \sum_{i \in n} c_i(\dot{x}_i(t)) - \sum_{j \in n} p_j v_j(t) \} dt, \quad (1)$$

s. t. $\mathbf{x}_0 > \mathbf{0}$, $\mathbf{v}_0 > \mathbf{0}$, so that $V(\cdot)$ has a maximum for some $x_i(t) > 0$, $v_j(t) > 0$, $\forall t$.

² A function $\mathbf{f}(\mathbf{x})$, $\mathbf{x} \in \mathcal{R}^n$, is quasiconcave if for any two points $\mathbf{x}_1, \mathbf{x}_2 \in \mathcal{R}^n$, we have: $\mathbf{f}[\alpha \mathbf{x}_1 + (1-\alpha) \mathbf{x}_2] \geq \min[\mathbf{f}(\mathbf{x}_1), \mathbf{f}(\mathbf{x}_2)]$, $\forall \alpha \in (0, 1)$.

2.1.2. The Solution

The $2n$ Euler conditions for (1) are:

- i) $f_{x_i}(\cdot) - \rho c_i'(\cdot) + c_i''(\dot{x}_i(\cdot)) \chi = 0$, where χ is the mean, $i \in n$
- ii) $f_{v_j}(\cdot) - p_j = 0$ $j \in n$, where the symbol $f_{(\cdot)}$ stands for first partial derivative.

For endpoint conditions, we have:

- iii) $\lim_{t \rightarrow \infty} \exp(-\rho t) c_i(x_i(\cdot)) \equiv 0$, $i \in n$.

Conditions i), ii) and iii) do not guarantee that any solutions satisfying initial and end-point conditions maximize $V(\cdot)$. The task here is to find at least one that does as we will show shortly. For now, however, it is useful to make precise the concept of scale elasticity:

- iv) $0 < \eta_v = [f_v(\cdot) v / \mathbf{f}(\cdot)] < 1$, $0 < \eta_{v_j} < 1$, $\forall j \in n$;
- v) $\eta_x = f_x(\cdot) x / \mathbf{f}(\cdot) > 1$, but $0 < \eta_{x_i} < 1$, $\forall i \in n$; but
- vi) $\eta = \eta_v + \eta_x > 1$,

where η is the scale elasticity. Obviously, the case of $\eta < 1$ derives from the concavity assumption for which solutions are well characterized.

Using the symbols $\mathbf{f}_{(\cdot) (\cdot)}$ for matrices of second-order cross partial derivatives, we posit the Hessian as:

$$H = \left[\begin{array}{c|c} \mathbf{f}_{v_j v_s} & \mathbf{f}_{v_j x_s} \\ \hline \mathbf{f}_{x_i v_s} & \mathbf{f}_{x_i x_s} \end{array} \right] = \left[\begin{array}{c|c} \mathbf{H}_1 & \mathbf{H}_2 \\ \hline \mathbf{H}_3 & \mathbf{H}_4 \end{array} \right], s \in n. \quad (2)$$

Since \mathbf{H}_1 is negative definite (n.d.), variable input levels can be found from ii) in terms of x_i and p_j . Substitution in iii) yields a stationary solution $\mathbf{x}^*(p_j; \rho)$ satisfying:

$$f_{x_i}[\mathbf{x}^*(p_j; \rho), \mathbf{v}(\mathbf{x}^*; p_j) - \rho c_i'(\cdot)] = 0, i \in n, \chi \rightarrow 0. \quad (3)$$

Thus, the firm selects some paths of quasi-fixed and variable factors so as to maximize $V(\cdot)$ for an initial condition $(\mathbf{x}_0, \mathbf{v}_0)$. At this juncture, one may ask: Can $\mathbf{x}(p; \rho)$ be taken as an appropriate solution? The general solution to i) and ii) is a $2n$ parameter family of paths, while initial conditions give only n stocks. The endpoint condition iii) must then be used to discard non optimal paths. Under the necessary conditions, stability should obtain as a consequence of the firm maximizing behavior, assuming

that there is at least one path that satisfies the right endpoint conditions. In a moment, we will be able to make a stronger statement about stability based on the existence of a globally stable manifold (to be defined).

One can otherwise look for topological equivalence near the origin with the transformation: $\dot{x}_i(t) = y_i(t)$ and (1) can be written as a $2n$ first-order system in $\mathbf{x}(t)$ and $\mathbf{y}(t)$. Expanding about the stationary point, we have:

$$\begin{aligned}\dot{\mathbf{x}}(t) &= \mathbf{y}(t) \\ \dot{\mathbf{y}}(t) &= \rho \mathbf{y}(t) - \mathbf{c}^{-1} \mathbf{A} \mathbf{dx},\end{aligned}\tag{4}$$

where $\mathbf{c} = \text{diag}(c_1'', c_2'', \dots, c_n'')$, and $\mathbf{A} = [\mathbf{H}_4 - \mathbf{H}_3 \mathbf{H}_1^{-1} \mathbf{H}_2]_{(\mathbf{x}, \mathbf{v})}$.

The Jacobian of system (4) is then:

$$\mathbf{J}(\mathbf{0}) = \left(\begin{array}{c|c} \mathbf{I} & \mathbf{0} \\ \hline \rho \mathbf{I} & -\mathbf{c}^{-1} \mathbf{A}_{(\mathbf{0})} \end{array} \right),\tag{5}$$

where \mathbf{I} is an $n \times n$ identity matrix, and $\mathbf{J}(\cdot)$ is of order $(2n \times 2n)$. As $\text{Tr}(\mathbf{J}) > 0$, $\det(\mathbf{J}) < 0$, the neoclassical economist would conclude by (5) that the solution of (1) is not well characterized, and that the instability depicted by (5) is attributable to IRTS.

Once again, the problem appears intractable. Therefore, if one is bent on obtaining convergence to a stable solution, one must invent a panoply of ancillary conditions to bring it about.

3. Insights from econophysics

An econophysicist would probably see (5) as the Jacobian of a multidimensional diffeomorphism, with a flow $\phi(\cdot): \mathcal{R}^{2n} \rightarrow \mathcal{R}^{2n}$ whose attractor, Λ , is either hyperbolic or nonhyperbolic³. If locally stable (u^s)

³ If $\mathbf{f}(\cdot): \mathcal{R}^{2n} \rightarrow \mathcal{R}^{2n}$, under the hypotheses of the Stable Manifold Theorem, \exists : i) an open subset E of \mathcal{R}^{2n} containing the origin such that $\mathbf{f} \in C^r(E)$, $r \geq 1$; ii) a k -dimensional local stable manifold ($u^s(\cdot)$) tangent to the stable subspace E^s of (5); iii) a $h = (2n - k)$ dimensional local unstable manifold ($u^u(\cdot)$) tangent to the unstable subspace E^u ; iv) an attractor Λ for $\mathbf{f}(\cdot)$. If $\mathbf{J}(\mathbf{0})$ has k simple and distinct eigenvalues with negative real part ($\text{Re}(e_k) < 0$) and h eigenvalues with positive real part ($\text{Re}(e_h) > 0$), then Λ is hyperbolic. Similarly if $\mathbf{J}(\mathbf{0})$ has k eigenvalues with $\text{Re}(e_k) < 0$, h eigenvalues with $\text{Re}(e_h) > 0$, and $m = (2n - k - h)$ eigenvalues with $\text{Re}(e_m) = 0$, in addition to ($u^s(\cdot)$), ($u^u(\cdot)$), there exists ($u^c(\cdot)$). Hence, Λ is nonhyperbolic.

and unstable (u^u) manifolds are invariant under the flow of $\mathbf{f}(\cdot)$ and hyperbolicity exists, it follows that any combination $(\mathbf{x}_0, \mathbf{v}_0) \in u^s(\cdot)$ at $t \geq 0$ will end up in the globally stable manifold $\eta^s(\mathbf{0}) = \cup_{t \leq 0} \phi_t(u^s(\mathbf{0}))$; similarly, if $(\mathbf{x}_0, \mathbf{v}_0) \in u^u(\cdot)$ at $t = 0 \rightarrow \eta^u(\mathbf{0}) = \cup_{t \geq 0} \phi_t(u^u(\cdot))$. If nonhyperbolicity exists, then there exists also a center $u^c(\cdot)$ such that if $(\mathbf{x}_0, \mathbf{v}_0) \in u^c(\cdot)$ at $t = 0 \rightarrow \eta^c(\mathbf{0}) = \cup_{t \leq 0} \phi_t(u^c(\cdot))$.

Moreover, if the origin is a hyperbolic fixed-point, $\eta^s(\mathbf{0})$ intersects $\eta^u(\mathbf{0})$ transversally at a positive angle, and all its successive iterates will lie at $\eta^s(\mathbf{0}) \cap \eta^u(\mathbf{0})$. The reason is that if there is one transverse homoclinic orbit, then there exist an infinite number of them accumulating at $\mathbf{0}$. This then results in a homoclinic tangle in which high enough iterates produce a horseshoe map. The existence of a homoclinic tangle in turn leads to bounded complexity. However, we will not dwell too much on hyperbolic attractors *per se*, because in high-dimensional chaos, equilibria are hyperbolic even if the attractor is nonhyperbolic. Ordinarily distinguishing hyperbolic and nonhyperbolic attractors might be meaningful in the presence of noise as the former appear less sensitive to noise than the latter. However, in real world situations, attractors are nonhyperbolic, and variations of parameters may produce both hyperbolic and nonhyperbolic equilibria. In the latter case though, $\eta^s(\cdot)$, $\eta^u(\cdot)$ and $\eta^c(\cdot)$ intersect tangentially. Then zero angle intersection and unstable periodic orbits that have many unstable expanding directions will also lead to bounded complexity (for more on this, see [25, 26]).

3.1. On Bounded Complexity

An Iterated Function System (IFS) such as the 1-D nonhyperbolic quadratic map suffices to display upon iterations a spectrum of invariant sets identifiable by their Lyapunov characteristic exponents (λ). The outcomes of the map, obtained by increasing values in the parameter set $P \in \mathfrak{R}_{++}$, are generic, but terms shown in Table 1 such as ‘strangeness’, ‘complexity’ and ‘chaos’ etc., need clarification.

Of particular interest is a needed distinction between “strange” and “chaotic” attractors’. *Strange attractors* may have non integer dimensions [see 27] and nonhyperbolic equilibria, but they are not chaotic even if they appear so to the naked eye. They are instead approximately Cantor point sets arising out of either the Smale’s horseshoe map or the accumulation point of the control parameter of period-doubling cascade. They are characterized by the presence of a countable set periodic orbits, an

uncountable set of aperiodic orbits (some may produce infinitely many values of the variables that never repeat), and a dense orbit, but they are not sensitive to initial conditions (SDIC).

Complexity, on the other hand, may be divided into high and low-dimensional chaos, separated by period-3 cascade. Attractors falling in the category of *high-dimensional chaos* have higher Hausdorff dimensions, D_0 , (hence a high number of active degrees of freedom). Since orbits will not visit every point in the attractor, the Kolmogorov-Sinai entropy (defined as the sum of positive Lyapunov characteristic exponents) is higher than in low-dimensional chaotic attractors. There are a number of points that need to be stressed. While most orbits are unstable, there are, however, a few isolated stable orbits. These attractors are very sensitive to parameter variations (SDPV) (i.e. slight variation may change a stable into an unstable orbit), but not sensitively dependent on initial conditions (SDIC). Hence, they are often referred to as complex rather than chaotic. One of the main characteristic distinguishing them from low-dimensional chaotic attractors is that at phase transition, they can reduce their own entropy by discharging some elsewhere; that is, they can self-organize themselves critically into low-dimensional chaos, by reducing their own degrees of freedom⁴. Most nonlinear and out-of-equilibrium systems found in nature tend to exhibit high-dimensional chaotic behavior.

In *low-dimensional chaotic* attractors, motion is organized around fewer degrees of freedom. Consequently, they have slightly lower D_0 , but appear more chaotic as they cumulate SDIC and SDPV. These attractors are rather rare in man-made dynamic systems. They are more common in biological systems that were previously high-D chaotic, but were unable to cope with their environment. When that is the case, high dim chaotic attractors can spontaneously self-organize themselves toward low-dimensional chaos where they become more adaptable to the surroundings. This type is usually referred to as ‘chaotic’ by the criterion of Echmann and Ruelle [28].

⁴ Ying-Cheng *et al.* [29] propose an alternative explanation for the phenomenon of self-organization. That is, if $\mathbf{X}_{n+1} = \mathbf{f}(\mathbf{X}; \mathbf{P})$, where $\mathbf{X} \in \mathfrak{R}^n$ and \mathbf{P} is the parameter set, then there exists a small region, $\Omega \in \mathbf{P}$ with a positive Lebesgue measure containing the invariant set of $\dim \iota < n$ and a low-dimensional manifold η of $\dim q > \iota < n$ containing variables $\mathbf{x} \in \eta \subseteq \mathfrak{R}^n$, so that $\mathbf{X}_{n+1} = \mathbf{f}(\mathbf{g}(\mathbf{x}))$. Then a sufficient condition for the asymptotic dynamics of the high-dim chaotic system to pass into a low-dim chaotic system is synchronization of variables in \mathbf{X} and those in \mathbf{x} .

Before ending this section, we reiterate and make precise a number of underlying concepts. We use the terms, model, market, and economy interchangeably throughout. Our definition of chaos is in the sense of Echmann and Ruelle [28]. The attractor is a thin subset of phase space to which a dynamic system tends, and in which the volume of the phase space shrinks to zero. While conservative systems can exhibit chaos, only dissipative systems can have strange attractors (characterized by a non-integer dimension). And estimating dimension in time series is perhaps the easiest way to distinguish the type of complexity depicted in Table 1.

With regard to the values of Table 1, let us mention also that quantitative methods for the analyses of time series have been refined in recent years mainly to reduce the data requirements for obtaining acceptable estimates such as D_0 and λ . A good example is the wavelet multi-resolution of Trusolf International that requires $n \geq 2^9$ observations for reliable estimates. Computation with the Benoit_{TM} gives $1.5 < D_0 < 2$ with an average value of D_0 of 1.7 for attractors characterized by high-dimensional chaos. For low-dimensional chaotic attractors, values are $1.0 < D_0 < 1.5$, with an average of 1.3. It is also interesting to note that the Hausdorff dimension of the Ikeda attractor is 1.7, while that of the Henon attractor (known to be a low-dimensional chaotic attractor at parameter values: $a = 1.4$, $b = 0.3$) is exactly 1.3.

3.2. A Complex U. S. Economy

An interesting question at this juncture is where would an actual economy, such that of the U.S., fit in the Table 1? To proffer an answer, we take the S&P-500 Index⁵, sampled daily, from 1950 to 2011, as a proxy for the U.S. economy. The index was first divided into 12 quasi-scale free segments. Each segment was subsequently differentiated logarithmically and filtered for white noise.

⁵ The process is denoted $Z_t = \sum_{i=1}^n (b_i X_i^{H_i})$, where $b_i \in \mathfrak{R}_{++}$, $H_i \in n \in (0, 1)$, $i \in n$, and X_i are input indexed by H_i . Z_t is a linear combination of Gaussian processes each with its own H . It is known in the literature as a mixed fractional Brownian motion that acquires its self-similarity property from self-similar processes and its long range dependence from Gaussian processes. Z_t is completely characterized by its zero mean and covariance function: $\text{Cov}(Z_t, Z_s) = 2^{-1} \sum (b_i)^2 [t^{2H_i} + s^{2H_i} - |t - s|^{2H_i}]$, $\forall t, s \in \mathfrak{R}_{++}$. However, it should be stressed that measurements containing systematic errors can be made more precise but not more accurate. Here we make no claim for accuracy for it is not known how close we are from true asymptotic values.

Table 1

Characteristics of Attracting Sets for Increasing Elements in Parameter Set depicted by the Iterates of the quadratic map. (1) Sensitive Dependence of Parameter Variation; (2) the Feigenbaum constant; (3) Sensitive Dependence on Initial Conditions taken in the sense of Echmann and Ruelle [28]; (4) the Hausdorff dimension; (5) Kolmogorov-Sinai entropy taken as the sum of positive Lyapunov characteristic exponents.

	Fixed-point	Period $\Gamma-2^k$, $k = 0,1,3, \dots$	Strangeness	Bounded Complexity		
				Chaos (High Dimension)	Period $\Gamma-3 \times 2^k$, $k = 0, 1, 2, 3, \dots$	Chaos (Low Dimension)
LCEs (λ)	< 0	< 0	0	> 0	< 0	> 0
SDPV ⁽¹⁾	no	yes, until $\delta^{(2)} = 4.6692..$	---	yes	yes	yes
SDIC ⁽³⁾	no	no	no	no	no	yes
$D_0^{(4)}$	≈ 1	$1.41 < D_0 < 1.57$	1.57	$1.5 < D_0 < 2$	≈ 1.2	$1.0 < D_0 < 1.42$
$K^{(5)}$	none	none	some	$\xi_H = \frac{\sum \lambda^+}{\sum \lambda^-} >$	some	$\xi_L = \frac{\sum \lambda^+}{\sum \lambda^-} >$

Before discussing our results (Table 2), however, it is necessary to return to the noise limitation. It is well-known that additive as well as multiplicative noise in time series must be removed prior to analyses. But in economics systems, there is another type of noise to which not enough attention is paid. It is a form of “endogenous noise” that cannot be removed precisely because it is endogenous. It arises from agents’ heterogeneity. The very fact that information sets of agents are incomplete in imperfect competition leaves room for hidden strategies, false signals, manipulations etc., which in turn produce only spurious observables, in nonhyperbolic attractors in particular. As there is no known procedure to deal with endogenous noise, it constitutes a serious limitation in empirical analyses of economic science.

With that limitation in mind, we posit the S&P-500 index as process Z_t . Z_t is perhaps the most likely process to account for input behavior and

to give an idea of the degree of complexity of the U. S. economy at the same time. Our results are given in Table 2.

Table 2.

The Hausdorff Dimensions of Self-similar Segments of the S&P-500 Index.

Dated Segments of the S&P-500	D_0 Scale	Parameter
2003-07	1.89	0.21
2007-08	1.72	0.28
2009-11	1.86	0.14
1972-80	1.78	0.22

Thus, according to these findings, the economy was in the category of high-dimensional chaos from 2003 onward. The only other time that the U. S. economy appeared as complex was during the high inflationary period 1972-80; that is, just before the 1981 crash. It is also interesting to note that Peters [6], using the Grassberger and Procaccia procedure [30], found a value of 2.33 for the correlation dimension (D_2) of the S&P-500 index, sampled monthly from January 1980 to July 1989. We computed the correlation dimension for the roughly similar period 1983-87 (the length of a segment) to a value of 2.3345.... While keeping the data limitation in mind, these findings tend to support the general notion that the real U. S. economy is living at the edge of chaos since 2003.

4. Conclusion and recommendations

This paper implicitly supposes a misunderstanding in the interaction of conventional economists and econophysicists. Conventional economists often refer to small, homogenous, rational, and far-sighted agents pursuing their interests in a dynamic construct whose mechanisms are inherently dynamically stable. Hence, in the absence of external shocks, the dynamic construct tends toward a steady state growth path. Econophysicists, on the other hand, argue that these characteristics appear invalid empirically. If there is a misunderstanding, it might arise from the fact that economists are referring to perfect competition (which does not exist), while econophysicists are alluding to actual economies.

If only economists would stop referring to perfect competition and focus on the mechanisms of real markets, and if econophysicists would only be more suspicious of economic and financial data, the grounds would be laid for a fruitful collaboration.

In the standard economic model, a steady-state equilibrium is a *sine qua non* assumption for closed-form solutions. This is justified because in a perfect market the equilibrium is a stable fixed-point. However, when economists attempted to add more realism to the model of maximization in the presence of IRTS, finalized in 1980s, they arrived at a complex system. But, bent on finding a stable equilibrium, instead of facing up to that complexity, they chose to add auxiliary conditions, such as symmetry, α -concavity, β -convexity, and upper bound on the discount rate etc., before appealing to a Turnpike Theorem. However, if markets are imperfect, the discount rate and the shadow price of national income cannot be measured with anything approaching accuracy; moreover, there is no general turnpike theorem to appeal to. The author examines a second solution concept in which the discount rate is neutral and input prices are taken to be market-clearing prices. A fragile equilibrium is possible only if initial conditions fall by pure chance in the locally stable manifold. Thus, in either case, complexity appears unavoidable and the elegant program proposed by the theory cannot be executed.

As econophysicists appear to be better equipped to deal with complex systems, collaboration between the two protagonists could be fruitful for economic science. Indeed, using methods of physics and the available data, the paper shows that a real economy such that of the U. S. is a reflexive dynamic system that is a. s. high dimensional chaotic, thereby providing a plausible explanation as to why economic science is unable to make medium and long-term probabilistic forecasts.

It is important under the circumstances to stress that any lacks in accuracy and precision in our result is due to the difficulty of eliminating the endogenous noise inherent to imperfect markets. In that connection, the protagonists must bear in mind that in complex systems many effects do not have obvious causes or causes might be too far removed to be correctly identified. However, these systems always through-off patterns. It is therefore recommended that the protagonists focus on pattern recognition rather than on accuracy in the measurements of observables thrown-off by the economic system. It then follows that major policy decisions in economics should be implemented only after being tested as pilot projects.

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GEOMETRIZATION OF ECONOPHYSICS: AN ALTERNATIVE APPROACH FOR MEASURING ELEMENTS OF RISK MANAGEMENT OF AN ECONOMIC SYSTEM

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***Abstract.** The relationship between micro-structure and macro-structure of complex systems using information geometry has been dealt by several authors. From this perspective, we are going to apply it as a geometrical structure connecting both microeconomics and macroeconomics. The results lead us to introduce new modified quantities into both micro-macro economics that enable us to describe the link between them. The importance of such a scheme is to find out-with some accuracy – a new method can be introduced for examining the stability of an economic system. This type of requirement is expressed by examining the stability of the equations of path deviations for some economic systems as described in a statistical manifold. Such a geometrization scheme of economic systems is an important step toward identifying risk management factors and so contributes to the growing literature of econophysics.*

***Keywords:** complexe economic systems, geometrization of econophysics, risk management factors, entropic dynamics, information geometry.*

1. Introduction

It is well known that the problem of risk management is related to socio-economic systems as well as to epidemiology. A central problem of risk management is the development of forecasting models to regulate or even prevent future incidents that might cause instability throughout a whole system. The necessity to manage risk has led many to seek a deterministic model that will allow us to describe exactly – within the limits of defined parameters – such a predictive model.

The demanding for such a model may begin with a system of ordinary differential equations to examine the evolution of the system. Such a system looks so naive to handle some current problems of

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economic systems even if there is some capability to express it in terms of non-linear partial differential equations. One of these is to search for such a way of thinking enables us to express any economical issue or financial situation by importing some ideas based on physics as it can be useful to revisit these problems by means of a new paradigm shift.

Our approach is based on describing economic problems using information geometry. This type geometry replaces every point in its manifold by a probability distribution of several correlated and mutually interacting events of each other. This application of information geometry allows us to examine in depth the correlation between the micro-economic elements as well as to describe how these correlations evolve within the macro-economic space, thus providing a mechanism to connect micro and macro economic factors together. However, in the meantime such a goal is farfetched but this approach of thinking may express that for every micro-economic element is responsible for establishing its corresponding macro-economic one. Thus, it may drag our attention to speculate whether or not the microeconomic element may exactly describe the well known corresponding macroeconomic element.

In other words, we propose that each macroscopic element is due to several identifiable micro-economic elements and that this relationship can be given precise definition using information geometry. The purpose of the present work is an approach to express non-traditional economics as types of asymmetric information theory as defined by statistical mechanics. The problem of establishing such a model, as an ability to explain its corresponding macroscopic elements by means of some statistical details of each element as a world of micro-observable. Hawkins et al. (2010) [1], mentioned that constrained probability can work to connect between micro-densities-expressing the micro elements -with macro-observable-defining macro-economic variables for a direct application of information geometry for describing the case within the mechanism of statistical mechanics. In this case, one can easily observe the problems of disequilibrium in non-conventional economics as a trajectory of paths expressed in statistical manifold. The link is expressed within the describing the statistical manifold i.e. it contains instead of point-like a probability distribution at each point. This approach can be expressed as an extension of 1-dimension information geometry problem has been introduced by A. Giffin (2009) [2]. An application of this approach on real economic issues-stock market fluctuations will be studied in our forthcoming studies.

2. Mathematical Modeling of an Economic System

It is well known that one of ways of describing a deterministic model is by means of introducing differential equations for the system to examine and predict its evolution at different times. An attempt to the describe such a primitive model of macroeconomic growth is as follows [3]

$$\frac{dK}{dt} = I(t), \quad (1)$$

Such that $Y = C(t) + S(t)$

$$S(t) = I(t)$$

and

$$S(t) = \mu Y(t)$$

$$K(\tau) = \mu Y(\tau).$$

Where $Y(\tau)$ is the national income, $S(t)$ is the amount of compensation and accumulation per year, $I(t)$ is a amount of investment per year; $K(t)$ is the amount of capital per year and ν is an arbitrary constant. For a better mathematical formulation, the above model can be modified to follow Lotika-Volterra is becoming [4]:

$$\frac{dK}{dt} = \alpha_1 KI + \alpha_2 K \quad (2)$$

and

$$\frac{dI}{dt} = \alpha_1 KI + \alpha_2 I \quad (3)$$

where α_1 and α_2 are constant coefficients. However, these constants do not match with the current situation especially for dealing with a large set of data which may impose some stochastic parameters. This leads us to replace them by a family of smooth probability distribution functions having its own means and variance [5].

3. Econophysics: Economics as Complex Systems

The interaction between physics and economics leads to study some irregular problems such as high frequency finance, financial risk and some complex systems using an interdisciplinary science called econophysics.

Econophysics was started in the mid 1990's [6] mainly dealing with complex problems in economics as well as financial markets, to obtain relevant explanations for vague problems in both economics and finance e.g. on heterogeneous agents and far-from-equilibrium situations. Accordingly, the notation of a complex system may lead to express it by means of thermodynamics. They are systems of many interacting agents of highly nonlinear features. This amount of data allows a detailed statistical description of several aspects of the dynamics of asset price in a financial market. These results are based on some data of complexity in the price of dynamics of financial assets [7].

The thermodynamic model induces temperature and entropy. With no information about these variables, it is not possible to find the correct equilibrium conditions for the two systems.

The fundamental law of equilibrium statistical mechanics is Boltzmann-Gibbs law, which states that the probability distribution of energy E is $p(E) = Ce^{-E/T}$ where C is a normalizing constant and T is an effective temperature. The main ingredient that is essential for the derivation of Boltzmann-Gibbs law is the conservation of energy. Thus one may generalize that any conserved quantity in a big statistical system should have an exponential probability distribution in equilibrium [8]. It has been found that laws of money are responding to the same laws of energy. i.e., money can also be conserved e.g. **financial potential + financial energy = constant** [9] and its distribution is following the Boltzmann-Gibbs law:

$$p(m) = Ce^{-m/\bar{T}} \quad (4)$$

$$\int_0^{\infty} p(m)dm = 1$$

and,

$$\int_0^{\infty} mp(m)dm = M / N,$$

taking $C = \frac{1}{\bar{T}}$ and $\bar{T} = M / N$, due to $M = n_b m^b$. Here m is money and \bar{T} is the average amount of money per economic agent which is analogous to the temperature in physical systems.

Let an economic system consists of N agents, the total income $E(t)$ corresponds to the sum of modes of income distribution between these agents as the statistical weight of the state with this income, using a characteristic function $n(E(t), N)$ for this task.

Now, it is possible to introduce the concept of equilibrium. We may consider two systems are in equilibrium, if the function of income distribution remains constant, there is no flow of income among agents appears. Let one system with the total income E_1 have N_1 , the number of agents while the other is E_2 , with its number of agents N_2 . If the system is composed by two subsystems $n_1(E_1, N_1)$ and $n_2(E_2, N_2)$, then the total income and number of agents become $E_1 + E_2$ and $N_1 + N_2$ respectively. This may give rise to consider that the state of equilibrium.

Let ΔE be a certain part of income which passes from sub-system (1) to sub-system (2), which produces a change in each statistical weight to become from $n_1(E_1 - \Delta E, N_1)$ to $n_2(E_2 + \Delta E, N_2)$.

According to the principle of equal probability, the most probable state of these subsystems is the one the greatest statistical one i.e. the maximum of the function $n_{total}(E_1, E_2, N_1, N_2)$. This whole system is regarded as it's based on that the total income remains $E_1 + E_2$, without transferring of agents, thus, the overall statistical weight of this system becomes

$$n_{total}(E_1, E_2, N_1, N_2) = n_1(E_1, N_1) \times n_2(E_2, N_2).$$

Considering in this case, $E_1 + E_2 = \text{constant}$, then

$$\Delta E_1 = -\Delta E_2.$$

From this perspective, the maximum of n_{total} is the maximum of $\ln(n_{total})$. Since, $\ln n_{total} = \ln n_1 + \ln n_2$ which gives the condition of maximum statistical weight is obtained from the equilibrium condition:

$$\frac{d}{dE_1} \ln n_1(E_1, N_1) = -\frac{d}{dE_2} \ln n_2(E - E_1, N_2), \quad (5)$$

$$\Delta E_1 = -\Delta E_2$$

to give

$$\frac{d}{dE_1} \ln n_1(E_1, N_1) = -\frac{d}{dE_2} \ln n_2(E_2, N_2).$$

If the two systems have such a condition

$$\frac{d}{dE_1} \ln n_1(E_1, N_1) = \frac{d}{dE_2} \ln n_2(E_2, N_2) = \frac{d}{dE} \ln n(E, N).$$

then one can regard it from a thermodynamic perspective the inverse of the temperature i.e.

$$\frac{d}{dE} \ln n(E, N) = \frac{1}{T}, \quad (6)$$

and the logarithms of the statistical weight is called the entropy of the system.

Thus, in a state of equilibrium the interacting systems should have the same temperature. In order to connect the above phenomena with economics, it is worth mentioning that an economical system is in state of equilibrium if it is almost homogeneous and it does not imply flows from one subsystem to another. However, the homogeneity exists only if there is no separation into such parts so that no major income flows are noted. The system is the state of equilibrium when the two subsystems have the same temperature which cannot be calculated without knowing the entropy of the system [10]. This is required to observe the case of transforming an economic quantities into some quantities following the laws of statistical mechanics to define what can be acting as an entropy for the system to be used for measuring the stability of it as a tool to present geometrically the metric of the statistical space as defined within Fisher formalism of information geometry to become a proposed candidate to connect micro-variables with macro-variables [11].

4. Entropic Dynamics: Information Geometry

The way to recognize details about the transition from one state to another for a given system is entirely by examining the change in their probability distributions. The most reliable information about the transition state is reaching to its maximum entropy. The maximum entropy may be interpreted geometrically by the possible trajectory in a statistical manifold that describes its evolution. It can be regarded that the method of maximum entropy can transform the manifold of states into a metric space [12]. This means that the change between two different states can be expressed in terms of a distance between them and this distance can be defined in a statistical manifold.

The underlying geometry of this space stems from considering that at each point of the space, there exists an n -dimensional manifold, a micro-space [13].

Let the micro-states of any economic system be labeled by x and let $q(x)dx$ be the number of micro-states in the range $d(x)$. Also, there exists a macro-state defined by Θ^α stands for the expected values for n_Θ variables expressing the micro-state in the following way:

$$\langle a^\alpha \rangle = \int dx p(x) a^\alpha(x) = \Theta^\alpha$$

where variables $a^\alpha(x)$ ($\alpha = 1, 2, n_A$). At each values of Θ^α there is a set of coordinates, expressing the macro-space. such that the set Θ defines the $2l$ -dimensional space of macro-space of the states of the system, the statistical manifold M_s . Thus, the probability distribution $p(x|\Theta)$ represents the prior information contained in $q(x)$ innovated by Θ^α [14] which can be obtained by maximizing the entropy:

$$s(p) = - \int dx p(x) \log \frac{p(x)}{q(x)}. \quad (7)$$

The difference between two states A^α and $A^\alpha + dA^\alpha$ is given by a small value dS^2 defined in the following way:

$$dS^2 = \int dx p(x|\Theta) \frac{\partial \log p(x|\Theta)}{\partial \Theta^\alpha} \frac{\partial \log p(x|\Theta)}{\partial \Theta^\alpha}. \quad (8)$$

A measure of distinguish-ability among macro-states of the statistical manifold is defined by assigning a conditional probability is belonging the statistical manifold to each macro-state. This kind of assignment endows the statistical manifold with a metric structure. Specifically, the Fisher-Rao information $g_{\mu\nu}(\Theta)$ i.e.

$$g_{\mu\nu}(\Theta) = \int dx p(x|\Theta) \partial_\mu \log p(x|\Theta) \partial_\nu \log p(x|\Theta), \quad (9)$$

where $\mu, \nu = 1, 2, 3, 2l$ and $\partial_\mu = \frac{\partial}{\partial \Theta^\mu}$ defines a measure of distinguish-ability among macro-states on the statistical manifold of M_s .

It is well known to apply information geometry it requires a metric g_{ab} is symmetric and positive definite and Fisher metric admits the following properties:

1. Invariance under transformations of micro-variables [15]:

$$p(x|\Theta) \rightarrow \hat{p}(\hat{x}|\Theta) = \left[\frac{1}{\frac{\partial f}{\partial x}} p(x|\Theta) \right], \quad (10)$$

2. Covariance under reparametrization of statistical macro-space,

$$g_{ab} \rightarrow \hat{g}_{ab} = \left[\frac{\partial \Theta^c}{\partial \hat{\Theta}^a} \frac{\partial \Theta^d}{\partial \hat{\Theta}^b} g_{cd}(\Theta) \right], \quad (11)$$

such that

$$g_{ab}(\hat{\Theta}) = \int dx \bar{p}(x | \hat{\Theta}) \bar{\partial}_a \ln \bar{p}(x | \hat{\Theta}) \bar{\partial}_b \ln \bar{p}(x | \hat{\Theta}).$$

5. Geometrization in Macroeconomics using Information Geometry

This geometrization scheme for describing macroeconomic growth models uses the richness of information geometry-defining each point in the macro-state space as a world of micro-structure with both the correlated and uncorrelated variables.

In each version geodesic and geodesic equations-working for examining the stability of the system will be different-as will be studied in future work.

In our present work we focus primarily on some primitive models-toy ones-to rewriting the economical issues as a mere set of non ordinary differential equations that might be adaptable to examine the degree of chaos by means of measuring the evolution of entropy in any economic system. It is evident that we cannot determine the evolution of micro-states due to insufficient data. Instead we can study the distance between total probability distributions with parameters (μ_1, μ_2, σ_2) and $\mu_1 + d\mu_1, \mu_2 + d\mu_2, \sigma_2 + d\sigma_2$ assuming that $\sigma_1 = 0$. Once the states of the system can be defined, then the problem of quantifying the difference between macro-states Θ and $\Theta + d\Theta$ is described by a dimensionless distance between the two states $p(\vec{x} | \vec{\Theta})$ and $p(\vec{x} | \vec{\Theta} + d\vec{\Theta})$ [14]:

$$dS^2 = g_{ij} d\Theta^i d\Theta^j, \quad (12)$$

where

$$g_{ij} = \int d\vec{x} p(\vec{x} | \vec{\Theta}) \left(\frac{\partial \log p(\vec{x} | \vec{\Theta})}{\partial \Theta^i} \right) \left(\frac{\partial \log p(\vec{x} | \vec{\Theta})}{\partial \Theta^j} \right)$$

is the Fisher-Rao metric

$$g_{ab}(\mu_x, \mu_y; r) = \frac{1}{\sigma^2} \begin{pmatrix} -\frac{1}{r^2-1} & \frac{r}{r^2-1} & 0 \\ \frac{r}{r^2-1} & -\frac{1}{r^2-1} & 0 \\ 0 & 0 & 4 \end{pmatrix}$$

$$g_{ij} = \begin{pmatrix} \frac{1}{\mu_1^2} & 0 & 0 \\ 0 & \frac{1}{\mu_2^2} & 0 \\ 0 & 0 & \frac{1}{\sigma_2^2} \end{pmatrix}$$

to get its line element [14]

$$dS_{M^3D}^2 = \frac{1}{\sigma^2} (d\mu_x^2 + d\mu_y^2 + 4d\sigma_x^2) \quad (13)$$

and its the non-vanishing affine connection becomes

$$\Gamma_{13}^1 = -\frac{1}{\sigma}, \Gamma_{23}^2 = -\frac{1}{\sigma} = \Gamma_{32}^1,$$

$$\Gamma_{11}^3 = \frac{1}{4\sigma(r^2-1)}, \Gamma_{12}^3 = \frac{1}{4\sigma(r^2-1)} = \Gamma_{21}^3, \Gamma_{22}^3 = \frac{1}{4\sigma(r^2-1)}, \Gamma_{33}^3 = -\frac{1}{\sigma}.$$

The geodesic equation describes a reversible dynamics whose solution is the trajectory between initial Θ_i and final macrostate Θ_f which can be expressed in the following way

$$\frac{d^2\mu_x}{dS^2} - \frac{2}{\sigma} \frac{\mu_x}{dS} \frac{d\sigma}{dS} = 0, \quad (14)$$

$$\frac{d^2\mu_y}{dS^2} - \frac{2}{\sigma} \frac{\mu_y}{dS} \frac{d\sigma}{dS} = 0, \quad (15)$$

$$\frac{d^2\sigma}{dS^2} - \frac{1}{\sigma^2} \left(\frac{d\sigma}{dS} \right)^2 - \frac{1}{4\sigma(r^2-1)} \left[\left(\frac{d\mu_x}{dS} \right)^2 + \left(\frac{d\mu_y}{dS} \right)^2 \right] + \frac{r}{4\sigma(r^2-1)} \frac{d\mu_x}{dS} \frac{d\mu_y}{dS} = 0. \quad (16)$$

correlated systems $r \neq 0$ one obtains:

$$\begin{aligned}\mu_x &= -\sqrt{\left(\frac{2A(r-1)}{B}\right)} \tanh\left(\frac{2AB}{2r-1} S\right), \\ \mu_y &= -\sqrt{\left(\frac{2A(r-1)}{B}\right)} \tanh\left(\frac{2AB}{2r-1} S\right), \\ \sigma &= -\sqrt{\left(\frac{-A}{B}\right)} \operatorname{sech}\left(\frac{2AB}{2r-1} S\right).\end{aligned}$$

6. Geometrization of Economic Systems

This concept is proposed analogously as in General Relativity such that the background of the manifold which is expressed within the elements of the macro-economic to be related in the following sense: every point in the manifold is expressed as a probability distribution of a micro-world. This can be expressed by means of applying a method based on finding the corresponding maximum relative entropy of the proposed economic system. Such entropy can be related to measuring amount of disorder of any system. This can be related to the concept of geometrization of macroeconomics stems from expressing every element which describes the case of macro-economy as a dimension: the more dimensions described in the space of macroeconomics, the greater precession of forecasting the behavior macro-economy. From this perspective, it will be important to start by defining the manifold of the macro-economy as a 2-dimensional curved space. The term curved is admitted to include the chaos in its contents. Equations of geodesic and geodesic deviation of this space will enable us to examine the evolution of such a system and its tendency of stability through its corresponding deviation vector.

In this work, we geometrize macroeconomics by proposing that all acting variables in an economic system can be expressed in terms of dimensions in a manifold-economical manifold. This technique may be used analogously to describe the evolution of epidemics using allometric spaces [2]

$$L = g_{ab} U^a U^b \quad (17)$$

where U is the tangent vector with respect to the parameter t . However, in this approach, we are going to obtain path and path deviation equations from one single Lagrangian using the Bazanski Lagrangian [16]:

$$L = g_{ab}U^a \frac{D\Psi^b}{Dt} \quad (18)$$

where $a, b = 1, 2, 3, \dots, n$ and $\frac{D\Psi^a}{Dt}$ is the covariant derivative with respect to a parameter t and the line element as defined by Rao [4]

$$dS^2 = \frac{1}{\sigma_i^2} d\mu_i^2 + \frac{1}{\sigma_i^2} d\sigma_i^2 \quad (19)$$

where, μ_i is the mean of the elements macro-economic space and σ is the standard deviation of the same elements. Taking into consideration in that macroeconomic space $K = K_1, K_2, \dots, K_n, I = I_1, I_2, \dots, I_n$ in which the space enclosed (K, I) is the 2-dimensional macro-space of Capital-Income.

Taking the variation with respect to the deviation vector Ψ^c and the tangent vector U^c respectively one obtains *the path equation*:

$$\frac{dU^c}{dt} + \Gamma_{ab}^c U^a U^b = 0 \quad (20)$$

and its *path deviation equation*:

$$\frac{D^2\Psi^c}{Dt^2} = R_{abd}^c U^a U^b \Psi^d. \quad (21)$$

Thus, the path and path deviation equations of the KI-model can be obtained from the following Bazanski Lagrangian [17]

$$L = g_{\mu\nu} U_{KI}^\mu \frac{D\Psi_{KI}^\nu}{Dt} \quad (22)$$

where $U_{KI}^\mu = (K, I)$ and $\Psi_{KI}^\nu = (\Psi_K, \Psi_I)$. Taking the variation with respect to the deviation vector Ψ^σ we get the following components of the path equation:

$$\frac{dK}{dt} + \Gamma_{11}^1 K^2 + \Gamma_{22}^1 I^2 + 2\Gamma_{12}^1 KI = 0, \quad (23)$$

and

$$\frac{dI}{dt} + \Gamma_{11}^2 K^2 + \Gamma_{22}^2 I^2 + 2\Gamma_{12}^2 KI = 0. \quad (24)$$

And taking the variation with respect to velocity vector U^σ we get the corresponding components of the path deviation equation [6]:

$$\frac{D^2\Psi_K}{Dt^2} = R_{112}^1 K^2\Psi_I + R_{121}^1 KI\Psi_K + R_{212}^1 KI\Psi_I + R_{221}^1 I^2\Psi_K, \quad (25)$$

and

$$\frac{D^2\Psi_I}{Dt^2} = R_{112}^2 K^2\Psi_I + R_{121}^2 KI\Psi_K + R_{212}^2 KI\Psi_I + R_{221}^2 I^2\Psi_K. \quad (26)$$

Although this step of geometrization elements of macroeconomics is quite useful, it is still unacceptable for describing the real factors of risk management issue. This is due to lack of contact between the variables of macro economics and microeconomics. Such unification cannot be achieved without getting some geometrical techniques to express and relate both these domains. One possible approach is to use the geometrization method of econophysics by applying information geometry of maximum entropy method.

7. Chaotic Instability in Information Geometry

It is well known that the Riemannian curvature of a manifold is closely connected with the behavior of geodesics. If we take a special $\sigma_x = \sigma_y = \sigma$, therefore, its corresponding Fisher-Rao metric becomes [18]

$$g_{ij} = \begin{pmatrix} \frac{1}{\mu_1^2} & 0 & 0 \\ 0 & \frac{1}{\mu_2^2} & 0 \\ 0 & 0 & \frac{1}{\sigma_x^2} \end{pmatrix}$$

to produce the line element

$$dS_{3MD}^2 = \frac{1}{\sigma^2} (d\mu_x^2 + d\mu_y^2 + 4d\sigma_x^2) \quad (27)$$

and its the non-vanishing affine connection becomes

$$\Gamma_{13}^1 = -\frac{1}{\sigma}, \Gamma_{23}^2 = -\frac{1}{\sigma} = \Gamma_{32}^1,$$

$$\Gamma_{11}^3 = \frac{-1}{4\sigma}, \Gamma_{22}^3 = \frac{-1}{4\sigma}, \Gamma_{33}^3 = -\frac{1}{\sigma}.$$

The geodesic equation describes a reversible dynamics whose solution is the trajectory between initial Θ_i and final macro-state Θ_f which can be expressed in the following way [15]:

$$\frac{d^2\mu_x}{dS^2} - \frac{2}{\sigma} \frac{\mu_x}{dS} \frac{d\sigma}{dS} = 0, \quad (28)$$

$$\frac{d^2\mu_y}{dS^2} - \frac{2}{\sigma} \frac{\mu_y}{dS} \frac{d\sigma}{dS} = 0, \quad (29)$$

$$\frac{d^2\sigma}{dS^2} - \frac{1}{\sigma^2} \left(\frac{d\sigma}{dS} \right)^2 - \frac{1}{4\sigma(r^2)} \left[\left(\frac{d\mu_x}{dS} \right)^2 + \left(\frac{d\mu_y}{dS} \right)^2 \right] = 0. \quad (30)$$

If the Riemannian curvature is positive, then the nearby geodesics oscillate about one another due to solution of geodesic deviation equations while when the curvature is negative, the geodesics are rapidly diverge from each and the solution of geodesic deviation equations may give an indication about the behavior of this divergence. This provides a way to estimate the degree of chaotic behavior in the system, which means the estimate the chaotic issue i.e.

$$\frac{d^2\Psi^1}{dS^2} + 2\Gamma_{11}^1 \frac{d^2\Theta^1}{(dS)^2} + \Gamma_{11}^1 \left(\frac{d\Theta^1}{dS} \right)^2 \Psi^1 = 0, \quad (31)$$

$$\begin{aligned} & \frac{d^2\Psi^2}{dS^2} + 2 \left[\Gamma_{23}^2 \frac{d\Theta^3}{dS} \frac{d\Psi^2}{dS} + \Gamma_{32}^2 \frac{d\Theta^2}{dS} \frac{d\Psi^3}{dS} \right] + \partial_3 \Gamma_{23}^2 \left(\frac{d\Theta^3}{dS} \right)^2 (\Psi)^2 \\ & + \Gamma_{32}^2 \Gamma_{33}^2 \left(\frac{d\Theta^3}{dS} \right)^2 \Psi^2 = \frac{1}{g_{22}} R_{2323} + \frac{d\Theta^2}{dS} \frac{d\Theta^2}{dS} \Psi^3 + \frac{1}{g_{22}} R_{2323} \left(\frac{d\Theta^3}{dS} \right)^2 \Psi^3, \quad (32) \end{aligned}$$

and

$$\begin{aligned} & \frac{d^2\Psi^3}{dS^2} + 2 \left[\Gamma_{23}^3 \frac{d\Theta^3}{dS} \frac{d\Psi^2}{dS} + \Gamma_{32}^3 \frac{d\Theta^2}{dS} \frac{d\Psi^3}{dS} \right] + \partial_3 \Gamma_{23}^3 \left(\frac{d\Theta^3}{dS} \right)^2 (\Psi)^2 \\ & + \Gamma_{32}^3 \Gamma_{33}^3 \left(\frac{d\Theta^3}{dS} \right)^2 \Psi^2 = \frac{1}{g_{33}} R_{2323} \frac{d\Theta^2}{dS} \frac{d\Theta^2}{dS} \Psi^3 + \frac{1}{g_{33}} R_{2323} \left(\frac{d\Theta^3}{dS} \right)^2 \Psi^3. \quad (33) \end{aligned}$$

After some manipulation, the solution of geodesic equation and geodesic deviation equation may be expressed as follows:

$$\mu_x = -\sqrt{\left(\frac{-2A(r-1)}{B}\right)} \tanh(-2ABS)$$

$$\mu_y = -\sqrt{\left(\frac{-2A}{B}\right)} \tanh(-2ABS)$$

$$\sigma = -\sqrt{\left(\frac{-A}{B}\right)} \operatorname{sech}(-2ABS)$$

and

$$\Psi_1 = (a_1 + a_2\rho)e^{-\rho s}$$

$$\Psi_2 = (a_3 + a_4\rho)e^{-\rho s} - \frac{1}{2\rho}a_5e^{-\rho s} + a_6$$

$$\Psi_3 = (a_3 + a_4\rho)e^{-\rho s}$$

where, a_1, a_2, \dots, a_6 are integration constants and ρ is a parameter defining the deviation vector such that $\Psi^i = \frac{\partial x^i}{\partial \rho}$, [14] allowing us to compute the chaotic behavior in the system using the scalar value of the deviation vector i.e.

$$\Psi^2 = \frac{1}{\mu_1^2}(\Psi_1)^2 + \frac{1}{\sigma_2^2}(\Psi_2)^2 + \frac{1}{\sigma_2^2}(\Psi_3)^2$$

which becomes:

$$\Psi = \bar{C}e^{\rho s}$$

where \bar{C} is an arbitrary constant that encodes information about the initial conditions and depends on the parameter ρ . Thus, studying in depth some examples of systems whose data may be expressed as a statistical manifold having a negative curvature less than 1 may show how chaotic systems may be controlled. This can be done through geometrization of the economic or financial system in order to maintain the risk in the system within any limits assigned.

8. Discussion and Concluding Remarks

In this paper, we have suggested a mechanism to express the differential equations of prey-predator model may be used to describe Capital-Income model into a space expressing all of its factors as dimension in a geometric space by considering each of its elements as a dimension in a manifold. Some authors have used an allometric space with a stochastic metric [4]. This could be applied as an introductory step to apply information geometry. This geometry has the advantage of expressing each individual data as micro-space each of which has its own macroscopic structure. In other words, we have described a mathematical technique for uniting microeconomics and macroeconomics. However, some problems are still existed in our current lives. The macrostructure produced by elements of microeconomics is not identical with that described in terms of space microstructure, described in terms of a space micro-structure is not identical. Accordingly, we may expect some current macroeconomic curves that are controlling the effect of negative curvature from the background, having tendency of chaotic behavior appeared in the system. From the perspective of economics, it may be considered a new tool for testing stable economy and its relation with its corresponding micro-economic items. This geometrization may provide a tool to study the stability of the economy of countries experiencing rapid change due to the transitional situation of their economies. This descriptive study will be assigned for the forthcoming work.

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THE OKUN'S LAW AND THE CHAOTIC UNEMPLOYMENT RATE GROWTH MODEL: G7

Vesna JABLANOVIC*

***Abstract.** The basic aim of this analysis is to set up a relatively simple chaotic unemployment rate growth model that is capable of generating stable equilibria, cycles, or chaos. This paper analyzes the local growth stability of unemployment rate in the G7 countries in the period 1990-2013. (www.imf.org) and confirms stable but monotonically increasing movement of unemployment rate in the G7 countries in the observed period.*

***Keywords:** Single equation model, Unemployment, Investment, Budget Deficit.*

JEL classification numbers: C2, J64, E22, H62.

1. Introduction

Almost 202 million people were unemployed in 2013 around the world. There is an increase of almost 5 million compared with the year before. Employment is not growing sufficiently fast to keep up with the expanding labor force. The euro area emerged from recession during the second quarter of 2013. In the United States, growth reached more than 4 per cent in the last quarter of 2013. Similarly, in Japan, growth remained steady in the first half of 2013. However, improvements in both productivity and competitiveness have not yet been strong enough to make a significant difference to the still large employment gap. It remains, so far, a recovery in economic activity, not in jobs. In the developed economies and European Union region, the unemployment rate remained in 2013 at 8.6 per cent, or 45.2 million people. It is expected to gradually decline to below 8 per cent around 2018. In 2013, 18.3 per cent of young people in this region were out of a job (ILO, 2014).

The analysis focuses on the G7 countries: Canada, France, Germany, Italy, Japan, the United Kingdom (UK), and the United States (USA). The unemployment rate measures the number of people actively looking for a job as a percentage of the labor force. Unemployment rate in the G7 countries in the period 1990-2013 is presented in Figure 1.

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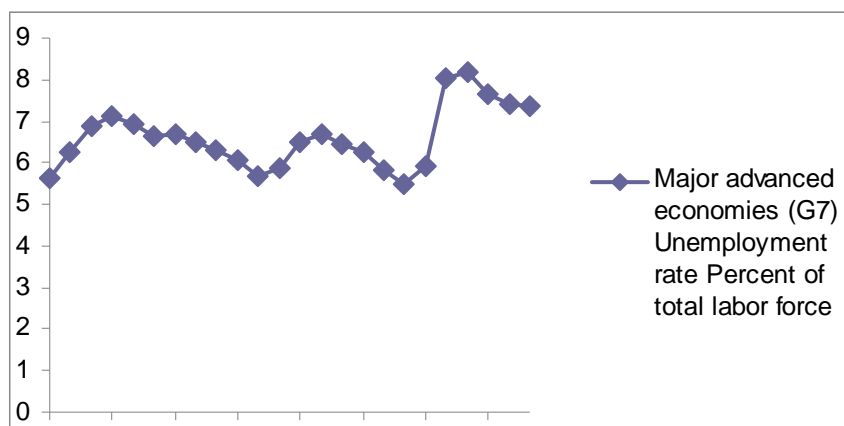


Figure 1. *Unemployment rate in the period 1990-2013: G7* (www.imf.org)

Namely, in an open economy, government budget deficit, as a negative public saving, raises real interest rates, crowds out domestic investment, decreases net capital outflow, decreases the level of asset prices, causes the domestic currency to appreciate. A decrease in aggregate demand causes output, unemployment and prices to fall. The recession may further increase budget deficit, unemployment, and public debt. Large government spending can lower private investment expenditures (crowding out). If the government consumes a larger share of the total output of goods and services via deficit finance, an equally smaller amount of output is available for private use.

When the government runs a budget deficit, it reduces the national saving. The interest rate rises. The asset prices decrease. Further, the higher interest rate reduces domestic and net foreign investment (net capital outflow). Reduced net foreign investment (net capital outflow), in turn, reduces the supply of domestic currency in the market for foreign-currency exchange, which causes the real exchange rate of domestic currency to appreciate.

Further, a rise in the equilibrium real interest rate induces greater saving and lower consumption. The increase in the equilibrium real interest rate also causes investment to decline. The total decline in private consumption and investment is equal to the rise in the government budget deficit. An expansionary fiscal policy action that increases the government budget deficit causes an increase in the real rate of interest that induces reductions in private consumption and investment. The total decline in

private spending, the sum of the amount by which private saving rises and private investment falls, exactly equals the amount by which the deficit rose. This reduction in private spending and aggregate demand caused by an increase in the government deficit is known as the crowding-out effect.

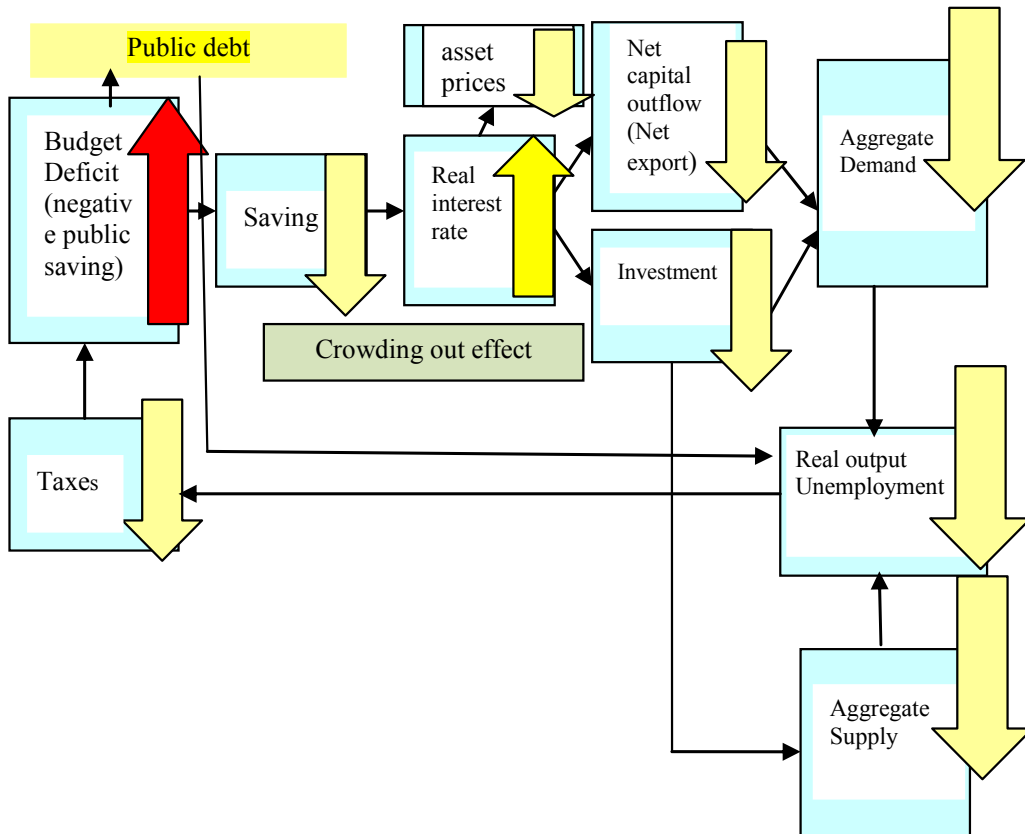


Figure 2. Causes of the financial crisis or the effects of a government budget deficit and public debt.

In Figure 2 we can examine the effects of the crowding out effect on unemployment. Figure 3 shows investment and general government net debt in the G7 countries in the period 1991-2013.

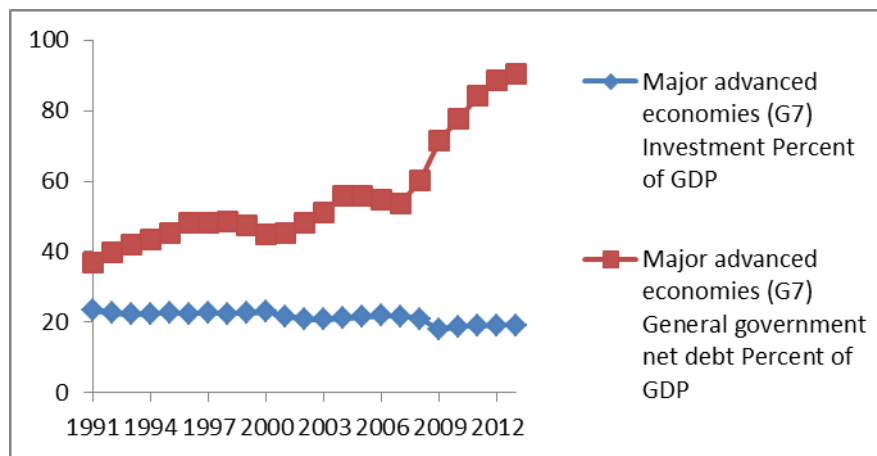


Figure 3. Investment (% of GDP) and general government net debt (% of GDP) in the period 1991-2013: G7 (www.imf.org)

2. The Model

Chaos theory started with Lorenz's (1963) discovery of complex dynamics arising from three nonlinear differential equations leading to turbulence in the weather system. Li and Yorke (1975) discovered that the simple logistic curve can exhibit very complex behavior. Further, May (1976) described chaos in population biology. Chaos theory has been applied in economics by Benhabib and Day (1981, 1982), Day (1982, 1983), Grandmont (1985), Goodwin (1990), Medio (1993), Lorenz (1993), Jablanovic (2011, 2012, 2013), Puu, T. (2003), Zhang W. B. (2006) etc.

Chaos theory started with Lorenz's (1963) discovery of complex dynamics. Deterministic chaos refers to irregular or chaotic motion that is generated by nonlinear systems evolving according to dynamical laws that uniquely determine the state of the system at all times from a knowledge of the system's previous history. Chaos embodies three important principles: (i) extreme sensitivity to initial conditions; (ii) cause and effect are not proportional; and (iii) nonlinearity.

The basic aim of this analysis is to set up a relatively simple chaotic unemployment rate growth model that is capable of generating stable equilibria, cycles, or chaos. It is important to analyze the local stability of unemployment rate growth in the G7 countries in the period 1990-2013 (www.imf.org).

Okun's (1962) paper regarding the unemployment – output relationship considers the measurement of potential output. Okun believed that the potential output should not be defined as the maximum output the

economy could produce. Instead, he argued that the potential should be measured at full employment, which he characterized as the level of employment absent inflationary pressures.

We can write the Okun's Law in this form:

$$(Y_t - Y_p) = -\rho (U_t - U_n) \quad (1)$$

where $\rho > 0$. Namely, deviations of the real output from its natural level are inversely related with deviations of unemployment rate, U , from its natural level, U_n . When unemployment rate increases above its natural level ($U_t > U_n$) real output tends to decrease below its natural level and vice versa.

Further, it is supposed:

$$U_n = \lambda U_t \quad (2)$$

$$Y_p = \mu Y_t \quad (3)$$

where: U_t – unemployment rate; U_n – natural rate of unemployment; Y_t – real output; Y_p – potential output; ρ – the coefficient which explains relation between deviations of real output from its natural level and deviations of unemployment rate from its natural level; λ – the coefficient which relates unemployment rate and natural rate of unemployment; μ – the coefficient which explains relation between real output and potential output:

$$\frac{I_{t+1} - I_t}{I_t} = \alpha - \beta B d_t \quad (4)$$

$$I_t = \gamma Y_t \quad 0 < \gamma < 1 \quad (5)$$

$$B d_t = \delta Y_t \quad (6)$$

where: α – an autonomous investment growth rate; γ – an investment rate; δ – the budget deficit rate.

By substitution one derives:

$$U_{t+1} = (1+\alpha) U_t - \left[\frac{\beta \delta \rho (\lambda-1)}{(1-\mu)} \right] U_t^2. \quad (7)$$

Further, it is assumed that the current value of unemployment rate is restricted by its maximal value in its time series. This premise requires a modification of the growth law. Now, the unemployment rate growth rate depends on the actual value of the unemployment rate, U , relative to its maximal size in its time series U_m . We introduce u as $u = U/U_m$. Thus y

ranges between 0 and 1. Again we index u by t , i.e., write u_t to refer to the size at time steps $t = 0, 1, 2, 3, \dots$. Now the unemployment rate growth rate is measured as

$$u_{t+1} = (1 + \alpha) u_t - \left[\frac{\beta \delta \rho (\lambda - 1)}{(1 - \mu)} \right] u_t^2. \quad (8)$$

This model given by equation (8) is called the logistic model. For most choices of α , β , δ , ρ , λ , and μ there is no explicit solution for (8). Namely, knowing of α , β , δ , ρ , λ , μ , and measuring u_0 would not suffice to predict u_t for any point in time, as was previously possible. This is at the heart of the presence of chaos in deterministic feedback processes. Lorenz (1963) discovered this effect – the lack of predictability in deterministic systems. Sensitive dependence on initial conditions is one of the central ingredients of what is called deterministic chaos.

This kind of difference equation (8) can lead to very interesting dynamic behavior, such as cycles that repeat themselves every two or more periods, and even chaos, in which there is no apparent regularity in the behavior of u_t . This difference equation (8) will possess a chaotic region. Two properties of the chaotic solution are important: firstly, given a starting point u_0 the solution is highly sensitive to variations of the parameters of α , β , δ , ρ , λ , and μ ; secondly, given the parameters of α , β , δ , ρ , λ , and μ the solution is highly sensitive to variations of the initial point u_0 . In both cases the two solutions are for the first few periods rather close to each other, but later on they behave in a chaotic manner.

3. The Logistic Equation

The logistic map is often cited as an example of how complex, chaotic behavior can arise from very simple non-linear dynamical equations. The map was popularized in a seminal 1976 paper by the biologist Robert May. The logistic model was originally introduced as a demographic model by Pierre François Verhulst. It is possible to show that iteration process for the logistic equation

$$z_{t+1} = \pi z_t (1 - z_t), \quad \pi \in [0, 4], \quad z_t \in [0, 1] \quad (9)$$

is equivalent to the iteration of growth model (8) when we use the identification (see Fig. 4)

$$z_t = \frac{\beta \delta \rho (\lambda - 1)}{(1 + \alpha)(1 - \mu)} u_t \quad \text{and} \quad \pi = 1 + \alpha. \quad (10)$$

Using (8) and (10) we obtain:

$$\begin{aligned}
z_{t+1} &= \frac{\beta \delta \rho (\lambda-1)}{(1+\alpha) (1-\mu)} u_{t+1} = \\
&= \frac{\beta \delta \rho (\lambda-1)}{(1+\alpha) (1-\mu)} \left\{ (1+\alpha) u_t - \left[\frac{\beta \delta \rho (\lambda-1)}{(1-\mu)} \right] u_t^2 \right\} = \\
&= \left[\frac{\beta \delta \rho (\lambda-1)}{(1-\mu)} \right] u_t - \left[\frac{\beta^2 \delta^2 \rho^2 (\lambda-1)^2}{(1+\alpha) (1-\mu)^2} \right] u_t^2.
\end{aligned}$$

Using (8) and (9) we obtain:

$$\begin{aligned}
z_{t+1} &= \pi z_t (1 - z_t) = \\
&= (1 + \alpha) \left[\frac{\beta \delta \rho (\lambda-1)}{(1+\alpha) (1-\mu)} \right] u_t \left\{ 1 - \left[\frac{\beta \delta \rho (\lambda-1)}{(1+\alpha) (1-\mu)} \right] u_t \right\} = \\
&= \left[\frac{\beta \delta \rho (\lambda-1)}{(1-\mu)} \right] u_t - \left[\frac{\beta^2 \delta^2 \rho^2 (\lambda-1)^2}{(1+\alpha) (1-\mu)^2} \right] u_t^2.
\end{aligned}$$

Thus we have that iterating (8) is really the same as iterating (9) using (10). It is important because the dynamic properties of the logistic equation (9) have been widely analyzed (Li and Yorke (1975), May (1976)).

It is obtained that:

- (i) For parameter values $0 < \pi < 1$ all solutions will converge to $z = 0$;
- (ii) For $1 < \pi < 3,57$ there exist fixed points the number of which depends on π ;
- (iii) For $1 < \pi < 2$ all solutions monotonically increase to $z = (\pi - 1)/\pi$;
- (iv) For $2 < \pi < 3$ fluctuations will converge to $z = (\pi - 1) / \pi$;
- (v) For $3 < \pi < 4$ all solutions will continuously fluctuate;
- (vi) For $3,57 < \pi < 4$ the solution become "chaotic" which means that there exist totally aperiodic solution or periodic solutions with a very large, complicated period. This means that the path of z_t fluctuates in an apparently random fashion over time, not settling down into any regular pattern whatsoever.

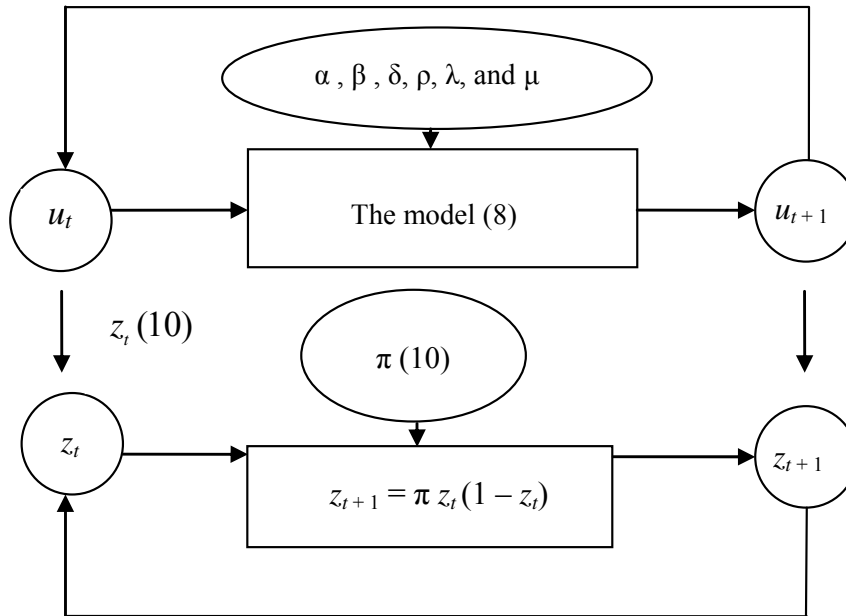


Figure 4. Two quadratic iterations running in phase are tightly coupled by the transformations indicated.

4. Empirical Evidence

The main aim of this paper is to analyze the unemployment rate growth stability in the G7 countries in the period 1990-2013, by using the presented non-linear, logistic unemployment rate growth model (11):

$$u_{t+1} = \pi u_t - \theta u_t^2 \quad (11)$$

where: u – unemployment rate, $\pi = 1 + \alpha$, $\theta = \left[\frac{\beta \delta \rho (\lambda - 1)}{(1 - \mu)} \right]$.

Firstly, data on unemployment rate are transformed (www.imf.org) from 0 to 1, according to our supposition that actual value of unemployment rate, U , is restricted by its highest value in the time-series, U^m . Further, we obtain time-series of $u = U / U^m$. The estimated results are presented in Table 1.

Table 1. The estimated model (11): G7, 1990-2013.
(R = 0.69119 Variance explained: 47.774%) (www.imf.org)

	π	θ
Estimate	1.296460	0.351578
Std.Err.	0.150934	0.182414
t(21)	8.589606	1.927359
p-level	0.00000	0.067571

5. Conclusion

The presented chaotic unemployment rate growth model (8) has to rely on specified parameters α , β , δ , ρ , λ , and μ , and initial value of unemployment rate, u_0 . But even slight deviations from the values of parameters: α , β , δ , ρ , λ , μ , and/or initial value of unemployment rate, u_0 , show the difficulty of predicting a long-term unemployment rate.

A key hypothesis of this work is based on the idea that the coefficient $\pi = 1 + \alpha$ plays a crucial role in explaining local growth stability of unemployment rate, where, α – an autonomous investment growth rate.

The estimated value of the coefficient π is 1.296460. This result confirms stable but monotonically increasing movement of unemployment rate in the G7 countries in the period 1990-2013. Decreasing budget deficits and increasing investment would generate decreasing unemployment rate in the observed countries.

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NEW ECONOMY Section

INTELLIGENT ENTERPRISES – A CAPABILITIES ORIENTED MODEL

Ioana ARMAŞ*

Abstract. *The present requests for the enterprises competitiveness and survival determine the necessity for its development as intelligent systems able to respond to the complexity of problems to be solved, and of conditions to be fulfilled imposed by the globalism and expansions of our world. To use only the IT&C solutions becomes insufficient if the enterprise, itself, has not corresponding capabilities to adapt and to evolve such that its responses (i.e., products and services) satisfy the society, markets, and to support its positive existence.*

From these point of views, in the present paper a model of the enterprise as intelligent system oriented towards its capabilities is developed.

Thus, the main behaviors in solving different problems will be considered, and the specific competitiveness problems will be identified and the context for which the intelligent enterprise concept will be defined. According to the previous results the capabilities oriented model of the intelligent enterprise will be determined by establishing the corresponding capabilities and the capabilities maps as the expression of the integrated abilities of the enterprise.

The results will be useful in building the new enterprise as an intelligent organism able to integrate the human factor in a global adaptive and intelligent context compatible to the future mutations induced by globalization.

Keywords: *intelligent enterprises, competitiveness, enterprises management, complexity, multi-agents, systems of systems, capabilities maps.*

1. Introduction

Competitiveness represents a complex request for the modern enterprises, focused both on its internal environment (i.e., functions, structure, organization, and relations) and its external context determined by competition, society, markets, collaborations etc.

Thus, the enterprises must face a multidimensional problem that must be solved beyond the algorithms and procedures, and requesting the ability to use specific knowledge, such that the final results fulfill the global target

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regarding the *enterprise's integrated quality* defined as [1] the integrated set of properties that build an observable, significant, and dominant existence of the enterprise in the external environment through its technical, economic and financial leadership abilities, and through its integration in the society, such that the enterprise's dynamics positively contributes to the external environment evolution.

To realize the above goals, specific capabilities must be implemented in the enterprise's 'organism' that defines the intelligent dimension in solving different problems.

2. Algorithms, procedures, knowledge

For any type of enterprise that acts in an operational context or working environment, a problem is defined as the transition, necessary to be determined, from a given configuration $C_i = C(t_i)$ to desired one $C_k = C(t_k > t_i)$, as in figure 1.

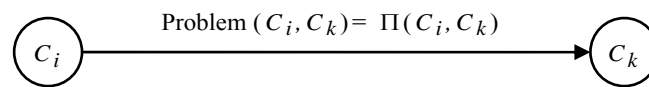


Figure 1. The general representation of enterprises' problems.

Solving a problem may be based on a succession of phases or on deductions and demonstrations acting upon information in a knowledge context. Thus, the following main types of solutions are identified:

- a. **The algorithm** defined as a finite and ordered succession of phases or steps that solve a given type of problems. The correctness of every algorithm must be mathematical or logical demonstrated, not by experience, such that when the given type of problem is presented at its detailed specifications, applying the algorithm will surely lead the solver to the correct and optimal solution. Also, it should be considered that algorithms encapsulate in an invisible manner knowledge, such that the operators that apply it, must not detain expert knowledge in the problem field.
- b. **The procedure** represents also a finite and ordered succession of steps that solves a given type of problems, but that is not abstractedly demonstrated to be correct, and is adopted and modified according to the experience. In applying a procedure, specific knowledge may be necessary at different levels. Using a

procedure does not warrant that the solution is a correct or an optimal one, such that, with every experience, procedures evolve and are continuously modified in order to obtain better solutions. Thus, the procedures represent heuristics, which encapsulate previous experience in the field.

An enterprise uses a large spectrum of procedures, from production, finance, quality management to relations with clients, and internal relations between the members of the organization.

- c. ***The reasoning based on knowledge*** solves complex problems that cannot be included in any crisp type regarding the specifications of the initial and final configurations, C_i and C_k . In establishing the solution for the problem $\Pi(C_i, C_k)$ knowledge of an expert in the field is necessary, and thinking processes must be deployed without having warranty that a solution exists or will be found. Almost all management problems in an enterprise are of this type, and this is why management solutions use not only given information, experience and knowledge, but also other human abilities as intuition, prediction etc.

Considering the above discussed tools, it becomes necessary to determine the main classes of problems that may be encountered by an enterprise.

Algorithms, procedures, and knowledge represent the main methods in solving the problems of an enterprise and in creating its behavior. The first two approaches are presently widely used, but the conditions for further developments request to create the abilities to use also the knowledge – based approach, respectively the reasoning capabilities of the enterprise.

3. The competitiveness induced problems for an enterprise

Competitiveness is the main goal of any enterprise, characterized by dimensional and structural complexities of the corresponding problems that determine the insufficiency of algorithms and procedures in attaining the attached objectives.

Considering the competitiveness dimensions regarding the internal and external environments [1] the following categories of problems may be identified and specified for the enterprise as an intelligent system [2, 3] according to figure 1 as in table 1, were: the problem $\Pi(C_i, C_k)$ has as

configuration components: C_i – the configuration of the enterprise at t_i for the internal and external environments, C_k – the desired configuration for the enterprise at t_k according to its competitiveness requests for the internal and external environments.

Table 1. Definitions and specifications of the main problems of the enterprise's competitiveness

1. THE CONTROL PROBLEM	
Definition	Considering the enterprise's configuration at any moment, t , a desired behavior is the goal to be attained.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise, represented at its level; • $C_k = C_{fM}(t)$ – the desired configuration for the enterprise, according to the competitiveness model.
Goal description	<p>If the following situation appears: $C_f(t) \xrightarrow{-} \otimes \xleftarrow{+} C_{fM}(t) > D$, where D is the accepted deviation from the target configuration, and $\xrightarrow{-} \otimes \xleftarrow{+}$ represents the evaluation and comparison operation developed as a process at the enterprise's internal level, then the goal is the realization of the relation $C_f(t) \xrightarrow{-} \otimes \xleftarrow{+} C_{fM}(t) \leq D$.</p>
2. THE CLASSIFICATION PROBLEM	
Definition	The assignation of the current configuration of the enterprise, or of its components, to a class, the set of classes being already established.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise; • $C_k = (C_f(t) \in S_i \mid S = \{S_1, \dots, S_i, \dots, S_n\})$ – the assignation of the enterprise's configuration to a specific class from a previously established set of classes.
Goal description	<p>For a current configuration of the enterprise, $C_f(t)$, considering a previously established set of classes $s = \{S_1, \dots, S_i, \dots, S_n\}$, based upon the knowledge at the enterprise's level, the following assignation is determined:</p> $\left. \begin{array}{l} s = \{S_1, \dots, S_i, \dots, S_n\} \\ C_f(t) \end{array} \right\} \rightarrow C_f(t) \in S_i.$

3. THE DIAGNOSIS PROBLEM	
Definition	The causes' identification for a configuration of the enterprise, representing a deviation from the normal or accepted states, according to the competitiveness model.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – an abnormal / unaccepted configuration of the enterprise; • C_k – causes of $C_f(t)$ as abnormal / unaccepted state.
Goal description	Considering the desired or normal configuration of the enterprise at moment t , as $C_{fN}(t)$, according to the competitiveness model, and N the accepted deviation from this state, if the current configuration $C_f(t)$ represents an abnormality, such that $ C_f(t) \xrightarrow{-} \otimes \xleftarrow{+} C_{fM}(t) > N$, then the corresponding causes will be determined as $\text{CAUSES}[C_f(t) \xrightarrow{-} \otimes \xleftarrow{+} C_{fM}(t) > N]$.
4. THE RECONFIGURATION / REORGANIZATION PROBLEM	
Definition	The identification and implementation of a new configuration of the enterprise compatible to the objective or normality, respectively to the desired or normal behavior of the enterprise.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise, that doesn't correspond to the desired / normal state or behavior; • $C_k = C_{f_1}(t_1), t_1 > t$ – the new configuration of the enterprise, compatible to the desired / normal state or behavior.
Goal description	Let $C_f(t)$ be the current configuration of the enterprise, and $C_{fQ}(t)$ its normal or desired configuration according to the competitiveness model, such that $ C_f(t) \xrightarrow{-} \otimes \xleftarrow{+} C_{fQ}(t) > W$, where W is the accepted deviation, then the objective is to determine and implement a new configuration, $C_{f_1}(t_1), t_1 > t$, compatible with normality or competitiveness targets, such that $C_{f_1}(t_1) \overset{\varepsilon}{\approx} C_{fQ}(t_1), t_1 > t$, where $\varepsilon > 0, \varepsilon \rightarrow 0$ is the compatibility degree.
5. THE DECISION PROBLEM	
Definition	For a given configuration of the enterprise, a solution is determined according to the specific models, in order to attain the set of established competitiveness goals.

Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise; • $C_k = C_{f_1}(t_1), t_1 > t$ – the configuration representing the solution for the set of established goals.
Goal description	Let be a set of objectives described by specific parameters, P , and the relation between these, $Q:(P,Q)$, and $C_f(t)$ the current configuration of the enterprise, then based on the specific models, M , the corresponding solution, S , actions, A , and resources, R will be determined in order to attain in a new configuration $C_{f_1}(t_1), t_1 > t$ the objectives (P,Q) .
6. THE PLANNING PROBLEM	
Definition	For a desired configuration, considering the current configuration of the enterprise, the necessary succession of pre-established actions is determined.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise; • $C_k = C_{f_1}(t_1), t_1 > t$ – the future desired/established configuration.
Goal description	Let $C_f(t)$ and $C_{f_1}(t_1), t_1 > t$ be the current and respectively, desired configurations, and A the set of necessary actions, then the succession graph of the actions of A and the corresponding intermediary configurations are determined such that the desired configuration to be attained from the current one.
7. THE PREDICTION PROBLEM	
Definition	The identification of a future configuration of the enterprise considering the current state and the environmental solutions.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise; • $C_k = C_{f_1}(t_1), t_1 > t$ – the future configuration of the enterprise determined by internal and external evolutions.
Goal description	Let $C_f(t)$ be a current configuration of the enterprise, M the competitiveness model, and I information regarding the internal and external environments, then the future configuration of the enterprise, $C_{f_1}(t_1), t_1 > t$, will be determined.
8. THE SUPERVISING PROBLEM	
Definition	The configurations of the enterprise will be determined at different moments in a time interval, corresponding to the competitiveness model and the information regarding the internal and external environments.
Configurations	<ul style="list-style-type: none"> • $C_i = C_f(t)$ – the current configuration of the enterprise, considered as the initial one;

	<ul style="list-style-type: none"> • $C_k = C_{f_1}(t_1 > t) (I_1, M), C_{f_q}(t_q > t_{q-1}) (I_q, M), q = \overline{2, n}$ – the successive configurations of the enterprise determined based upon the corresponding information $I_q, q = \overline{1, n}$ at $t_q, q = \overline{1, n}$ moments, and the competitiveness model M.
Goal description	For a given competitiveness model M , and an initial configuration of the enterprise $C_{f(t)}$, according to the information $I_q, q = \overline{1, n}$ determined at different moments $t_q, q = \overline{1, n}, t_1 > t, t_q > t_{q-1}$, the corresponding configurations of the enterprise, $C_q, q = \overline{1, n}$, will be determined.
9. THE VERIFICATION / AUDIT PROBLEM	
Definition	For the current configuration of the enterprise is established if it satisfies the set of previous defined requirements or the set of competitiveness requests.
Configurations	<ul style="list-style-type: none"> • $C_i = C_{f(t)}$ – the current configuration of the enterprise; • $C_k = C_{f(t)} \cap \Gamma$ – the degree in which the enterprise satisfies a set of requests or conditions.
Goal description	For a current configuration of the enterprise, $C_{f(t)}$, and a set of previously specified conditions or requests, Γ , the degree in which $C_{f(t)}$ satisfies Γ , $\alpha = C_{f(t)} \cap \Gamma, \alpha \in [0, 1]$, where $\alpha = 0$ for not fulfillment of Γ , and $\alpha = 1$ for total fulfillment of Γ , will be determined.
10. THE IDENTIFICATION PROBLEM	
Definition	For a set of information regarding the enterprise or its external environment, acquired in a time interval, the corresponding model of the enterprise or of the external environment are determined.
Configurations	<ul style="list-style-type: none"> • $C_i = C_{f(t)} = \{I(t), t \in [t_0, t_f]\}$ – the information set regarding the configuration of the enterprise, or of the external environment; • $C_k = M$ – the model of the enterprise or its external environment.
Goal description	Let be a set of information, $\{I(t), t \in [t_0, t_f]\}$, that describes the configuration of the enterprise or of its external environment, the corresponding model, M , will be determined.

4. The intelligent enterprise

According to the identified effective problems (see Table 1) the intelligent enterprise will be defined as an intelligent system (see [2]) as following:

Definition 1. The intelligent enterprise is the enterprise able to solve in a non-algorithmic manner the fundamental effective problems in various combinations, such that:

- acquires information by communication and evaluations from its internal and external environments;
- processes the information based on knowledge, experience, and models, and thus, constructs representations of the competitiveness environment;
- identifies the effective problems to be solved in order to attain its goals, and finds the corresponding solutions based upon reasoning;
- implements the establishes actions in order to attain its goals and develops the desired evolution in the multidimensional competitiveness environment.

In these conditions, an intelligent enterprise is an intelligent agent, due to its action possibilities, such that autonomy in the competitiveness environment is a main characteristic in the evolution of the enterprise accordingly to its solutions in reacting to the specific phenomena and events, and in considering a proactive behavior.

The interconnections between intelligent enterprises in following a common goal determine structures as:

- a. *intelligent systems of systems* in which individual intelligent enterprises functionally cooperate in solving the corresponding problems according to an organizational structure and an accepted protocol, but preserving its individuality and autonomy;
- b. *intelligent multiagents* as open structures in which many intelligent enterprises interact by cooperation and/or competition, according to an agreed protocol, related to a common competitiveness environment in attaining a global target or goal, but maintaining their individual goals and targets.

5. The capabilities oriented model of the intelligent enterprise. Capabilities maps

In order to develop the abilities for solving different types of effective problems as combinations of the fundamental effective problems

determined in Table 1, the intelligent enterprise must have corresponding capabilities that will determine its functions and organizational structure. Considering the analogy with the intelligent systems design (see [2]) the main capabilities of the intelligent enterprises will be identified as in Table 2.

Table 2. The main capabilities of the intelligent enterprise

Capability	Description
<i>Lg</i>	Use and understanding of multiple languages with different levels of complexity (i.e., from formal to natural languages)
<i>Inf</i>	The recognition, understanding, and representation of data and information from the competitiveness environment (i.e., internal and external environment of the enterprise).
<i>Com</i>	Communication with and within the competitiveness environment.
<i>Rn</i>	Reasoning developments regarding different problems specific to the competitiveness environment.
<i>Ln</i>	Learning from experience, interactions with other agents etc.
<i>Ctr</i>	Control at its internal and external levels.
<i>Krm</i>	Knowledge representation and management.
<i>Mem</i>	Internal memory development and use.
<i>Adf</i>	Adaptation and flexibility in the competitiveness environment.
<i>Evl</i>	Evolution in the competitiveness environment.
<i>Itr</i>	Internal representations of the interactions with the external environment.
<i>Rct</i>	Reactivity
<i>Pct</i>	Proactivity
<i>Act</i>	Action
<i>Cwo</i>	Co-working with the human factor and other entities from the competitiveness environment.
<i>Itg</i>	Integration of the human factor, technical resources and other agents.
<i>Cin</i>	Compatible interfacing with the external environment, such that a specific image of the enterprise is created, that can be considered as the enterprise's avatar in the competitiveness environment, and interfacing with the human factor.
<i>Tem</i>	Temporal estimations.
<i>Rst</i>	Response to stress and risk management.
<i>Prs</i>	Processing resources, abilities, and other resources.
<i>Ikw</i>	Internal knowledge about the enterprise, its structure, goals, and specific processes.

Thus, a capability map of the intelligent enterprise can be developed related to its main dimensions: P – the problem or goal environment; H – the integration of the human factor and of other specific internal agents; E – the external context of the competitiveness environment. In these conditions, the capabilities map will be developed as in figure 2, where an identification of capabilities for a planning problem is presented. Also, in Table 3 the corresponding specifications are developed.

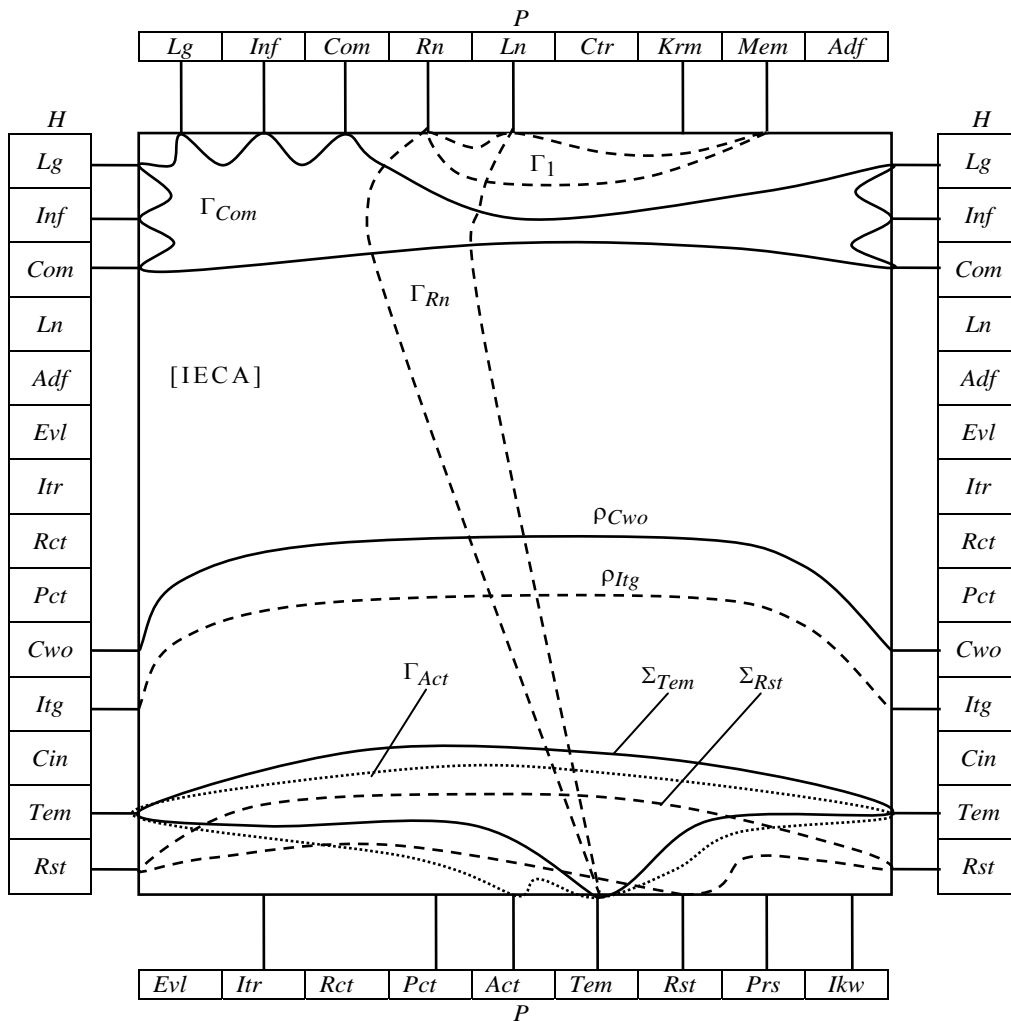


Figure 2. The capability map of the intelligent enterprise. The capability map for a planning problem [IECA] – Intelligent Enterprise’s Capability Area.

Table 3. Specifications for the elements of the capability map from figure 2.

Element	Capability	Dimensions	Specification
Γ_{Com}	Communication area	$P - H - E$	Communication context realization.
Γ_1, Γ_{Rn}	Planning areas	P	Reasoning for planning and corresponding temporal estimations.
ρ_{Cwo}	Co-working	$H - E$	Co-working between the human factor and the external context, that can introduce supplementary conditions.
ρ_{Itg}	Decisional integration	$H - E$	Integration of the human factor and the external context at the level of final decision.
Σ_{Tem}	Temporal estimations	$P - H - E$	Temporal estimations of the interactions with the problem environment, the human factor, and the external context.
Γ_{Act}	Temporal action area	$P - H - E$	Temporal estimations of the enterprise's actions considering P, H, E dimensions.
Σ_{Rst}	Risk management	$P - H - E$	Risk management in planning, by considering the specific aspects at P, H, E levels.
Itr	Internal representations	P	Internal representations of the interactions with the external environment
Ikw	Internal knowledge	P	Internal knowledge regarding the enterprise.
Pct	Proactivity	P	Proactivity in planning.
Prs	Resources	P	Resources for planning problem solution, processing and implementation.
Krm	Knowledge	P	Knowledge representation and management for planning.

In the development of the capability map, the following interconnections between the capabilities are considered:

- μ_i – open curves connecting different capabilities of the intelligent enterprise;
- ρ_i – open curves between different dimensions considering a common capability;
- Σ_i – closed curves between the same capabilities considered for different dimensions;
- Γ_i – areas that connect different capabilities at the same dimension, or from different dimensions.

6. Conclusions

The complexity and dynamics of the competitiveness environment determine a new frame of requirements for the enterprise's ability to solve problems, to implement solutions in order to survive and evolve in a global context.

The present paper proposes the model of the intelligent enterprise in order to attain these goals and for this context develops a capability oriented model for intelligent enterprises.

From this point of view, the fundamental effective problems determined by the competitiveness environment, are defined, and the corresponding solving approaches are discussed, highlighting the necessity to implement and develop the intelligent dimension of the enterprise.

Thus, the intelligent enterprise is defined, and accordingly the intelligent systems of systems and intelligent multiagents are considered as interconnecting structures of intelligent enterprises.

In this context, the capabilities of the intelligent enterprise are identified and the capability map for the intelligent enterprise design is developed as a management tool in creating the new generation of economic systems – the intelligent organizations.

Thus, the results of the research are oriented towards the construction of a global economic environment in which enterprises are intelligent organisms able to respond and to act proactively, in which the human factor will be integrated at its highly level of abilities, such that the new intelligent enterprises will have corresponding capabilities to be social integrated in the globalized world.

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MANAGEMENT STATISTICS USING DATABASES

Raul ȘERBAN*

***Abstract.** In our days, open and low-cost access to appropriate, timely and reliable information and statistics on emerging economies and international financial flows is of heightened importance to policy makers, investors and civil society. Therefore this paper will present the possibility to use a management system with interconnected databases.*

***Keywords:** system, database, statistic database, information fluxes.*

1. Introduction

The concept of the statistics has evolved over a period of time comprising many different facets of the organizational function. Statistics is a necessity of all the organizations. The initial concept of statistics was to process data from the organization and to present it in the form of reports at regular intervals.

In other words statistic means things like designing new products, streamlining a production process or evaluating current vs. prospective customers, today's business managers face greater complexities than ever before. Running a shop on instinct no longer suffices. Statistics provide managers with more confidence in dealing with uncertainty in spite of the flood of available data, enabling managers to more quickly make smarter decisions and provide more stable leadership to staff relying on them.

Management based on statistics in an organisation comprises the following processes:

- a) Initiation of actions;
- b) Ratification of initiatives;
- c) Implementation of actions;
- d) Monitoring of implementations and actions.

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These viewpoints in Management statistics using databases are:

- a) The viewpoint of quality management;
- b) The viewpoint of economics;
- c) The empirical viewpoint;
- d) The historical viewpoint;
- e) The viewpoint of statistical programmes.

In order to speak about modern statistics we must refer to a system largely capable of handling the data from collection to processing

Not many years ago, processing information and statistic of a business was performing manual and transmission was done on paper. The invention of electronic computers has led to the idea that a modern information system can only be fully mechanized and automated. This idea was quickly abandoned because not all the management and execution can be standardized, thus remains a series of activities that cannot be driven solely by computer. In this component of the system people are operating information according to their meaning. Such processed information appears on the entry and exit, where people are identified them.

The primary objective of an information system for economic analysis is provided with maximum information necessary to the management board. We can appreciate that, the computerization of information systems is in fact a process of increasing their efficiency and therefore the notice of decision.

The level of computerization of an economic analysis system depends strictly on the level of complexity for decision aggregation and potential financing in commercial enterprise. Therefore, in order to achieve a permanent system, to be compatible with all platforms on the market but with a reduced share of the level of funding – Web 2.0 technology has allowed the appearance of such systems that run in web browsers on secure systems, allowing a total compatibility between existing platforms at the moment.

This paper will try to present the model of an information system that can make an economic analysis used for generating statistics.

2. Statistical database (SDB)

A statistical database is one that provides data of a statistical nature. The term statistical database is used in two contexts:

- Pure statistical database: This type of database only stores statistical data. An example is a census database. Typically, access control for a pure SDB is straight forward: Certain users are authorized to access the entire database.
- Ordinary database with statistical access: This type of database contains individual entries; this is the type of database discussed so far in this chapter. The database supports a population of users who are allowed access to selected portions of the database using DAC, RBAC, or MAC. In addition, the database supports a set of statistical users who are only permitted statistical queries. For these latter users, aggregate statistics based on the underlying raw data are generated in response to a user query, or may be precalculated and stored as part of the database.

In order to design an SDB we can first design the structures of triggers, query, tables, forms etc.

A form trigger in SDB is a set of SQL statements which affect record insertions, updates and deletions during form completion. Before creating triggers, it is important to fully understand the use of SQL in the database system.

The database system provides for several types of triggers in the construction of forms. First, it includes built-in triggers of its own. In addition, it enables you to create your own triggers:

- Column (or Field) triggers;
- Row triggers;
- Form triggers.

It should be noted that the term form trigger is used in two senses:

- generically, to refer to all triggers activated by either exiting a form column, exiting the row or entering/exiting the form;
- and to refer to a specific type of trigger – Pre-Form and Post-Form – that takes effect when the form is entered or exited, respectively.

One example of using triggers is when we manage warehouse balances using statistics.

Warehouse balances are affected whenever there is a receipt of goods from a supplier, a transfer of items from one warehouse to another or a

shipment of goods to a customer. These three transactions are itemized in the *RECITEMS*, *TRANSITEMS* and *SHIPITEMS* forms, respectively. All three forms share the same base table: *DOCITEMS*.

Because of the similarities between these forms, a trigger in one form can easily be included in the other two. The following example makes efficient use of included triggers and included buffers.

The starting point was the *TRANSITEMS* form, as it records transactions for *both* receiving and sending warehouses (*RECITEMS* only refers to receiving warehouses, whereas *SHIPITEMS* only refers to sending warehouses). We created two buffers: one to check warehouse balances and the other to update.

The Pre-Insert trigger for *TRANSITEMS* checks the balance of the sending warehouse, designated in the upper-level form (:\$.WARHS), since goods cannot be sent out of the warehouse if their quantity exceeds the warehouse balance. It is not necessary to check the balance in the receiving warehouse (the quantity received is in no way related to the existing balance). Thus, the trigger sets the values for the variables in the *WareBal* buffer as follows and then activates that buffer:

```
SELECT :$.WARHS, :$.PROD, :$.QUANT
INTO :WARHS, :PROD, :QUANT
FROM DUMMY ;
#INCLUDE TRANSITEMS/WareBal.
```

The Pre-Delete trigger performs a similar task, checking balances in the *receiving* warehouse before allowing for record deletion. This is to ensure that the balance is large enough to cover the cancellation of the recorded receipt. The trigger is nearly identical to the Pre-Insert trigger, the only difference being the reference to: *\$.TOWARHS* rather than to: *\$.WARHS*.

The Pre-Update trigger checks balances for *both* receiving and sending warehouses.

3. Using Oracle managing optimizer statistics

In Oracle Database, optimizer statistics collection is the gathering of optimizer statistics for database objects, including fixed objects.

Because the cost-based approach relies on statistics, we must generate statistics for all tables and clusters and all indexes accessed by our SQL

statements before using the cost-based approach. If the size and data distribution of the tables change frequently, then regenerate these statistics regularly to ensure the statistics accurately represent the data in the tables.

Oracle generates statistics using the following techniques:

- Estimation based on random data sampling;
- Exact computation;
- User-defined statistics collection methods.

To perform an exact computation, Oracle databases requires enough space to perform a scan and sort of the table. If there is not enough space in memory, then temporary space might be required. For estimations, Oracle databases require enough space to perform a scan and sort of only the rows in the requested sample of the table. For indexes, computation does not take up as much time or space.

Some statistics are computed exactly, such as the number of data blocks currently containing data in a table or the depth of an index from its root block to its leaf blocks.

Oracle databases recommend setting the `ESTIMATE_PERCENT` parameter of the `DBMS_STATS` gathering procedures to `DBMS_STATS.AUTO_SAMPLE_SIZE` to maximize performance gains while achieving necessary statistical accuracy. `AUTO_SAMPLE_SIZE` lets Oracle databases determine the best sample size for good statistics.

For example, to collect table and column statistics for all tables in the OE schema with auto-sampling:

```
EXECUTE
DBMS_STATS.GATHER_SCHEMA_STATS('OE',DBMS_STATS.AUTO_
SAMPLE_SIZE);
```

To estimate statistics, Oracle selects a random sample of data. You can specify the sampling percentage and whether sampling should be based on rows or blocks. Also the documentation of Oracle databases recommends using `DBMS_STATS.AUTO_SAMPLE_SIZE` for the sampling percentage. When in doubt, choose row sampling.

- **Row sampling** reads rows without regard to their physical placement on disk. This provides the most random data for estimates, but it can result in reading more data than necessary. For example, in the worst case a row sample might select one row from each block, requiring a full scan of the table or index.

- **Block sampling** reads a random sample of blocks and uses all of the rows in those blocks for estimates. This reduces the amount of I/O activity for a given sample size, but it can reduce the randomness of the sample if rows are not randomly distributed on disk. Block sampling is not available for index statistics.

When you generate statistics for a table, column, or index, if the data dictionary already contains statistics for the object, then database updates the existing statistics. Database also invalidates any currently parsed SQL statements that access the object.

The next time such a statement executes, the optimizer automatically chooses a new execution plan based on the new statistics. Distributed statements issued on remote databases that access the analyzed objects use the new statistics the next time Oracle database parses them.

When you associate a statistics type with a column or domain index, Oracle database calls the statistics collection method in the statistics type, if you analyze the column or domain index.

4. Conclusions

Database economic statistics systems in many companies are largely in their infancy. However, with rapidly growing usage of mainframe, minicomputers and microcomputers we can expect to see considerable developments in this area in the next few years. There is a good deal to be done by many companies to improve their analytic systems. To achieve this firms need help and assistance in choosing a system which best meets their own particular need. Obtaining a system is not by itself the solution to the problem, however. Employees need to be trained both how to use the system and how to operate it.

The primary objective of this paper work has been highlighting the importance of the databases in designing an economic statistical system that can be used in any enterprises. As we mentioned in this paper, information, specifically the power of information, is the main competitive advantage of companies on the market.

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

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PERFORMANCE-BASED BUDGET AS AN ELEMENT OF NEW PUBLIC MANAGEMENT IN THE PUBLIC FINANCE SYSTEM IN POLAND

Anna ŚWIRSKA*

***Abstract.** The public sector and, especially, the system of public finance in Poland needs constant reform and improvement. Although many improvements have already been introduced, the public system is still far from perfect. The New Public Management (NPM) concept, which concerns a market orientation and a higher level of effectiveness in public administration, suggests several changes which may lead to a better usage of public resources and a better quality of public services.*

The aim of this article is to present the main aspects of performance-based budget in Poland as a tool of NPM. The performance-based budget is implemented as a facultative form of budgeting and concerns expenditures in particular. A higher effectiveness in spending public money and raising the quality of public services are its goals.

The period of time covering the implementation of a performance-based budget started in 2006 and is divided into two phases: 1 – (2006-2012) the introduction and implementation of performance budget planning, 2 – development of the role of effectiveness of the performance budget.

***Keywords:** New Public Management (NPM), public finance, budget planning, performance budget in Poland.*

1. Introduction

Nowadays, an observation of the public administration system leads to the conclusion that it is inefficient and that public resources are not issued rationally. Certainly there are many examples of such economic inefficiency in each country. Polish economy faces many symptoms of mismanagement in the public sector and unnecessary extravagance, therefore society expects a greater transparency, especially in the public financial sector.

The New Public Management (NPM) concept, which concerns a market orientation and a higher level of effectiveness in public

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administration, proposes several changes which may lead to a better usage of public resources and a better quality of public services.

Due to numerous concerns regarding the rational management of public money, the Ministry of Finance in Poland has been searching for an effective tool of budgetary expenditure management. Development challenges faced by the Polish administration are speeding up work on the implementation of performance budgeting at the state level.

The aim of the article is to present the main aspects of performance-based budget in Poland as a tool of NPM. The performance-based budget is implemented as a facultative form of budgeting and concerns expenditures in particular. A higher effectiveness in spending public money and raising the quality of public services are its goals.

The period of time covering the implementation of a performance-based budget started in 2006 and is divided into two phases: 1 – (2006-2012) the introduction and implementation of performance budget planning, 2 – development of the role of effectiveness of the performance budget.

2. New Public Management¹ – basic assumptions

Public administration today is totally different from that of several decades ago. It has changed along with the development of societies, economies and technology. Communities are more and more heterogeneous, connections and partnership between organizations are more complex, the relations between public and private sector have become more complicated, and allocation of public money more difficult.

One of the most influential factors that led to the emergence of New Public Management was the shift in state ideology. Since 1970, the change toward a neo-liberal state, which rejects the welfare state, opposes a large public sector, doubts government capacity, blames public bureaucracy, and denies in public sector superiority, caused an appearance of market competition in major Western countries (ex. US, Canada, Great Britain, New Zealand) [1].

New Public Management (NPM) is widely understood as a managerial approach to public administration. Pollitt [2] defines NPM as “a vision, an ideology, or a set of approaches and managerial techniques derived from private sector.” According to John Stewart and Kieron Walsh

¹ this term was firstly used in 1991 by Ch. Hood in his article “A Public Management for all seasons?” in *Public Administration*, t. 69 (1).

[3], the main objective of NPM is to improve the economy, efficiency, and effectiveness of the public sector and increase the service quality.

In order to achieve these goals it is necessary to:

- 1) make the public organizations aware of results achieved,
- 2) use strategic planning and management,
- 3) separate the roles of the buyer from the service provider,
- 4) form market relations and organize competition in the process of providing services,
- 5) focus on customer-oriented activities,
- 6) create more flexible conditions of employment, work, salaries,
- 7) and separate public policy from operating management (so called de-political management).

Ch. Hood [4] listed seven main elements of the New Public Management:

- 1) the introduction of professional management in the public sector,
- 2) clearly defined standards and measures of activity,
- 3) a greater emphasis on performance control,
- 4) a focus on the disaggregation of public sector units (split into smaller organizational units, grouped by type of service),
- 5) the introduction of competition into the public sector,
- 6) emphasis on the use of public sector management methods and techniques used in the private sector,
- 7) emphasis on greater discipline and efficiency in the use of resources.

H. Wollmann [5] states that the task of NPM is the abolition of a rigid Weberian approach to public administration and the implementation of management rules. This management is understood as:

- 1) managing administrative activities and monitoring and auditing them,
- 2) setting of targets and monitoring the effects of their execution (management by results),
- 3) increasing the innovation and flexibility of administrative activities by the transfer of responsibility for financial and human resources.

All in all, the authors' enumerated points as seen above show that NPM is a reorientation from public administration to a more flexible management, which concentrates on clearly defined standards and measures of public administration activity, customer orientation, strategic planning and management by results. Focus on results comes from the belief that public sector organizations do not pay attention to the quality of services. The assessment of their activities should refer to the results and

be made on the basis of clear and measurable standards and performance indicators.

Although the concept of New Public Management is widely recognized, the European Public Management concept is also distinguished in public administration science. D. Miller and W. Dunn [6] try to make comparisons and identify principles that represent both approaches. The following table summarizes these key points.

Operating principles of NPM and EPM

New Public Management	European Public Management
The government has a responsibility to 'steer' the delivery of public services in addressing public issues.	Reliability and predictability serve to eliminate arbitrariness in the delivery of public services.
The government ought to be 'community-owned' and there exists a role of empowering citizens and communities to exercise self-governance.	An organization's activity should be open and transparent, thus the organization can be open and ready for supervision and scrutiny.
The role of competition is indispensable, as through competition the best ideas and most efficient delivery of services can emerge.	Accountability should be defined as answerable for its actions to other administrative, legislative, or judicial authorities.
Governments should be driven by their missions and be judged on the results that they generate.	Output of public administration should be efficient and effective.
Citizens and consumers of public goods should be viewed as customers.	
Agencies – bureaucracies - 'earn' their allocation of resources by demonstrating the value in terms of the public good that will be generated by the 'investment' that elected officials would make in particular agency.	
An emphasis should be on preventing rather than curing public problems orientation.	
Participation of the broadest possible number of people and institutions in the decision-making process should be maximized.	
Market forces should be leveraged and market based strategies utilized in the delivery of public goods and services.	

Immediately noticeable is the far more general and broad European approach to public management, but also it passes over in silence the participatory and empowering principles of New Public Management.

Although not all of these clues for better management in the public sector can be introduced (some of them may lead to a loss from the perspective of society and its requirements because of the pursuit of tangible results in the undertaken activities), some are worth consideration.

3. Performance budgeting as an element of New Public Management

New Public Management relates to market oriented public services. It recommends creating competitive conditions for the public sector and decentralizing leadership, as well as the transfer and dissemination of rationalization mechanisms and the techniques of the private sector. So far, the broadest and deepest reforms in this regard have been introduced in the United Kingdom, New Zealand, Australia, the United States, and France. The actions undertaken relate primarily to the introduction of the devolution and marketisation of public services [7]. Among these countries, New Zealand is the state with the most flexible and market-oriented public system, including the public finance system. As recommended by the European Union, the OECD [8], and the International Monetary Fund [9], a new budgeting system is also being implemented by Central European countries.

A key element of the NPM concept is to develop a new relationship between the public authority and the citizen that should focus on satisfying citizens' needs. As a result of this approach, public service takes on a new dimension: results-oriented. Together with changes in the state-citizen relationship, NPM also raises issues related to the administration of public funds. In Poland, reforms in this area include, first of all, rational restrictions on spending public money, both state and local, as well as a change in approach to the system of economic-financial measurement. For the financial management of the state, this means ensuring a conscious decision making process connected with state expenditure as well as taking into account the degree of effectiveness and efficiency of the intended goals [10]. Such a radical change in the public sector not only includes a transformation of philosophy at the central level, and at the national, but also at the level of local administration.

In context of the Polish public finance system, NPM assumes a gradual transition from the administration of funds (the traditional model)

to an active model with clearly defined objectives for state expenditure, beneficiaries and the measurable effects of potential projects.

The traditional model (often called the administrative model) is based on a traditional budget and is considered to be inefficient in terms of the use of resources and the achievement of desired objectives, whereas an active financial management model is based on efficient information, modern methods of budgetary procedure and a strategic approach. Of particular importance in this model are: funds management, management of other current assets, projects and investments, and liquidity management. This approach is characterized in Poland by innovative methods of planning and budget construction and is called performance-based budgeting [11].

Although the idea of combining performance and resources appeared in the early 20th century, there is no standard definition of performance budgeting. A variety of terms and definitions are incorporated under the label of performance budgeting: budgeting for results, performance-based budgeting and performance funding [12]. The OECD defines performance budgeting as a form of budgeting that relates funds allocated to measurable results (OECD, 2005a) [13]. This definition was a starting point in distinguishing three phases or semi types of performance budgeting [14]:

- presentational budgeting,
- performance-informed budgeting,
- direct/formula performance budgeting.

The first two categories are the most popular types of performance budgeting in the world.

Although a new method of budget planning exists at the state level, the administrative method still dominates in most Polish local governments. It is not stated when and in what way the performance budget will be introduced on a local administration level, but some of them have implemented performance budget voluntarily. The introduction of performance budgeting may initially cause an increase in work and administrative costs caused by double planning, but in the long run, it may bring benefits in expenditure reduction and in the functioning of the entire financial management of the local government.

Performance budgeting obtains a distinctive value for Polish government in a time of obtaining European funds and their rational usage. Its construction and methodological frame allows for an increase in the efficiency of spending public money as well as an improvement in the control of fund-flows.

3.1. Methodology of Polish performance-based budget

Performance budgeting (in some sources one can find the term “task budget” instead of “performance budget,” but both are correct) appeared in Poland as an answer to the defective traditional method of budget planning. The traditional approach still existing in local units of planning a budget is based on the apex and structure of a previous budget period’s planned expenses and on the realization of the previous year’s budget (with a corrected inflation rate). The corrections on the individual disposers are made intuitively or as a result of political pressures. More importantly, the necessity of making the connection between the apex of designated financial expenditures and the realization of definite tasks and accomplished effects is not taken into account. This ensures that the traditionally planned budget concentrates first of all on the assurance of control of financial flow, but does not give information about the expenses, nor about intentional results [15].

According to E. Malinowska-Misiąg [16] performance budgeting covers:

- a) financial planning concerning a particular set of public tasks;
- b) allocating funds and establishing the indices which measure the degree of achievement of a particular public goal;
- c) compliance of expenditure limits and the degree of achievement of a particular public goal.

S. Owsiak [17] identifies a performance-based budget as a financial plan of an economic entity, in which, despite the applicable budget classification, homogeneous tasks are specified. These tasks are determined by specific goals, costs, efficiency and measures of effectiveness. Also, a particular person is assigned to realize a task and this person is responsible for the task’s fulfillment and its result.

M. Postuła (who is responsible for the implementation of performance budget in Poland and works in the Ministry of Finance) and P. Perczyński [18] in their book “*Budget Task Force in Public Administration*” (*Budżet Zadaniowy w Administracji Publicznej*) write: ‘performance-based budget is a method of public finance management in shaping a consolidated plan for public expenditures. It is prepared for more than one year, in a system of state functions and tasks for realization. Indices measuring the degree of task realization are the integral part of performance-based budget’.

According to these definitions, several features or advantages of a performance-based budget can be enumerated. The essence of this method of budget planning is to increase the efficiency of public expenditures. In terms of public finance, such a budget [19]:

- eliminates overlapping goals of departments,
- does not give the opportunity to finance goals that have already been implemented and realized,
- increases the openness and transparency of the state budget,
- helps in the control of spending money and its achieved results,
- allows for the financing of tasks in the long term,
- gives the opportunity for choice among different public objectives and allows for a selection of those that best serve economic growth,
- requires new public authorities, selected in the next election, to continue a pro-development policy,
- ensures consistency between strategic planning and operational activities undertaken,
- allows a global approach to tasks and public finance,
- allows particular ministries to conduct their own strategy of management of public resources by developing operational plans which specify tasks for realization.

The concept of performance-based budget applies mainly to the expenditure side of budgeting, which largely informs the efficiency of public funds spending. In this method, the planning of budget expenditures is arranged in reference to specific tasks, objectives and indicators. The essence of the performance-based budget is the introduction of the management of public resources through properly substantiated and hierarchical goals for achieving specific results which are measured by the established system of indices.

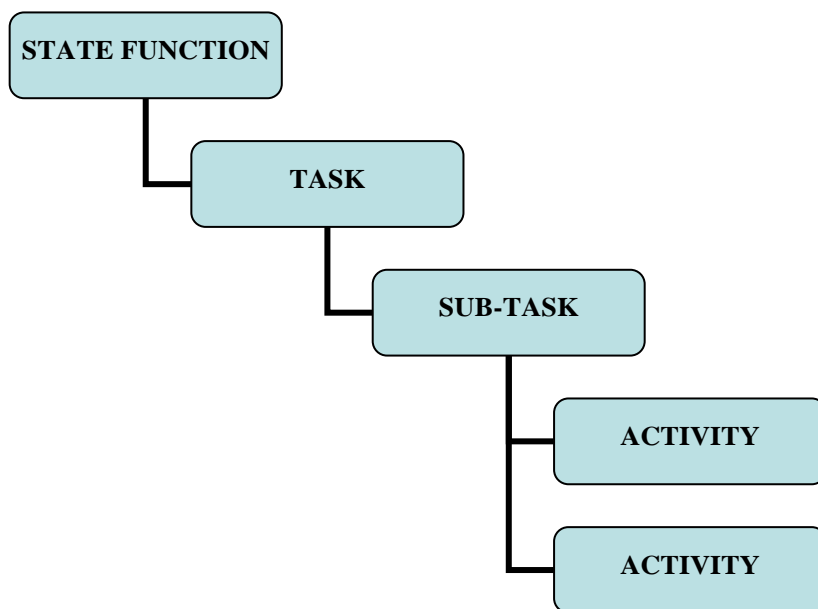
Selection of appropriate aims, as well as their proper formulation, is fundamental to an effective functioning of the performance budget. Properly chosen objectives allow for an unambiguous and transparent selection of the reasons for spending money on a given task and task-related socio-economic needs. It simplifies the assessment of the degree of implementation of a particular task. Thus, it evaluates the effectiveness and efficiency of public institutions such as local government units. During the defining of the objectives, one should have in mind [20]:

- the quality and quantity of performed tasks,
- the degree of implementation of tasks,
- the terms of feasibility,
- efficiency.

According to SMART [21], methodology and standards used in the European Union, objectives in the performance-based budget should be:

- specific – objectives should be precise and concrete enough not to be open to varying interpretations. They must be understood similarly by all.
- measurable – objectives should define a desired future state in measurable terms, so that it is possible to verify whether the objective has been achieved or not. Such objectives are either quantified or based on a combination of description and scoring scales.
- achievable – if objectives and target levels are to influence behavior, those who are responsible for them must be able to achieve them.
- realistic – objectives and target levels should be ambitious – setting an objective that only reflects the current level of achievement is not useful – but they should also be realistic so that those responsible see them as meaningful.
- time-dependent – objectives and target levels remain vague if they are not related to a fixed date or time period.

Polish performance-based budget construction is based on a four-level system and consists of the following elements (Scheme1):



Scheme 1. Elements of performance-based budget in Poland.

Each of the state functions (of which there are currently 21 in Poland) consist of a number of tasks which are divided into subtasks and are fulfilled by a particular activity.

A person (ministry) or a department that disposes a particular sum of public money for spending defines within the realized tasks:

- the objectives achieved as a result of the task,
- indices specifying the degree of achievement of the objectives,
- the planned expenditures for the financial year as well as the next two years,
- sources of planned expenditures for financing,
- subtasks within a given task,
- the individuals or the units performing the task.

A task within the performance-based budget can be understood as an activity to be performed which will result in the implementation of the strategic objectives of the state and will meet the needs of society. Obviously, the tasks placed in a performance-based budget should be consistent with system budget classification [22]. S. Heciak defines a task as the smallest, indivisible part of the budget, but general enough that the budget, which is the setting of all tasks, is readable and clear [23]. S. Owsiak [24] classifies tasks into three groups according to the following criteria:

- due to type,
- due to the recipient of the product / service,
- due to the time of realization.

In order to properly determine the degree of realization of the task and the execution of the budget, it is necessary to create appropriate measures (indices). The construction of measures adequate to the objectives is considered to be a key priority in improving the efficiency of financial management, but at the same time, it is also the most difficult. According to J. McDavid, L. Hawthorn [25], the indices used for an evaluation of the task or subtasks should measure:

- the significance of the task,
- effectiveness,
- efficiency,
- utilities,
- durability.

In copy, one can read of multiple typologies of measures applied to a performance-based budget. According to the methodology commonly used

in the European Union, the indices are divided into three groups, taking as criterion the desirability of their use [26]:

- measures of impact,
- outcome measures,
- measures of the product (result).

Indices measuring impact are considered to be the most difficult to construct. They relate to the long-term consequences of a particular task and measure change within the realization of the task. On one hand, they can measure the direct effects of the task, but these effects become apparent only after a long period of time.

Outcome measures are associated with the direct effects of the task. They measure the results achieved through the activities covered by the goal which is pursued by a relevant expenditure on the level of the tasks (ex. the ratio of the cost of implementing a system helping children and young people from underprivileged families to the number of children and young people covered by this aid).

Measures of product/result observe the specific projects within a particular task over a short period of time, or assess a service or a product manufactured by the public sector (ex. the cost of construction of 1 km of road) [27].

Regardless of the typology and classification, all measures used to assess the degree of the implementation of tasks [28]:

- should be relevant to the measures specified on other levels of the budget classification system of performance-based budget,
- should be defined in such a way to allow for the continuity of measurement in the long term,
- should measure only the scope of influence of the performer of the task/subtask,
- should be easy to monitor and verify, and should therefore have a reliable and readily available source of data.

3.2. Performance-based budget in Poland – implementation phases

Implementation of performance budgeting, as shown by international experience, is an extremely complex, multi-step process. Its final shape is determined by a number of factors – including the national inimitabilities of public finance and the social and economic conditions of the country.

Considering all aspects of Polish economy, the first stage of the implementation of performance-based budget spanned the years 2006 to 2012. What is more, this tool of modern management of public finances takes the presentational budget form of OECD typology. In following years, the presentational budget's development will be directed by performance information, which allows for the acquisition of knowledge about its effectiveness [29].

Performance budget has two functions: informational and managerial. These features are very important and distinguish performance-based budget from traditional. According to the schedule of implementation in Poland, a performance budget at present is in most cases an informative document. However, prepared according to certain principles and methods, it may be used as a tool to improve the effectiveness and efficiency of management in departments and ministries. These complementary functions of performance budget are the most important profits of the project and distinguish it from the classic style of budgeting [30].

Taking the complexity of various important factors into consideration, key components in the successful implementation of performance budgeting in Poland may be as follows:

- the legal system,
- knowledge and experience of persons responsible for finance management in departments,
- standards for defining goals and measures for particular tasks.

The performance budget has been implemented in Poland since 2006 and is recognized as one of the key projects in the Convergence Programme and in the Document of Implementation National Reform Programme during 2005-2006. This type of budgeting was also intended to be a tool to facilitate control of the deficit and debt, as well as the implementation of the Lisbon Strategy.

In the first half of 2006, Polish government took the initiative to start work on the reform of public finances and introduced modern methods of budgeting. As an effect, the first document on modern methods of budgeting in the financial public sector was published. One of the most important issues was to add some notes about performance budget planning in basic Polish strategic documents: the National Reform Programme and the National Development Strategy. Next, an attempt to introduce performance budget was undertaken in two sections – Science and Higher Education.

In successive years, the concept of performance budgeting evolved and Polish government decided to create legal frames for it. According to a

new amendment to the Public Finance Act in December of 2006, all disposers of public money are obliged to prepare their departments' expenditures in performance budget form. Thus, since 2008, almost all departments' expenditure budgets have been prepared as performance budgets, being subdivided into tasks and subtasks.

In January 2008, the Ministry of Finance prepared a schedule of implementation for a performance budget for the years 2008-2015. Below, the results of performance-based budget implementation are presented.

2008	<ul style="list-style-type: none"> - the implementing of this programme resulted in a new methodology with a functional and task-based budget; it was presented in the Regulation of the Minister of Finance, May 9, 2008, in a detailed manner, with procedure and time limits for the development of materials for a draft of the Budget Act for 2009, - detailed analysis of legal acts were conducted, - projects which allow for application for EU funds to implement the new method of budgeting was prepared, - for the first time, long-term programs in task-oriented form were presented in the Budget Act.
2009	<ul style="list-style-type: none"> - new Public Finance Act with legal frames for long-term planning was introduced, - 22 functions of the Polish state were created (instead of the previous parts in performance budget). This formed the basis for standards of defining the tasks and formulating objectives in performance budgeting, - the procedure for coordinating work on the budget was prepared and implemented, - for the first time, financial plans of selected public sector units were drawn up and presented in support of the Budget Act for 2010. - guidelines for designing the informatics system supporting performance budget were developed.
2010	<ul style="list-style-type: none"> - 1st stage of work on performance budgeting enabling monitoring of public spending concluded, - for the first time aims and measures of the state budget (a three year perspective in the system of functions, tasks and subtasks) were prepared and presented, - the concept of monitoring implementation of the performance budget in the new functional layout was developed.
2011	<ul style="list-style-type: none"> - indices and measures basis for all functions of the state was created, - the first monitoring and reporting of performance budgeting were performed.
2012	<ul style="list-style-type: none"> - first draft of the performance-based budget was drawn up, paralleled by the classical state budget for 2013, - methodology of effective public finance management was implemented at the central level, and long-term planning and a comprehensive database of measurement were implemented.

2013*	– for the year 2013, a plan to prepare guidelines for a system of evaluating performance budgeting and implementing an information system that supports performance-based budget.
2014*	– for the year 2014, a plan to prepare a report on the implementation of the state budget in the form of performance-based budget for the year 2013, placed for the first time in the Budget Act. – equally important is the development of an evaluation document, which will serve as a support tool in the development of the state budget for 2014.
2015*	– preparing an evaluation report to determine how the performance-based budget influences the public finance system.

* planned

Source: <http://budzet-zadaniowy.info/artykuly/arykul/budzet-zadaniowy-w-polsce-stan-prac>, and M. Postuła, P. Perczyński, *Budget Task Force in Public Administration (Budżet zadaniowy w administracji publicznej)*, Warszawa 2010, p. 177

The timetable for implementing performance-based budget presented above indicates that creating a Polish system of performance budgeting is a complex, tedious, and rather difficult work. The timeframe for the implementation of a performance-based budget is divided into the introduction and implementation phase (till 2013), and the development of an effective performance budget (from 2014).

The majority of the enumerated activities presented above in the implementation programme base concern the legal aspects of the public financial system. Thus, it may be assumed that the legal framework for introducing performance-based budget is extremely important to its effective implementation. Each document and report on implementing performance-based budget is available to society. In this aspect, even in the introduction phase, a performance-based budget realizes the NPM requirement for transparency and availability to citizens.

4. Conclusions

Performance-based budget is an essential tool for modern public finance management. Its advantages are emphasized in publications and reports of such institutions as the World Bank and the Organization for Economic Cooperation and Development (OECD).

As an element of New Public Management, performance budgeting allows for:

- increased efficiency and effectiveness in the public finance sector,
- increased transparency of public expenditures,

- measured effects of performed tasks and objectives,
- consequences drawn for persons who are responsible for the implementation of the objectives and tasks.

For the Polish economy, especially in time of crisis of public administration and in a loss of confidence in government, performance-based budget seems to be a necessary tool for better public management.

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RETHINKING THE STRATEGIES IN BANKING SECTOR BETWEEN NECESSITY AND OPPORTUNITY

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***Abstract.** Romanian banking sector, as the European one, has been affected by the economic instability manifested worldwide. The global imbalances have imposed changes both in the institutional architecture and in the behavior of the banks in assessing and analyzing the risks assumed. The article presents the main lines of action proposed for the stabilization and strengthening of the Romanian banking system, and also the assessment of the obtained results that, in certain circumstances, require corrective actions. The preponderance of foreign owned banks exposes the entire domestic financial system to the contagion phenomenon that sometimes generates catastrophic effects that are hard to predict and especially to manage. This justifies the increased attention from both national and European oriented institutions.*

***Keywords:** contagion effect, crisis, strategy.*

JEL Classification: E44, G01, G32.

1. Introduction

The economic and financial instabilities manifested internationally have had significant consequences for our country in terms of an increasingly open economy to external markets. The dependence of European Union, both commercial and financial had a double negative impact: on one hand it facilitated the transmission of external shocks from the foreign financial system to the local one and on the other hand it made more difficult the economic recovery, due to the decrease in demand in the European Union, Romania's main trading partner.

The magnitude of the crisis and the bank failures that occurred meanwhile demonstrated the weakness of the existing regulatory and supervisory framework, characterized by deregulation, lax capital requirements and unsustainable growth of credit. All these, required the

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need to support banks in order to maintain system stability (NBR, 2013, p. 158).

The main challenge for the authorities in the context of economic recovery is to create a legal framework and to establish new regulating rules in order to prevent and ensure a higher absorption of the economic shocks. It is also required a close cooperation between European institutions so as to ensure a uniform competition environment and a single regulatory framework based on the following principles:

- a stricter and more efficient surveillance of the persons and of the capital origin;
- the dissolution of para-banking industry and of the shadow banking activities;
- submission of new financial products to national and European authorization and supervision etc. (EESC, 2012, p. 7).

The structure of the paper seeks to carry out, in the first part, an analysis regarding the main macroeconomic indicators, to capture the magnitude of the economic crisis, while in the second part it is reviewed the Romanian banking sector with the changes that took place at its level.

2. Macroeconomic position

Romanian banking sector remains subject to the external economic pressures, which have had negative impact on financial stability. Although the local banks have not held in their portfolios toxic assets, the contagion effect has allowed for the negative consequences to spread in the Romanian banking sector as well, even if not as fast as in the rest of the European countries. At the same time the decreasing confidence in the financial system, which accompanied the economic crisis was felt in the domestic banking sector as well.

The efforts made at the European level in order to maintain stability, like the foundation of the European Banking Union and the improvement in the support programs, have contributed significantly to the restoration of confidence in the banking sector.

Regarding the internal factors that led to the restoration of investors' confidence, they had in mind, on one hand Romania's exit from the excessive deficit procedure in 2013, driven by framing the level of deficit in the Maastricht criteria (Fig. 2.1), and on the other hand the inclusion,

starting with March 2013, of the bonds issued by the state in the composition of the bond market indexes issued by emerging countries (Barclays capital and JP Morgan) who have supported the loans at much lower interest.

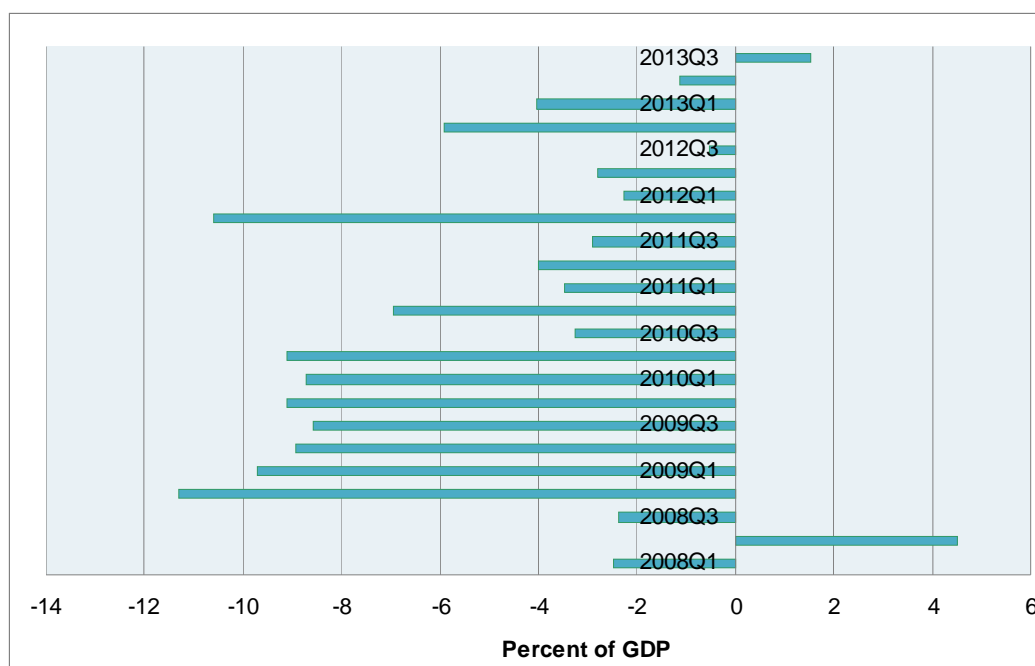


Figure 2.1. Budget deficit.

Source: Eurostat.

If prior to the year 2008 the economic growth was supported by the capital inflows, once the crisis emerged, the capital inflows have decreased drastically, leading from a rate of 17.6% of GDP net capital inflows in 2007 to a rate of -2,5% of GDP in 2009. This phenomenon accompanied by a tightening of credit conditions resulted in a 12 percent reduction in real terms of demand in 2009. The collapse of the aggregate demand has triggered a severe recession in the national economy, reflected in a significant contraction of GDP (Fig. 2.2).

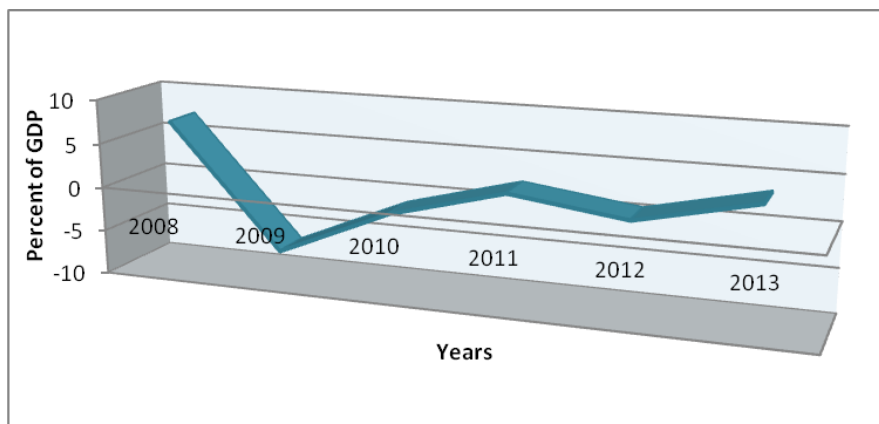


Figure 2.2. Real GDP rate.

Source: Eurostat.

The deterioration of economic condition both nationally and at the European level, have made necessary the subscription of loan agreements with International Monetary Fund, World Bank and European Commission, to support the economy to counter the negative effects of the economic crisis. The measures taken in this regard have increased Romania's public debt (Fig. 2.3), but it is still below 60%, the level set by the Maastricht criteria.

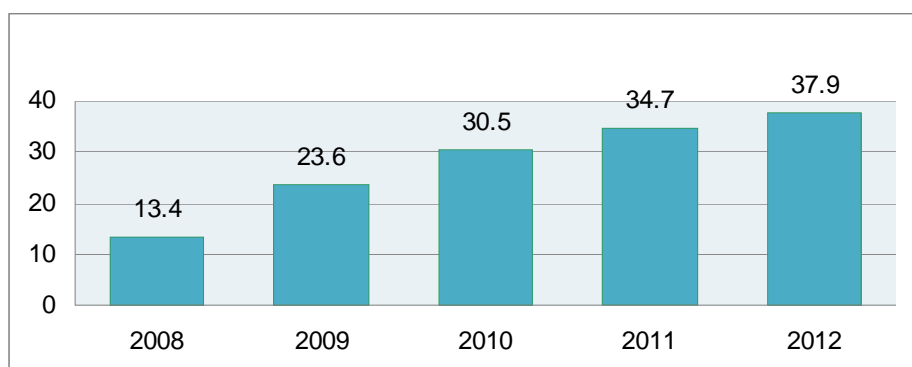


Figure 2.3. Public Debt.

Source: Eurostat

Reviving economic growth requires both, a stable and predictable fiscal, monetary and financially framework, which can provide certainty to investors and meets the needs of the real economy and of the consumers. To achieve this goal, fiscal policy should be oriented so as to support investments that generate future income, income that will help cover the

debt created during the economic recession. The priorities established at the level of monetary policy need to consider: (i) financial sector stability; (ii) restore access to credit; (iii) improving access to long-term financing (World Bank, 2013, p. 24).

3. Banking sector challenges

The economic crisis has required a thorough reconsideration of the current situation of the banking sector, considered stable and well regulated, in order to determine the origins of this major economic downturn.

If the first measures adopted have aimed the interest rates, and were adopted as emergency measures to counteract the crisis effects, on long term however, it is found that the stability of the financial system requires legislative, fiscal and prudential changes. Since 2008 the European Union has adopted more than 50 legislative measures, with different time schedules, all aiming to strengthen the financial system and to allow supervisors to intervene if any risks are detected. The new imposed regulations which require strengthening capital structure, countercyclical optional reserves, mandatory liquidity rates etc., will generate additional audit and reporting costs, actions that are expected to have an impact on banks organization and will require structural changes (EESC, 2012, pp. 4-9).

The uniform application of the regulations poses risks especially in developing countries, where the banking sector has not reached its potential level. In order to comply with the new regulations adopted and in the context of a free movement of capital, the parent institutions may request a repatriation of the capital, which will no longer be used to fund the local economy, and which may determine a reduction of the investments at the national level.

In Romania from the 41 credit institutions, 27 have foreign private capital, 2 have local private capital, 9 are branches of foreign banks, 2 are totally or partially owned by the state, and one is a cooperative organization (NBR, 2013, p. 29). The repatriation of capital, by complying with the regulations and to cope with the economic crisis have materialized in the Romanian banking sector by withdrawing 19 percent of the parent funding, between the end of 2012 and December 2013 (IMF, 2014, p. 8). In these circumstances banks have had to rely largely on local funds, ensuring a stronger dependence between household's deposits and borrowed funds was created. The dependence between lending and domestic savings, coupled with a slow recovery of the economy has created a vicious circle, whose negative effects propagate over time.

The unfavorable external context and the implications it has had on the national economy led to an increase in the non-performing loans in the economy, limiting the contribution of the financial system to economic recovery (Fig. 3.1).



Figure 3.1. The evolution of nonperforming loans and of the credit/deposits ratio (percent)

Source: National Bank of Romania.

This evolution shows that many of the strategies implemented by the banks were not viable. The lending decisions without a thorough verification of the persons who contracted the loans and the relaxation of the conditions that needed to be met in order to get the loan, turned against the banks once the crisis emerged. Many of the banking system leaders have admitted that one of the lessons learned from the economic crisis, was that during the economic booms anyone can be successful, but in recession the strategies applied make the difference. Rethinking these strategies may be the solution to overcome the problems that currently exist in this sector. Also, another lesson arising from the current economic context it is that the banks should return to their core activities, less risky and that allow them a greater control over information. The private interest of the banks has prevailed throughout the whole period of growth, the banks activities were extended more and more, in order to gain profit without taking into account the risk they run. These activities with complex products that involve high risk should be left to the investment banks who afford to take these risks.

The correction of the banks errors and the tighter correlation with the economic recovery, have required the intervention of the regulation authorities. Through its monetary policy instruments, with pronounced cyclical character, the National Bank of Romania sought to revive the lending and to support the economy. In the period 2008-2013 the interest rate was reduced by 6 percentage points, and it is estimated that it will further decrease, if the inflation keeps the downward trend. However, the results of the monetary policy measures implemented, aiming lending resumption, fail to appear. The differences between the interbank interest rates and the reference rate, the high volatility of the interbank rates make it difficult to transfer the results of the measures taken by the national authorities to the banking sector and afterwards in the real economy.

The implementation in practice of the results of the monetary policy applied by the National Bank is highly difficult also due to the way this sector is regulated. The economic crisis has shown that in some cases regulation doesn't keep up with markets innovation. Moreover, the lax regulation is considered beneficial to the economy precisely due to and in the support of the innovation potential. This obvious option for deregulation has not allowed the construction of an institutional structure of regulatory and supervisory authorities in the European Union. The competition in the banking sector has led to the development of new products and services that meet the current market demand, but the regulatory framework has not been adapted to the new market realities. At the same time, the economic development and the relative long periods of prosperity have put the development of the crisis management mechanisms on a secondary base. Thus, once the crisis emerged, many of the existing measures in this respect proved to be inadequate. The lesson that can be drawn from this is that the crisis management mechanisms must be continuously updated, so they could respond effectively to unexpected situations (Isărescu, 2009).

The way that the crisis manifested not only in the banking sector but also in the national economy shows that structural reforms are still needed in order to support a sustainable development and economic and financial recovery.

4. Conclusions

The economic crisis has demonstrated on one hand the fragility of the financial system to shocks and on the other hand the need to strengthen financial supervision architecture in order to meet the general needs of the economy.

Banking sector reform must be based on reducing the excessive risks taken by the banks, the limitation of the activities interdependence, meaning a separate conduct of less risky activities and of those involving significant risks, a greater level of competition, transparency and responsibility etc. Also, the development of the banking sector should be closely supervised and regulated.

Economic consolidation measures taken at the national level are more difficult to elaborate because it must be within the regulatory framework that exists at the European Union level in order to preserve and prevent fragmentation of the single market, on one hand, and on the other hand it must be appropriate to the specificities of the existing banking model in the national economy.

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PROMOTION OF ALCOHOL PRODUCTS

Teresa NOWOGRÓDZKA*

***Abstract.** In the elaboration an attention was paid to the promotion tools in the branch of alcohol products; the traditional forms of promotion were discussed together with its new trends more and more frequently applied. In case of described branch it is difficult to apply some forms of promotion that results from the certain bans and other legal restrictions in the adequate Legal Acts. These restrictions concern mainly the products like: alcohol, nicotine, medical drugs, gambling games and lotteries.*

Due to a wide spectrum of issues connected with the promotion of above-mentioned products the author focuses on the tools promotion permitted on the market of alcohol products. Capabilities for acquiring clients were introduced and creation of new methods of promotion in the environment of limited advertising alcohol products.

Promotion as a method of communication between enterprises and particular branches with customers is an inevitable element for functioning on a market and for competing among enterprises.

***Keywords:** promotion, tools of promotion, product placement (PP).*

1. Introduction

On the market of products and services an advert became a tool for competition among suppliers trying to expose their product and doing everything to make buyers choose their product. But a part of producers and suppliers has a limited access to customers. It results from the fact that an advert as a tool for promotion has been considerably restricted by the adequate Legal Acts. Restrictions on the advert concern the following products: alcohol, drugs prescribed by physicians, nicotine products and some gambling games as well as lotteries.

These restrictions were implemented for a public sake and health of community so nobody opposes their justification, but this ban is a considerable challenge for suppliers forced to search the alternative

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methods of access to customers to get them acquainted with a trademark and to make them buy a certain product in the spectrum of goods accessible on a market.

The enterprises offering products covered with legal restrictions on the advert established the collection of promotion methods enabling their trade marks to capture attention of customers. These methods draw an attention for a permanent creation of new competitive tools to gain customers in the environments of restricted advert.

2. Role and importance of promotion

The term promotion comes from Latin words “promotio, promovere that mean: support, leading ahead, favoring” [Witkor 2010, s. 40].

Most of promotions definitions refer to a confined vicinity mainly to business and relations among enterprises and a buyer; according to M. Rydel promotion is “information support for a firm offer” and its essence is “communication of seller with a market environment to create needs, informing a market about an offer, persuading to buy.

It is necessary to remember that not every process of communication in an enterprise is a promotion. To consider a promotion such a communication process ought to achieve purposes of a firm, to have a reflection in results and to use the certain set of tools stimulating a sale.

Promotion performs the three basic functions: informative function – because it points at the knowledge of customers about an offer of enterprise, it announces an existence of a firm or a product and about their qualities. A stimulating function – because in assumption it is expected to raise certain reactions (it has to activate a sell, its task is to supply customers with motivation clues on favor of brand a decision). And a competitive function is reflected in competing among enterprises beyond the decreasing prices as the best access to customers to give them a promotion offer (with simultaneous disruption of competitive offers) that favors a belief of customers that an offer is better than others [Altkorn 2000, s. 289]. A promotion is a dialogue between an enterprise and a customer, but it is not enough when the enterprise send communications identified by a recipient. A feedback is necessary when a customer takes an action based on a promotion offer.

2.1. The basic tools for promotion

With a use of appropriate instruments and tools an enterprise influences a market. In a framework of each of them there are various forms of promotion activities for firms. It is necessary to emphasize that amounts and kinds of these forms are modified together with a development of new media.

Based on the accessible sources it is possible to distinguish five tools for promotion: advert, public relations, personal sell, promotion of sell, direct marketing.

The most frequently quoted definition of advert in the literature of this topic is adopted by American Marketing Association (AMA) “any paid form of impersonal introduction and support of goods, services or idea by a certain sender” [Rydel 1998, s. 87].

Referring to the above mentioned communication between a market and an enterprise it is possible to point at another definition of advert: it is a basic form of communication of a firm with a market. It is designated for passing market information connected with a product of firm as well as shaping needs of customers and coordinating a demand.

Advert messages can be divided to traditional (television, radio, press, external and advert in a cinema and video) and modern assets that resulted from the civilization development (Internet, digital communication, patronage / sponsoring regarded by some authors as a separate kind of promotion, product placement, ambient – media and Point of Sale – POS) [Strużycki 2007, s.104-129].

All the above mentioned forms of promoting alcohol products are applied to various extents but – according to the author – due to a unique character of concept it is worth paying an attention for two of them: Product Placement (PP) and Ambient Media.

Product placement occurs as usual in show of trade marks or products in intervals of movies when a hero of movie uses products of firms and presents by the way trade marks during the plot. Actors use trade marks beyond the stage and talk about products.

An excess of advert in the modern media and environment got customers tired with adverts and they partially become resistant against when ignoring or just avoiding adverts. It resulted with a new trend of

advertising – an advert should not be recognized as what it is. An example of fitting the requirements of market is just PP that has changed its meaning within the recent years. Recently it has been perceived as a manipulation, dishonest advert identified with a crypto-advert; at present it gains popularity and importance due to a considerable growth of interest in such a kind of advert and its importance. A popularity of PP is influenced with its credibility, easy understanding and approval of recipients. For an advertiser it is important that he can avoid limitations connected with a time of medial emission and lack of high expenses connected with emission of spots on television. Because of presentation of a trade mark in popular movie an advertise gains a wide range of message (on a worldwide scale) that covers not only the emission of movies in cinemas but then on DVD and on TV.

A disadvantage of PP is a low frequency of advert emission because most of recipients watch them once during an emission on TV.

Ambient Media includes all kinds of advertising activity designated for the access to a selected target group of customers with a use of extraordinary and surprising carriers or events. It is a relatively new asset of passing messages (a term ambient media started functioning in the Great Britain about 1999) that strongly affects a recipient due to lack of schematic activity and an element of surprise. An advert Ambient Media occurs wherever when a potential customer does not expect it that is why it raises the interest and favors copying with a standard reaction of modern recipient avoiding reception of adverts. Relations with an environment called PR (public relations) as an element of promotion aiming at closer relation between an enterprise and a community. A policy of publicity and goodwill is used for shaping positive relations between an enterprise and an environment; a goal is achieved by frequent contacts of customers with the media [Altkorn 2000, s. 341].

The news received from the media is regarded as more credible than reports in adverts because enterprises put more and more effort in creation of positive PR among others.

A sponsoring is a tool promoting a product or a firm; institutions, persons, sport and cultural events, press publications, programs and broadcasts are sponsored. An important role is played by a prestige and importance of ventures – the more popular venture and its social

respect the more efficient sponsoring [www.esponsor.pl/run/n/Sponsoring, 18.02.2008].

Another tool use for promotion of firm is a personal sale; its characteristic quality is a direct impact on a buyer in the field of interpersonal contacts. The basic functions of personal sale rely on contacts with customers, persuading them to use services or to test a product. A personal sale has a function of informing in detail the customers about products and services, range of use and ways of application. A personal sale may favor a creation of friendly (amicable) image of enterprises, good atmosphere and it is a reason for which a customer wants to return to a place of purchase he likes.

Promotion of sale the other way is also called an additional promotion – it constitutes of tools aiming at short-term and very dynamic growth of sale. It covers a set of instruments increasing the attractiveness of offer due to additional psychological and economical stimuli. The tools for promotion of sale are: customer promotion (its instruments are price reductions, samples of goods, coupons, refinanced offers, bonus of purchase, trade stamps, cards for customers, games and lotteries), trade promotion (discounts, products free of charge, expenses on adverts, financial support) internal promotion (system of profits, bonuses, financial incomes, trips, training), business promotion (fairs, trade shows, conferences).

Due to sale promotions it is possible to enrich a knowledge of customers about new products, growth of products sale, acquiring loyalty of customers, gaining new stands for sale, growth or maintenance of sale after a season and also a regulation of content in stores (e.g. end of season sales) [Kotler 2005, s.620].

On favor of direct marketing it is possible to reach the customer beyond sale stands; an important role is played by electronic databases with addresses of customers and demographic data favoring an identification of customers needs to give them the most suitable inquiry. An application of direct marketing is possible on account of using the proper marketing channel e.g. trade visits, postal advert and telemarketing, marketing of direct reaction (with use of radio, press and media) as well as electronic marketing.

3. Restrictions on promotions of alcohol products

Restrictions on promotion of alcohol products are in the Legal Act from 26 October 1982 on upbringing in sobriety a counteracting an alcoholism' the strict definitions about promotion are formulated there. According to this Legal Act promotion of alcohol products – it is a public tasting alcohol drinks, giving requisites connected with alcohol drinks, organizing premium sales of alcohol drinks and another forms of public encouraging purchases of alcohol products. “ an advert of alcohol drinks – it is a public spreading trade marks of alcohol drinks or graphic symbols connected with them as well as graphic symbols of entrepreneurs producing alcohol drinks not different than names and graphic symbols of alcohol drinks when they are used for popularizing trade marks of alcohol drinks. Information for business relations between entrepreneurs dealing with production, turnovers wholesale and trade of alcohol drinks is not regarded as an advert when sponsoring is a direct or indirect financing.

For popularizing, strengthening and growing a fame of name, producer or distributor, trade mark or another labeling that characterizes an entrepreneur, his activity, product or service in exchange of information about sponsoring”, “information about sponsoring is a presentation of information including a name of sponsor or his trade mark in connection of sponsoring. The Legal Act determines for instance restrictions on spreading information advertising a beer. Such information cannot be directed to teenagers or to present them. It cannot connect drinking an alcohol with driving vehicles and it excludes statements about medical, stimulatory or sedative impacts of alcohol. Drinking alcohol cannot be demonstrated as the method of solving conflicts. A permitted advert of beer must not encourage for drinking excessive amounts of alcohol and for moderation of drinking as well as for abstinence in negative manners (e.g. by making someone ridiculous). Such an advert must not reflect a high percentage of alcohol in drinks as a positive quality of given alcohol drink. Moreover, a promotion and an advert of beer must not be associated with learning, working, relax, resting, sexual attractiveness and professional or private success.

The Legal Act includes also restrictions concerning a promotion of beer. When it takes place on television, radio or a theatre it cannot last between 6 am to 8 pm. An exception is an advert emitted by organizers of

sport events in time of duration. Video cassettes, and carriers like that, press for children and teenagers, paperback/hardback of magazines and journals must not be used as carriers for an advert and promotion of beer. It is important that an advert and promotion of beer must not be conducted in a presence of youngsters. An advert on pillars, columns, billboards and other surfaces used for advertisements is permitted under condition that 20% of surface covers information about disadvantages from drinking alcohol or a prohibition on its sale for underage persons. Size, pattern, content and a method of presenting such information is determined by the minister adequate for the healthcare under legal regulations.

In order to limit abuses or dishonest promotion of alcohols the legislator prohibited advertising and promoting goods of which trade mark, graphics and wrapping are matched with alcohol drinks. Informing about any sponsoring of drinks exceeding 18 % of alcohol by producers and distributors is forbidden; in case of alcohol drinks from 8 to 18 % information about sponsoring the sport events, concerts (in the news, magazines, journals, tickets, invitations). Moreover such information must not be announced by a person or with use of a human image.

The above mentioned restrictions do not cover promotions and adverts in a wholesale, sale stands designated exclusively for alcohols, or selected stands. The restrictions do not concern alcohol drinks in places for consumption of meals.

4. Techniques applied for promotion of alcohol drinks

One of promotion forms applied on the Polish market of alcohol is edition of magazines dedicated for a certain trademark like Absolut Vodka issuing quarterly "ABSOLUT REFLECTIONS" covering information connected with the trademark and with the implemented innovations.

A placement of adverts in branch magazines designated for trade partners and customers is applied as well. Trade partners receive them in postal deliveries and customers have an access to such a kind of press in shops for alcohol sale and in the entire channel HoReCa (Hotels, Restaurants Cafeteria and other stands for consumption of meals selling high percentage alcohols). Adverts in such a kind of press do not have any legal restrictions for instance in magazines Trade or Trade News. The

magazines are dedicated exclusively to the alcohol branch but they refer to all foodstuffs.

The other forms of promotion are adverts and articles sponsored in the consumer magazines pondering alcohol topics; these are paid magazines sent to buyers. Magazines are created for connoisseurs and people connected with the alcohol branch. The most popular magazines in Poland are: "World of Alcohols" dedicated to all people interested in alcohol products and "Shake & Drink" offered to bartenders available for all customers as well.

Examples of modern promotion forms in the discussed branch are the complex virtual platforms on the Internet. Websites of alcohols are available to all adult users and the advertising content can be interpreted as trade information that contributes in a dynamic growth of interest in such media. Alcohol producers want to gain the highest amount of people visiting such websites so the on-line games, music and downloaded pictures besides of standard information about firms and trademarks are accompanied with advises on serving drinks, competitions, information on agenda of organized events and forums, photos and comments about recent events. The very well prospering virtual platforms have trademarks: Żubrówka (Bison Vodka) www.zubrowka.pl and Żołądkowa Gorzka (Bitter Vodka) www.zoladkowagorzka.com.

A part of producers interpreting restrictively the legal acts does not create such websites in Polish but their equivalents in English are easily accessible and they also attract the Polish net surfers for example the trademarks Wyborowa (www.wodka.com) Bacardi (www.bacardi.com) Absolut (www.absolut.com).

In promotions of high percentage alcohols the activities are aimed at a viral marketing. It is based on quick and large spreading of information on the Internet by its users. Information in a virtual advert is made to be attractive and sent by them to their fellows who also send their messages to another fellows etc. An effective action in a viral marketing was taken by a producer of Bols trademark. The message included an advertising contents, and information about the most modern rectification line. The other example of activities connected with a viral marketing was the action "Redmentor 2007/2008" when a trademark Johnnie Walker on demand of customers gave them a hand with organizing parties in their houses and offices. Consumers could send e-mail messages or phone calls with

information of about a planned party and a team of three persons from Johnnie Walker arrived with full service stuff; the only condition was a purchase of at least 2 bottles of Johnnie Walker. The venture as announced as a training session to not violate the legal acts restricting promotions of alcohol drinks. The website dedicated exclusively for this action was created to let the net surfers spread a link informing about this unusual venture [www.redmentor.pl, 22.07.2008].

Untypical forms of advert are actions in a “whispered marketing”. The firms specialized in such an activity have been already created; the first on the Polish market is the Streetcom. Agencies for whisper marketing employ trendsetters (a person preferring an urban lifestyle with attractive personality keen on marketing innovations with numerous social contacts is paid for promotion of given mark to friends and newly acquainted people – it comes natural without revealing tasks of whispered marketing). Ballantine and Danzka rip such an opportunity [Latacz 2008].

Groups of enthusiasts dedicated to the selected trademarks of alcohols can be found on the vast majority of social portals. When sharing a portal one can meet groups keen on Wyborowa, Bols, Bacardi, Absolut.

However the mobile advert of high percentage alcohols is not permitted it happens that it is uses as logotypes of alcohol trademarks placed on vehicles of trade representatives of alcohol producers e.g. cars with labels Sobieski belong to representatives of the firm.

Apart from the above mentioned forms of advert it is worth paying attention to actions taken in the alcohol branch in the field of public relations. One can notice lack of legal regulations restricting firmly relations of enterprises with the environment. Due to variety of actions in public relations the implementation of such forms of promotions is not easy, simultaneously the public relations are one of leading tools enabling enterprises a communication with an environment and their functioning in communities. One of examples can be organization and participation in meetings and cultural events (e.g. the Grey Goose trademark present in meetings of car customers of Porsche, the Gala of 100 Most Prominent Gentlemen hosting Stock And Wodka Żołądkowa Gorzka (Bitter vodka) took a part also in many events – for instance – during the fashion show by Natalia Jaroszewska accompanying the auction, premiere of movie Rezerwat, Final Gala of plebiscite Internetowy Samochód Roku 2007

(a trademark of car winning competition on the Internet) the Gala of Polish vodka and others) [www.polmos-lublin.pl, 05.08.2008].

The actions in public relations use also include: images of famous persons (e.g. Stock, Wódka Żołądkowa Gorzka), creative dispatch (sending interesting materials to journalists to let them write articles of texts e.g. the auction by the agency PR EURO RSCG Sensors for V&S Luksusowa Zielona Góra, press conferences or branch competitions (e.g. Polish competitions Złote Kielichy (Golden Chalice) Teraz Polska (Poland right now) or international competitions: IWSC International Wine and Spirit Competition, Superior Taste Award, Monde Selection, San Francisco World Spirit Competition.). The Polish vodkas were presented here and gained high notes in assessment.

Apart from the above mentioned actions in promotion of alcohol products it is necessary to draw an attention for public relations visible in the press as sponsored articles e. g. in Newsweek where a skewer for crumbling an ice made of gems and gold was ordered by the producer of Belvedere vodka. It was designated for preparing drinks in the most expensive clubs all over the world. The article was to emphasize the exclusive character of trademark.

In connection with bans on the advert the public relations of high percentage alcohols is very

Popular (e.g. in male magazines like CKM in foreign films broadcasted in Poland – “Clover field” in 2008 presented the Belveder vodka and “Casino Royal” in 2006 advertised Smirnov vodka; in the Polish movie Testosteron in 2007 Sobieski vodka was on the tables.

The famous and frequently used form of advert is: sport sponsoring (eg. Nemirof, Sobieski), organizing club meetings (WŻG, Bacardi, Brandy Metaxa), loyalty programs or engagement of the CSR (social responsibility of business – e.g. Wyborowa – that placed on its packages warning against drinking alcohol by pregnant women; it is necessary to emphasize that is was an action by producer of this vodka)

In a promotion of alcohol products there are also the following activities: loyalty programs on the channel off-trade (e.g. Polmos Lublin S.A), competitions linked with trainings and loyalty programs for barmen (Johnnie Walker, Ablolut, Polmos Lublin), participation in branch fairs, patronage shops (Sobieski, Chopin Luxory), advert spots emitted in places of sale (e.g. Finlandia) or consumer competitions on the channel off-trade.

Nothing but a packing is important as the carrier for information about a product (e.g. WŻG, Soplca), samples of drinks miniatures of bottles (e.g. Absolut Baileys), gadgets for purchasing (e.g. vodka-cup were enclosures to bottles of WZG, Absolut), price reduction (WŻG Polmos Lublin) or wedding promotions.

5. Conclusions

In spite of restriction the producers and distributors of alcohol products promote actively their goods. Restriction on promotions do not remove them totally and the construction of legal regulations give the entrepreneurs a possibility of various interpretations. They promote goods when avoiding conflicts with the obligatory law; the new methods of promotion are still developed.

The entrepreneurs promoting alcohol products take a risk of applying techniques that are not interpreted by everyone as legal activities.

In spite of restrictions promotion is an important tool for competition among products of restricted advert. A structure of alcohol consumption reflects an efficiency of promotion. Disproportions in restrictions on promotion covering beers (drinks with 8% alcohol and high percentage alcohols (more than 18 %) contributed in changes in the structure of alcohol consumption in Poland. The capabilities of advertising for the producers of beer made it the most frequently consumed alcohol drink. Simultaneously, difficulties in advertising high percentage alcohols contributed in diminishing an importance of vodka in the general structure of alcohol consumption in Poland. The enterprises offering product covered with the legal restriction of advert established the set of promotion methods enabling their trademarks reaching an awareness of customer.

In the branches where the basic and traditional methods of advert were limited the new techniques were generated to not collide with the legal regulations. It bears the witness on importance of promotion and the fact that the restrictions cannot get rid off.

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EUROPEAN UNION VS ECONOMIC FREEDOM UNDER THE GLOBAL CRISIS IMPACT

Romeo-Victor IONESCU*

Abstract. *The paper deals with the idea of analyzing the impact of the economic freedom on national economic development. In order to realize this, the analysis is focused on three steps. For the beginning, we determined the place of the EU28 in the global economic freedom approach using the Index of economic freedom and the comparative analysis. The second step of the analysis consists of a TwoStep cluster analysis, supported by SPSS19 software, which is realized in order to support the idea that the economic freedom, connected to the economic development, created three clusters from the Member States. The clustering criterion is BIC (Schwarz's Bayesian Criterion). Finally, the analysis is focused on a forecast of the index of economic freedom till the end of 2020, in order to observe if the disparities across the world economy. The dependent variables in this forecast are the economic freedom rates and the independent variable is time. The forecast method is ARIMA. Whole analysis process and all conclusions of the paper are supported by the latest official statistic data, pertinent tables and diagrams. The main conclusion of the paper is that the economic freedom supports the economic development. Its global trend was positive in 2013-2014. There is not global economic actor in world top 10 according index of the economic freedom. Only two Member States are ranked on the global top 10. Moreover, there are great disparities across the EU28 related to the economic freedom. As a result, the Member States can be grouped into three different clusters. Romania will have a positive trend of the economic freedom score until 2020, better than the global trend of this index. The disparities between EU Member States will not be fixed on short and medium term and the solutions seem to be found at national level.*

Keywords: *economic freedom, rule of law, government size, regulatory efficiency, open markets, economic forecasts.*

1. Introduction

A very sensitive issue for the economists is the economic freedom. There are a lot of approaches related to the indicators able to quantify this freedom and the way of using them.

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An interesting point of view has Niclas Berggren, who considers economic freedom as an intrinsic value, on one side, and as a dependent variable, on the other hand [1].

Other specialists tried to find connections between economic freedom, investment and economic growth. As a result, the economic freedom supports the FDI inflows in the host countries and the result is the economic growth. This approach is available if the host countries are characterised by appropriately skilled labor, liberalized markets and economic stability [2].

The economic freedom is opposite to socialist policies. This is why Hayek criticized socialist policies as the slippery slope that can lead to totalitarianism [3].

Other researches were focused on the idea that there is a relatively large correlation between economic freedom and both per capita income and per capita growth [4].

Goodin, Rice, Parpo, and Eriksson created the measure of discretionary time, as an estimate of how much time people have at their disposal during which they are free to choose the activities in which they participate, after taking into account the time they need to spend acquiring the necessities of life [5].

A recent paper deals with the connection between the economic freedom and globalization. The analysis takes into account the government size, using the total tax revenue and total expenditures as share of GDP, and the economic growth [6].

On the other hand, some papers analyzed the connection between more competitive markets' reforms, lower human rights violation and increase government's respect for human rights [7].

Nowadays, the importance of the economic freedom concept increased. As a result, The Heritage Foundation in Partnership with The Wall Street Journal realized and calculated the Index of Economic Freedom [8]. This index covers 186 countries in 2014. It was estimated since 1995 and is focused on the size of the economic freedom in the world. The global average economic freedom score has reached 60.3, the highest ever recorded in the 20-year history of the Index. World economic freedom has improved by 0.7 point from last year and 2.7 points from 1995.

2. Research methodology

The analysis in the paper follows at least **three steps**. First is that of determining the place of the EU28 in the global economic freedom

approach using the Index of economic freedom and the comparative analysis. This index is built on four components (see Figure 1).

According to Figure 1, there are different elements in the analysis. From the legal point of view, the property rights respecting and the decrease of the corruption are very important for the national economy.

Moreover, the taxation level and the impact of the government expenditures are able to support sustainable development.

Other important element is the effect of the economic policies' implementation, which is quantified by business, labor and monetary freedom.

Last, but not the least, the openness degree of the national economy has positive impact on international trade, investment and finances.

The second step of the analysis is the cluster analysis, which is realized in order to support the idea that the economic freedom, connected to the economic development, created three clusters from the Member States. Moreover, we can talk about a EU28 with three economic development speeds.

The analysis is supported by SPSS19 software, under TwoStep cluster analysis, where the categorical variables are the above four economic indicators and the distance measure is log-likelihood. The clustering criterion is BIC (Schwarz's Bayesian Criterion).

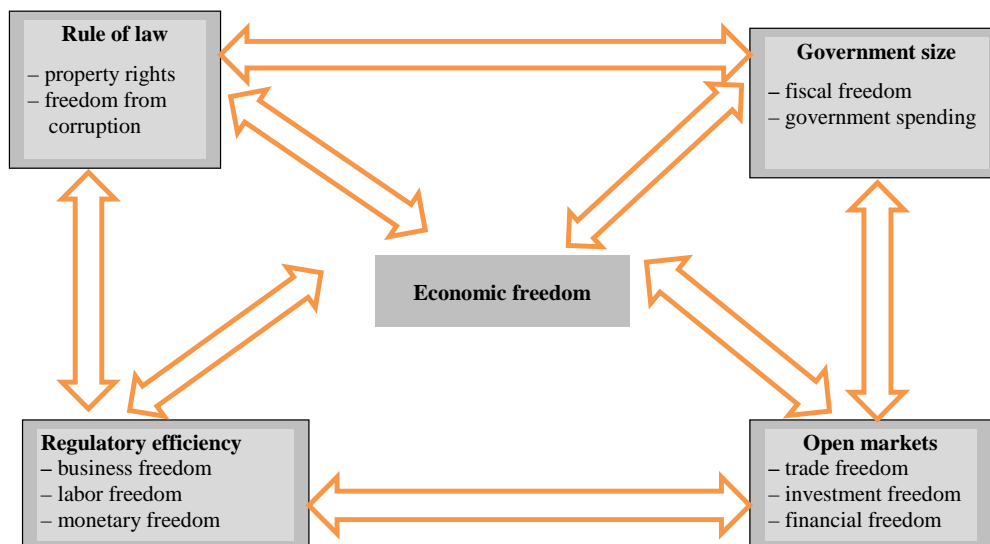


Figure 1. Index of economic freedom approach.

Source: personal contribution.

Finally, the analysis is focused on a forecast of the index of economic freedom till the end of 2020, in order to observe if the disparities across the world economy. The dependent variables in this forecast are the economic freedom rates and the independent variable is time. The forecast method is ARIMA.

3. Results

The global index of economic freedom achieved 60.3 in 2014, the highest value till now, but not all its components had positive trends. The rule of law decreased by 0.3 for each of its two components; the other three elements of the index increased. The highest increased in 2014 was achieved by investment freedom (3.3) and the lowest by fiscal freedom and financial freedom (0.1). The values of ten economic freedoms in 2014 are presented in Figure 2.

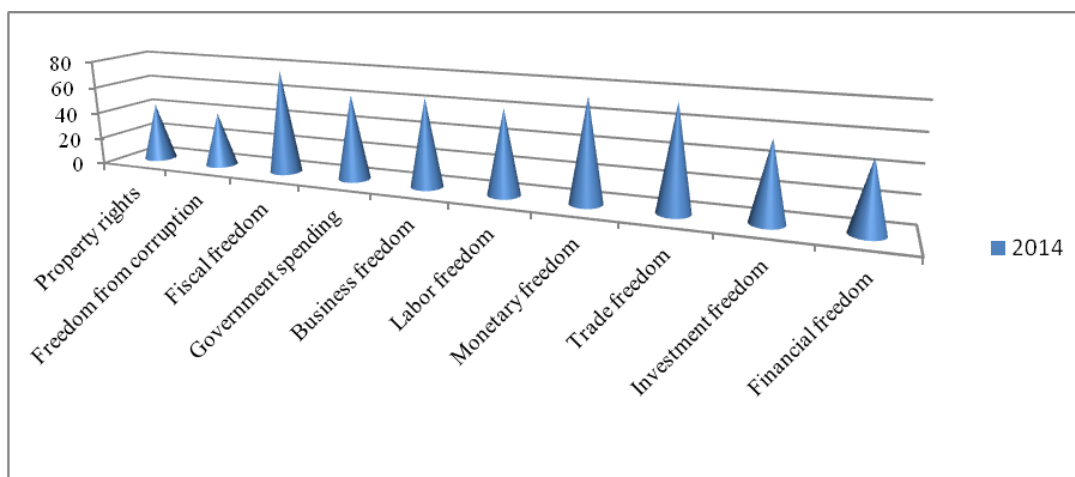


Figure 2. Index of economic freedom in 2014.

Source: personal contribution.

According to Figure 2, the most important element which supports the economic development in 2014 is the fiscal freedom (77.3). It is followed by trade freedom (74.8) and monetary freedom (74.2).

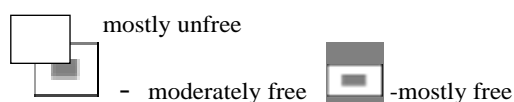
Europe achieved above or equal scores to global average for eight components of the index of freedom. The two exceptions are fiscal freedom and government spending.

There are six free national economies in 2014: Hong Kong (90.1), Singapore (89.4), Australia (82.0), Switzerland (81.6), New Zealand (81.2) and Canada (80.2).

12 EU Member States are ranked as mostly free economies, 15 as moderately free economies and one as mostly unfree economy (see Table 1).

Table 1
EU country rankings.

Rank	Country	Overall	Change
9	Ireland	76.2	0.5
10	Denmark	76.1	0.0
11	Estonia	75.9	0.6
14	UK	74.9	0.1
15	Netherlands	74.2	0.7
16	Luxembourg	74.2	0.0
18	Germany	73.4	0.6
19	Finland	73.4	-0.6
20	Sweden	73.1	0.2
21	Lithuania	73.0	0.9
24	Austria	72.4	0.6
26	Czech Republic	72.2	1.3
35	Belgium	69.9	0.7
42	Latvia	68.7	2.2
46	Cyprus	67.6	-1.4
49	Spain	67.2	-0.8
50	Poland	67.0	1.0
51	Hungary	67.0	-0.3
57	Slovakia	66.4	-2.3
58	Malta	66.4	-1.1
61	Bulgaria	65.7	0.7
62	Romania	65.5	0.4
69	Portugal	63.5	0.4
70	France	63.5	-0.6
74	Slovenia	62.7	1.0
86	Italy	60.9	0.3
87	Croatia	60.4	-0.9
119	Greece	55.7	0.3



There are only two Member State in world 10 top (Ireland and Denmark) in 2014. Moreover, three Member States achieve better ranks than the main EU economic competitors: USA (12th rank), Japan (25th rank) and China (137th rank). The problem is that these three European economies (Ireland, Denmark and Estonia) are small national economies.

In 2014, 18 Member States improved their ranks, 2 states maintained their ranks and 8 states faced to negative trends. The highest improvement was achieved by Latvia (2.2) and the lowest by Slovakia (-2.3). Greece succeeded in increasing its index of economic freedom by 0.3 in 2014.

According to Table 1, we can divide the Member States into three clusters: states with positive trend of the index of economic freedom, states with no change in economic freedom trend and states with negative trend of the index of economic freedom. In order to support this idea, we used the cluster analysis (see Figure 3).

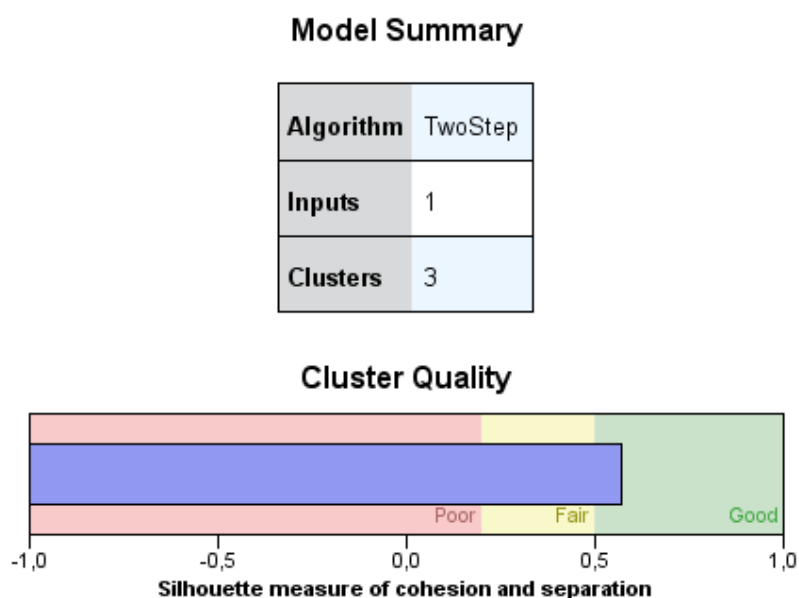


Figure 3. Cluster analysis under Index of economic freedom in 2014.

Source: personal contribution.

According to the trend of the index of economic freedom, the result of the above cluster analysis is good enough to support the idea of three clusters across the EU28.

Romania achieved a score of 65.5 and a growth of 0.4 in 2014. Its rank is supported by fiscal freedom, government spending, labor freedom, trade freedom and investment freedom (see Figure 4).

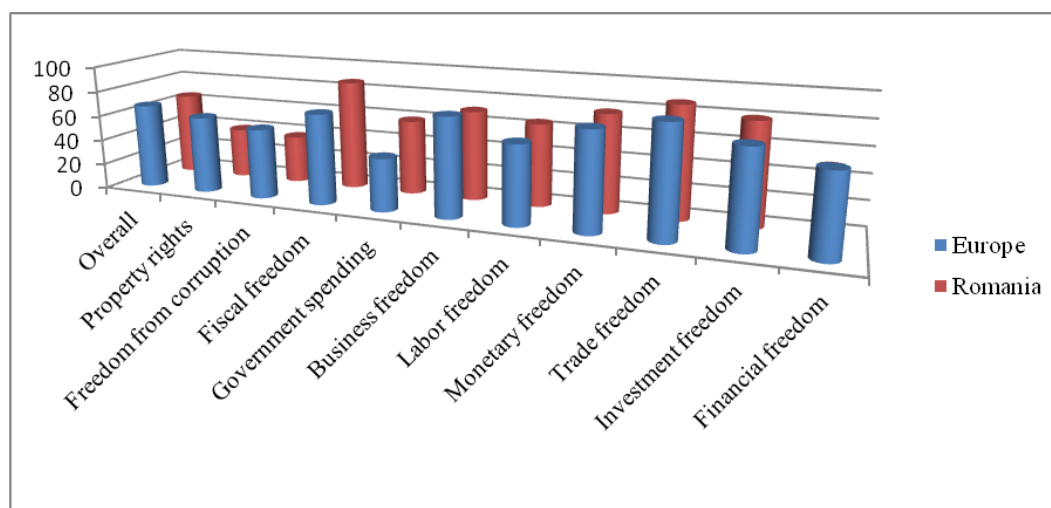


Figure 4. Components of the Index of economic freedom in Europe and Romania in 2014.

Source: personal contribution.

Worst ranks are those related to propriety rights, freedom from corruption and financial freedom.

4. Discussion

There is no-doubt that economic freedom is essential for the sustainable development in the world economy. On the other hand, different global economic crisis, as that starting in 2007, can have negative impact on the index of economic freedom trend.

This is why the next step of the present analysis is to realize a forecast of the global index of economic freedom until 2020. We used the official data for 1995 to 2014 time period as the base of this forecast [9].

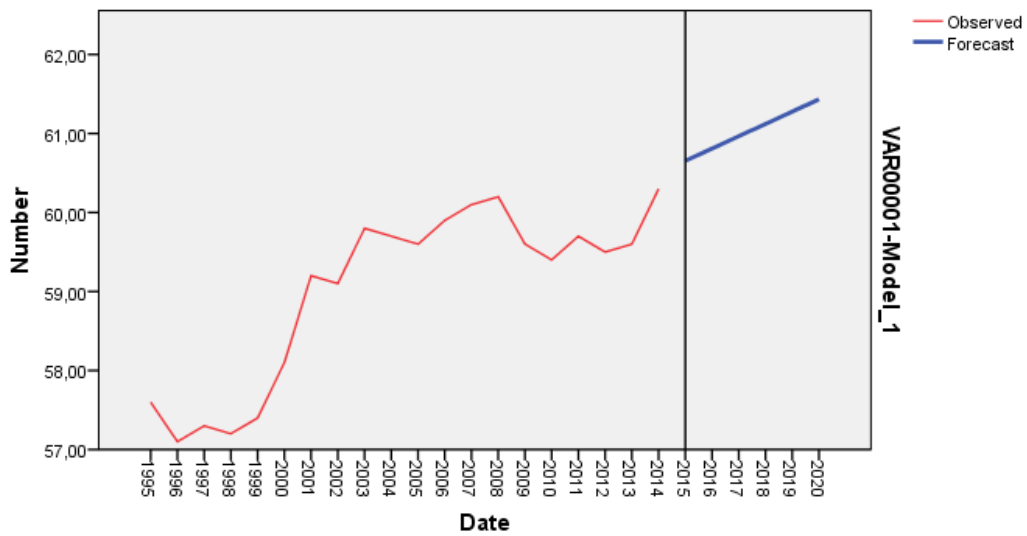


Figure 5. Global index of economic freedom forecast.

Source: personal contribution using SPSS19 software.

According to Figure 5, the economic freedom will increase slowly to 61.5 in 2020. This means an annual average increase of 0.2. Maybe the greatest problems will be in mostly unfree and repressed national economies, which represented 49.43% from the number of analyzed countries in 2014.

What about Romania? The same forecast leads to a positive conclusion (see Figure 6).

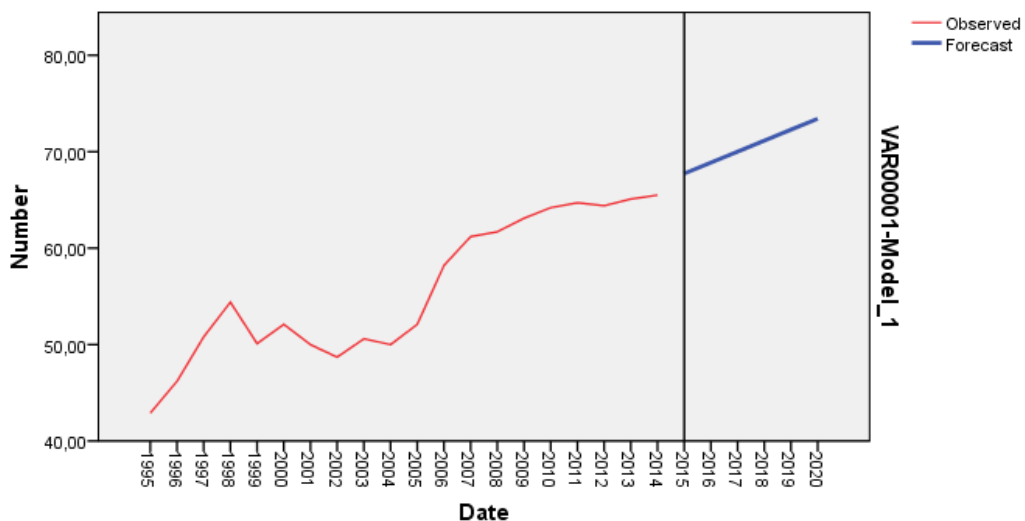


Figure 6. Romania's index of economic freedom forecast.

Source: personal contribution using SPSS19 software.

According to the above forecast, Romania will achieve an index of economic freedom of 70.4 in 2020, greater than the global one.

5. Conclusions

Economic freedom supports the economic development. Its global trend was positive in 2013-2014. There is not global economic actor in world top 10 according index of the economic freedom.

Only two Member States are ranked on the global top 10. Moreover, there are great disparities across the EU28 related to the economic freedom. As a result, the Member States can be grouped into three different clusters.

Romania will have a positive trend of the economic freedom score until 2020, better than the global trend of this index.

The disparities between EU Member States will not be fixed on short and medium term and the solutions seem to be found at national level.

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ANNEXES

1. Index of global economic freedom forecast

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Model Fit

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R-squared	,689	.	,689	,689	,689	,689	,689	,689	,689	,689	,689
RMSE	,635	.	,635	,635	,635	,635	,635	,635	,635	,635	,635
MAPE	,932	.	,932	,932	,932	,932	,932	,932	,932	,932	,932
MaxAPE	1,695	.	1,695	1,695	1,695	1,695	1,695	1,695	1,695	1,695	1,695
MAE	,550	.	,550	,550	,550	,550	,550	,550	,550	,550	,550
MaxAE	1,013	.	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013	1,013
Normalized BIC	-,608	.	-,608	-,608	-,608	-,608	-,608	-,608	-,608	-,608	-,608

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
VAR00001-Model_1	1	,689	71,354	18	,000	0

2. Romania's index of economic freedom forecast

PREDICT THRU END.

* Time Series Modeler.

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Time Series Modeler

[DataSet0]

Model Description

			Model Type
Model ID	VAR00001	Model_1	ARIMA(0,0,0)

Model Summary

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile							
					5	10	25	50	75	90	95	
Stationary R-squared	,845	.	,845	,845	,845	,845	,845	,845	,845	,845	,845	,845
R-squared	,845	.	,845	,845	,845	,845	,845	,845	,845	,845	,845	,845
RMSE	2,963	.	2,963	2,963	2,963	2,963	2,963	2,963	2,963	2,963	2,963	2,963
MAPE	4,237	.	4,237	4,237	4,237	4,237	4,237	4,237	4,237	4,237	4,237	4,237
MaxAPE	11,010	.	11,010	11,010	11,010	11,010	11,010	11,010	11,010	11,010	11,010	11,010
MAE	2,264	.	2,264	2,264	2,264	2,264	2,264	2,264	2,264	2,264	2,264	2,264
MaxAE	5,989	.	5,989	5,989	5,989	5,989	5,989	5,989	5,989	5,989	5,989	5,989
Normalized BIC	2,472	.	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472	2,472

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)			Number of Outliers
		Stationary R-squared	Statistics	DF	Sig.	
VAR00001-Model_1	1	,845	47,270	18	,000	0

LEADER – MANAGER OF A MODERN SELF-GOVERNING ORGANIZATION

Kazimierz PIOTRKOWSKI*

***Abstract.** The constant changes in many areas results in the necessity of a new approach to any organization including a self-governing organization. In today's world it is not only modern technology, funds or information that are the source of changes, but people. The issues discussed here are to do with a new attitude towards management of basic local authorities unit, which is the commune (gmina), managed by a vojt as a leader – manager. Based on the research, a set of characteristics of a leader – manager in a modern self-government organization were identified and presented. Special attention was paid to his attributes in the context of the core-activity of his work, which had a big impact on the development of the region and its community.*

***Keywords:** leader, leadership, manager, self-governing organization.*

1. Introduction

There is a lot of space in publications dedicated by authors to leaders of big firms and enterprises, but wrongly, less attention is given to self-governing leaders – who serve regional and local communities and have an impact on their development.

The biggest human capital inputs into an organization today are: passion, enthusiasm, innovation, creativity, involvement and also an ability to work as a team. Each organization has a defined capital of which, releasing and wise use on the level of a person, group of people or the whole organization is undoubtedly in the leader's hands. Present times show that each organization needs such a leader, who will be able to release the above mentioned actions and create favorable conditions for such an attitude. Organizations which need a new model of leadership are local authorities (self governing organizations), like commune (gmina), powiat (district), wojewodship (county). Creating suitable forms of cooperation and influence depends on voits (chief administrator), starosts (district governor), wojewodes (provincial governors). Effective and

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successful companies and organizations functioning in the above mentioned areas without a doubt depend on the leader – manager.

In this article the issue of leadership in the basic territorial unit lead by *voit* (chief administrator) as its leader is discussed. The author of this publication puts special attention on the essential characteristics of a local-government.

2. The essence of self-government functioning

Social-economical processes largely depend on territorial administration: regional and local. It is influenced by a range of competencies and above all by efficiency and rationality of the operations performed. Fundamental changes in the structure of local authorities took place in the nineties, which resulted in (in a way) decentralization of public authority. Decentralization was implemented by the legislation from the 8th March 1990 regarding local authorities¹ and the Legislation Act from 22 March 1990 about local organs of general government administration in the Republic of Poland² by introducing territorial level in the country – self-governing administration, having the full independency legally, financially, with their own budget and independent incomes. The next step of decentralization of the country was in 1998, when a new territorial structure was introduced by an additional administrative division on the level of *poviat* (district) and *voivodeship*³. The introduction of a three layered division in the country resulted in splitting their scope and responsibilities and performed tasks between each layer of the public government system⁴.

¹ Legislation act of 8th March 1990 o samorządzie gminnym (on self-governing communes) (original text: Dz. U. z 1990, nr. 16, poz. 95; text: Dz. U. z 1996 r, nr. 13 poz. 74; text: Dz. U. from 2001, nr. 142, poz. 1591).

² Legislation act of 22nd of March 1990 o terenowych organach rządowej administracji ogólnej (on territorial organs of general administration) (original text: Dz. U. from 1990 r., nr. 21, poz. 123; text: Dz. U. z 1998, nr. 32, poz. 176).

³ Ustawa o wprowadzeniu zasadniczego trójstopniowego podziału terytorialnego państwa (Legislation act on three layers territorial division of the government). (Dz. U. z 1998, nr. 96, poz. 603 with later changes).

⁴ Szerzej: O podziale kompetencji w ujęciu procentowym, przytaczając wyniki z Raportu MSWiA (On percentage division of competences according to the Report of MSWiA – *Polish public administration after the reform. Ustroj-kompetencje-liczby (System – Competenciese – Numbers)*, Warsaw 1999, p. 18-80, writes J. Hauser (red.), *Public administration*, Wydawnictwo Naukowe PWN, Warsaw 2005, p. 200.

In local government the basic element is still a commune, although the three layered division took place. A commune in that way became a model to establish an institutional concept of self government of poviats and voivodeships, of their apparatus, sharing tasks and internal and external legislation acts. Owing to the above fact the commune, being the basic element of local government system, did not lose anything in the process of dividing tasks between the three layers of government made after 1998 and we can say, that further decentralization did not have a negative impact on the role of commune in the system of splitting the power in the local governments. An essential element to the functioning of a society is creating a social peace which enables its efficient operation. A special importance is assigned to self governing organs, led by, among others, voivodes as leaders⁵.

Local self-government is local and regional community organization – commune (gmina), poviats (district) or self-government voivodeship. It is in a way a public legislation cooperation of a population, sharing common interests and public needs. This is self-governing decentralization. Being closer to people is the aim of those unit's functioning. Under the constitution self-governing units are allowed to perform most of the local administration tasks⁶. For the self-government to not only function effectively but also to be a foundation of local community it has to have a leader. We have to underline here, that a leader does not have to be a voivode, a starosta or a president of the voivodeship. It could be any of the self-governing organization's employees having a set of characteristics and certain attitude.

3. New leadership in public organization – local self-government

There were many honored leaders in the history of the world. Starting from ancient times, where exceptional leaders were admired, like Alexander the Great (Macedonian) right up to today's economic world, where organizations are competing for the best marketing position,

⁵ **Communal self-government** – separated from the state local community functioning within the commune (gmina), based on the legislation constituted for independent public administration and equipped in funds to allow realisation of imposed tasks.

⁶ <http://www.infor.pl/prawo/wybory/samorzadowe/203765.Organizacja-samorzadu-terytorialnego.html> (law/elections/self-government, Organisation of territorial self-government).

influences, capital and clients. Nowadays people like Lee Iacocca, Bill Gates, Steve Jobs, Max De Pree are admired for their art of leadership like in the past Napoleon Bonaparte, who fascinates historians. Who can also be recognized as a leader in today's world?

Today we call a leader, somebody exceptional who is influencing other people with his personality and his authority. A man, voluntarily followed by others is a leader – from English “*to lead*”.

According to the Encyclopedia, a leader is a member, who by dint of specific personality characteristics or his position imposes his point of view on the others, and also manages and unites the group's activity⁷.

In English literature the term “leadership” is connected with formal governing of an organization⁸.

According to R.W. Griffin *leadership is a process of using influence, without using force in order to create objectives for groups or organizations”. Positive reinforcement through motivating to actions orientated to achieving objectives and helping to identify the culture of the group or organization.*

*As a characteristic, leading is a set of attributes assigned to a person who is perceived as a leader. So leaders are people who have an influence on others without using force; leaders are accepted by others in their role*⁹. The author of that definition precisely defines the essence of an organization, paying special attention to the way a leader influences the members of an organization.

M. Armstrong, author of many publications in Human Resources Management, defines leadership in a very general way: *Leadership is achieving results through people. It is present everywhere where an objective or a task is performed and where there is more than one person needed to achieve it*¹⁰. This general approach to leadership does not expose the inspirational role of the leader in the context of influencing others and winning followers between members of an organization.

In contrast A. K. Kozminski and W. Piotrowski quoting leadership theory they emphasize the practical aspect: *The role of a leader is to set objectives, to mobilize the team to achieve them and to create*

⁷ Encyklopedia Popularna PWN, wyd. trzynaste, s. 638., [Popular Encyclopedia](#) 13th edition, p.638.

⁸ F. Fiedler, *A contingency model of leadership effectiveness*, Academic Press, New York 1964.

⁹ R. W. Griffin, *Podstawy zarządzania organizacjami (Principles of management)* PWN, Warsaw 1989, p. 491

¹⁰ M. Armstrong, *Jak być lepszym menadżerem (How to be an even better manager)*, Dom Wydawniczy ABC, Warsaw 1997, p. 225.

*organizational and material conditions for action*¹¹. According to this definition, leadership is based on setting objectives and inspiring others to realize those objectives.

An essential question arise: What is leadership? Who is a leader? What characteristics and competencies should self-government have?

We need to note, that the definition of leader as well as leadership itself is being constantly transformed along with economic development and progress in social and psychological studies, management and many other fields of science. The above mentioned definitions describe leadership in a general manner depending on the area where the definition is located. A leader managing an organization should take into account its character. The profile of an organization, its culture, mission, objectives and present situation, which are internal and external factors – should all be considered. Without a doubt the above circumstances depends on the leader's type of management and his work with people.

Leadership is influencing other peoples' behavior; it is a type of social influence. This social influence has a special meaning in the case of self-government local leaders. We talk about their authority and the power of a leader that others voluntarily give in to¹².

Leadership is inseparably connected with vision, motivation, a human need of self-improvement, facing difficult challenges together with the followers, inspiring employees to work more effectively and showing the advantages from common efforts they make. In a sense, it is giving people opportunities by creating physical and psychological conditions, to perform what the leader is requiring from them.

The term for leader and leadership is still evolving and that process will continue, until the leaders will have their followers.

That definition is also very flexible, because depending on an organization's activity; the leader matches his performance to manage the team effectively and in a way to create a new leadership definition. There is only one unchangeable element – leadership is an art of managing people, which means leading them without using physical or psychological force – that being the free will of the followers.

In front of managers of public administration there are two massive challenges. On one hand releasing the earning potential of the people in that administration, on the other hand building the loyalty of new employees, employees of the next generation.

¹¹ A.K. Koźmiński, W. Piotrowski (red.), *Zarządzanie. Teoria i praktyka (Management. Theory and Practice)*, PWN, Warsaw 2004, p. 69.

¹² <http://www.econom.pl/nauka/socjo6.php3>

The new leadership pre-conditioned by requirements and progress in the twenty first century is not a sense of power, but a conscious responsibility for the common good of human potential and their organization. In the post-industrial management model, based on teamwork, a leader above all else is the creator of the vision of the organization's development, the strategist and the mentor. Facing up to changes of the future requires the leader exposing his professionalism in his destined area. By that we mean his knowledge, skills, experience, attitude and motivation.

A leader, who has to perform in today's reality of following the international economic growth trends, should have all the competencies enabling him to perform using different management styles depending on the situation and his flexibility and openness for changes, which will allow him to quickly and effectively change the management style aimed for optimization in realizing targets.

A leader cannot wait for directions, but takes actions responsibly, chooses the path with the consciousness of the objectives. He should be obliged to act morally correct, follow the code of ethics, and at the same time assert those rules into the culture of organization existing within the local authorities, in order to fulfill the market requirements and serve the local community in the best way. The modern approach to leadership in local authorities, which should keep abreast of the times, should focus on leaders (managers) presenting a visionary belief, allowing for the right prediction of marketing tendencies, clients needs, ability to react to changes, courage, willingness to take a risk, persistence in achieving goals and a willingness for self development.

4. A modern leader – attributes and skills

During the last number of years there were some major changes in the self-governing organization's management. There were few reasons for that: an obligation for managers to be involved in the works of the departments reporting to them, the necessity of creating teams and teamwork, emphasis on increasing quality requirements of performed tasks and services and the demand for increasing professional qualifications. Presently we can note a strong trend in local authorities for implementing theories and practices used in private companies on those institution's grounds. We can say that the officials are increasingly open to modern solutions and willing to modernize local authorities' institutions. The

effectiveness of local authorities translates into societies' satisfaction and the development and increase in their standard of living.

Further to this the following questions arise: How to define the effectiveness and efficiency of a leader – manager, like *voit* (chief administrator), *starost* (district governor), mayor? According to what criteria they should be assessed? I will try to answer these questions further on. Without doubt one way of assessment, are various types of competitions, contests and scientific research. One method of realizing entrepreneurial abilities, their development and assessment is rivalry. With that kind of initiative of releasing entrepreneurship and identifying leader's abilities, as well as assessment of local government activities, but first of all their leaders – managers for the last fourteen years on a national scale is proposed by the **Institute for Private Enterprise and Democracy** affiliated by **Polish Chamber of Commerce** under “**Gmina (Commune) Fair Play**” slogan. Local authorities can compete in six categories:

- **village communes (gmina),**
- **multifunctional (urban/rural),**
- **villages and small towns,**
- **middle size towns,**
- **large towns,**
- **touristic communes.**

Assessed is the person who entered the competition voluntarily, which is: a *voit*, a mayor, a *starost*, a *voivode* or a president presenting certain achievements in the below areas¹³:

- an innovation in promoting investments
- a particular contribution in development of ethics and rules of law
- a particular contribution in developing European cooperation on the local and regional level
- an outstanding input in the creative use of human capital in local government and increasing their educational level
- other outstanding economic, social and cultural achievements within self-governing institutional framework.

This type of competition has different aspects to it not only of assessing the functions of a self-government and an institution, but most importantly reveals human's performance, their characteristics and skills (of *voit* (chief administrator), *starost* (district governor), mayor, presidents) as leaders – managers. We call a leader an outstanding person having

¹³ The rules of the competition 13th edition of „Gmina Fair Play”.

influence on other people. Traditionally, leaders are in control of everything they are responsible for. The new leaders are enabling their employees to take responsibility for their work and they provide them with necessary authority¹⁴.

A new approach to **leadership and management** was described most accurately by H. Mintzberg: *a leader cannot just like that delegate on others management tasks: instead of separating management from leadership, we should treat managers as leaders and understand leadership as a well performed management*¹⁵. In this concept the author of that work views leaders – self-government managers, in his research trying to identify their main attributes, which are inseparable from their profession.

As proven by research, leadership in self-government organizations is closely connected with performing functions like voivode, mayor etc. It needs to be underlined that territorial self-governing leaders are aware of the political character of those institutions and are able to achieve their goals in those conditions¹⁶.

What are their attributes that decide their success and help them to be nominated as the best and the most efficient in operating (managing) as leaders – self-government leaders?

On the base of analysis of laureates' of "Gmina Fair Play" reward achievements, as well as interviews with them (managers of the year) we can describe the main characteristics of a self-government leader – manager¹⁷. Professionalism of a leader – manager in a modern organization, especially in building a leadership brand, was something that was brought to attention in many international publications¹⁸.

Identifying leaders qualities – self-government manager with his profession, which had an impact on the success of an organization managed by them are presented on graphic 1.

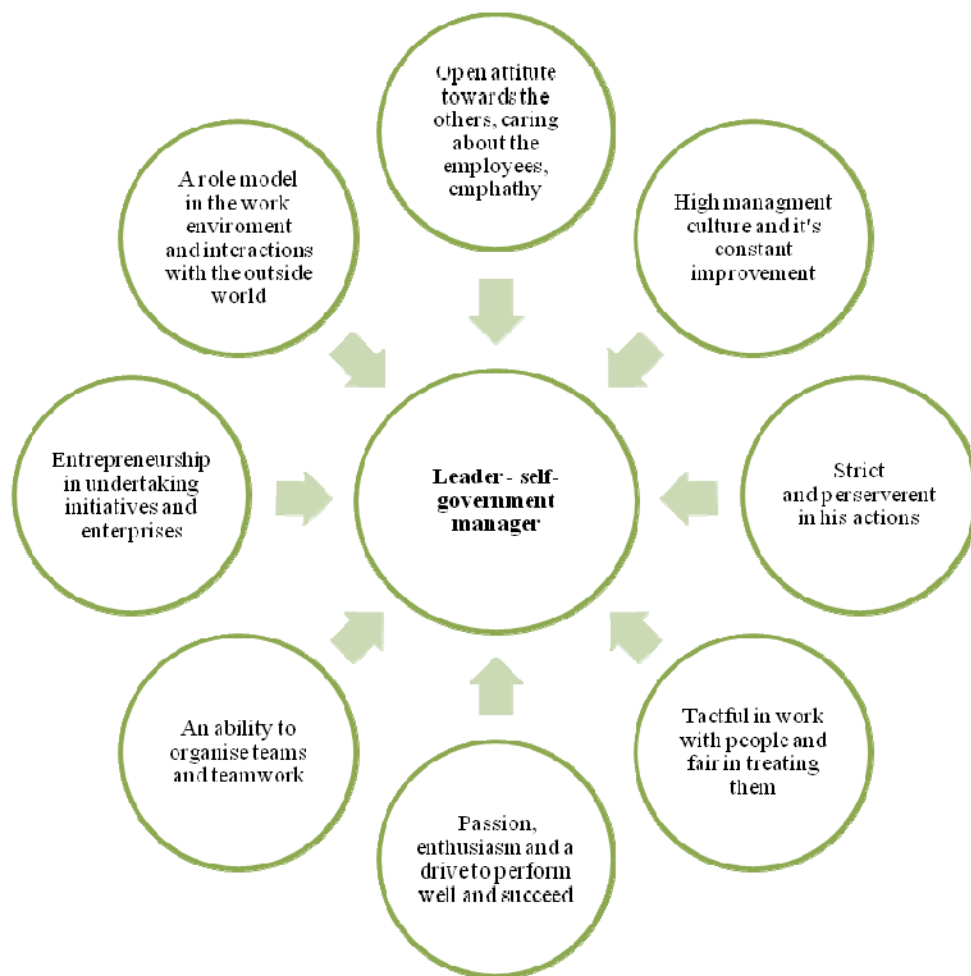
¹⁴ L. Holpp, *Jak kierować zespołami (Managing teams)*, wyd. I, Wydawnictwo RM, Warsaw 2001, p. 98.

¹⁵ H. Mintzberg, *Zarządzanie (Management)*, Oficyna a Wolters Kluwer business, Warszawa 2012, p. 26.

¹⁶ Independently from their political group or views, the local leaders are assets by communities in which they function.

¹⁷ The results, interviews with the winners of each edition of "Gmina Fair Play" presented in the local and national press.

¹⁸ Harvard Business Review Polska, *Marka przywództwa jako sposób budowania kultury liderów (Leadership trademark as a way of building a breeding ground for leaders)*, nr. 68, October 2008, artykuł nr. R0707G.



Graphic 1. Leader's characteristics – self-government manager associated with his profession.

Source: Own elaboration.

The presented leadership attributes are connected with working with people, which involves not only extraordinary inspiration of subordinates (inner environment), but also, surroundings with which self-government is collaborating, interacts and manages in the work progress. The activation of local communities by leaders – self-government managers, as one of the essential features is a subject of research of many scientists¹⁹.

¹⁹ A. Ścisło, *Aktywizacja przedsiębiorczości członków społeczności lokalnej jako strategia sukcesu jej lidera (Entrepreneurship activation within local community as a success strategy of a leader (na przykładzie (on examples of Bełchatow) [in:] Nowoczesne systemy zarządzania (Modern Management Systems), Wydział Cybernetyki, Instytut Organizacji i zarządzania (Cybernetics and Management Department), Zeszyt Naukowy (Book) nr. 8, Warsaw 2013, pp. 37-47.*

5. Conclusions

Today's reality has created new self-governing models resulting from a dynamic development of societies and businesses. That is why – self-government leaders should understand and be aware of how a modern organization should function. Their activity requires a multidimensional approach and an efficient and effective performance in those new conditions. Only leaders can face those new challenges – managers with a set of attributes, which make them work effectively. Resulting from scientific research, a list of the most important characteristics are: passion, enthusiasm, drive to perform well and succeed and an ability to organize teams and to work as a team, being a role model, being open, high management culture, being strict and perseverant, treating people fairly, and entrepreneurship in undertaking initiatives and enterprises. This new approach to leadership in self-government local organizations should not give a sense of power, but be a conscious responsibility, to serve human welfare by effective functioning of self-governing organizations, and as a result serve the welfare of the whole local community.

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- [18] <http://www.infor.pl/prawo/wyборы/samorzadowe/203765,Organizacja-samorzadu-terytorialnego.html> (law/elections/self-government, organization of territorial self-government).

COMMON MISTAKES IN COMBATING THE ECONOMIC AND FINANCIAL CRISIS

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Alexandru Cătălin POPA**

***Abstract.** It's been more than five years after the beginning of the global financial crisis and its negative effects can still be felt in the present. Almost all countries in the world have been affected by this crisis to some extent. Authorities' responses depended not only on the specific conditions of their economies, but also by the different political and economic vision of the decision makers. This paper proposes a brief analysis of the effectiveness of different types of anti-crisis measures, focusing on common mistakes made by authorities around the world.*

***Keywords:** financial crisis, monetary policies, fiscal policies, anti-crisis strategies.*

JEL codes: E44, Q54, E43.

1. Introduction

Any government is to some extent responsible for the wellbeing of its citizens and must have a proper answer to their economic problems. The crisis first appeared in the US and originated in the subprime loans granted by their commercial banks to households and secured by mortgages. Although in the beginning the government response to the financial crisis seemed a little reluctant, today we can see that it was a far more promptly than the European one. At least on paper, the US seems to have overcome the financial crisis, having more than four years in a row of solid economic growth.

The economic crisis in Europe has one part of its roots in the financial sector and another part in the fiscal policies adopted by many of the Member States prior to 2008. The European Union is basically an economic union of 28 states between which there are significant differences in key areas that relates with the crisis development. Nevertheless some of the

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Member States that were most affected by the economic crisis turned their hopes to the European institutions. The problem was that those institutions were not prepared to help and were very reluctant to do so. The truth is that this is the biggest crisis that the European Union had to face since its formal creation in 1993 by the Treaty of Maastricht. This can be an explanation for the fact that EU seems to have almost completely failed in anticipating the crisis and didn't do a very good work regarding its management.

This article is structured in five parts. After a brief introduction, chapter 1 is dedicated to a general view of how this financial and economic crisis emerged and developed in both continents, with emphasis on things that seem to have gone wrong in the results of authority's responses to the issues. The third part of the paper treats two of the European countries most affected by the financial crisis, namely Greece and Cyprus. Greece is the best example of everything that went wrong with the anti-crisis strategies. Cyprus is another EU and Euro Area country that was very affected by the financial crisis, but different from Greece in key areas that prove to count very much in the outcomes of the crisis development here. A closer look to these two countries reveals all the major things that work or didn't work in the case of Europe. Conclusions are presented in the fourth part of the paper.

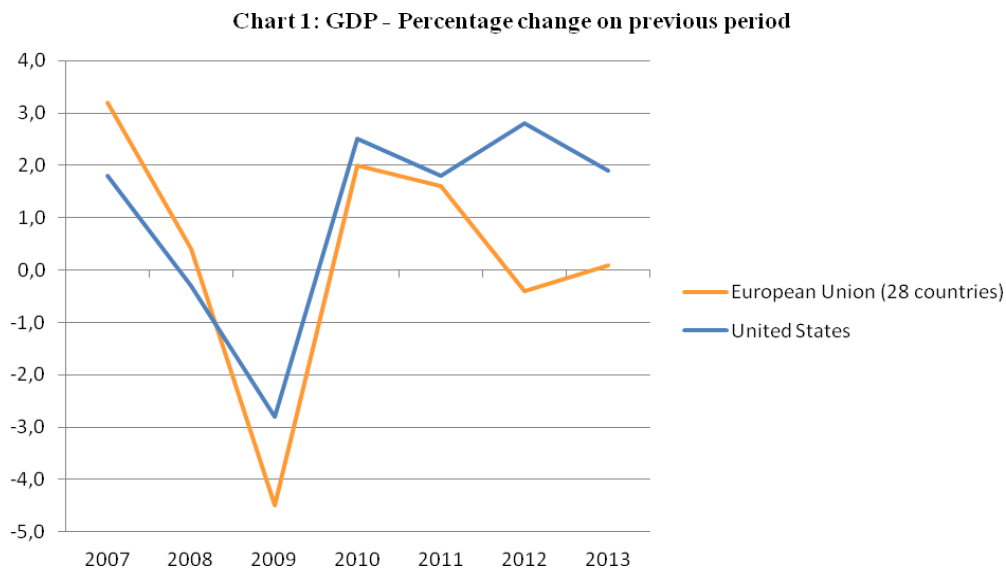
2. Handling the crisis: US vs. Europe

The subprime lending is considered by many to be the main culprit for the financial crisis. Prior to the year 2008 this happened all over the world, but especially in the United States. In simple terms, the American financial system seems to have been unable to filter the good lending clients that would pay their debts on time from the undesirable ones. The reasons for this are plenty and they relate to regulation, corporate governance and the way all the parts of the financial system are connected.

Although it the crisis begun in 2007 in the US, the bankruptcy of Lehman Brothers in the fall of 2008 is a major turning point in the development of the economies world over. The US administration at that time responded quickly and expectedly by ensuring additional financial resources in the market in a heroic attempt to compensate for the mistrust

of many in the US financial system and in the economic future of all. The efforts were not light, and the politicians had many problems convincing the taxpayers that some financial entities are simply “too big to fail”. However, now, at almost six years since after the Lehman Brothers bankruptcy, one can easily assert that the US overcome the crisis, having a steady economic growth rate of about 2.5% per year in the last four years and with a government public debt that finally seems to have stabilized at 100% GDP. The costs for this adjustment, however, were pretty high many people have lost their houses, their jobs and their trust in a better future.

In the case of European Union, things developed quite different, as EU still continues to struggle to have economic growth. The graph bellow illustrates this fact.



Source: Eurostat.

The interesting thing is that the recipe for addressing the short time problems was basically the same in the two continents. Also, it’s rather hard to say that the European problems were bigger than the US ones. It’s true that in the European Union the crisis overlapped with some serious internal problems related with fiscal policies in some states, but we must not forget that subprime lending was mostly done in the US and the European banks imported the crisis by buying toxic assets only to some

extent. In these authors opinion, the crisis development was worse in Europe than in US due to the fact that the response wasn't firm enough, especially in the beginning. It was pretty hard for the US politicians to convince their voters to spend billions of US dollars from their taxes in order to help some major banks and insurance companies, but it was even harder in the European Union to convince for example the German people to help the Greeks overcome their problems.

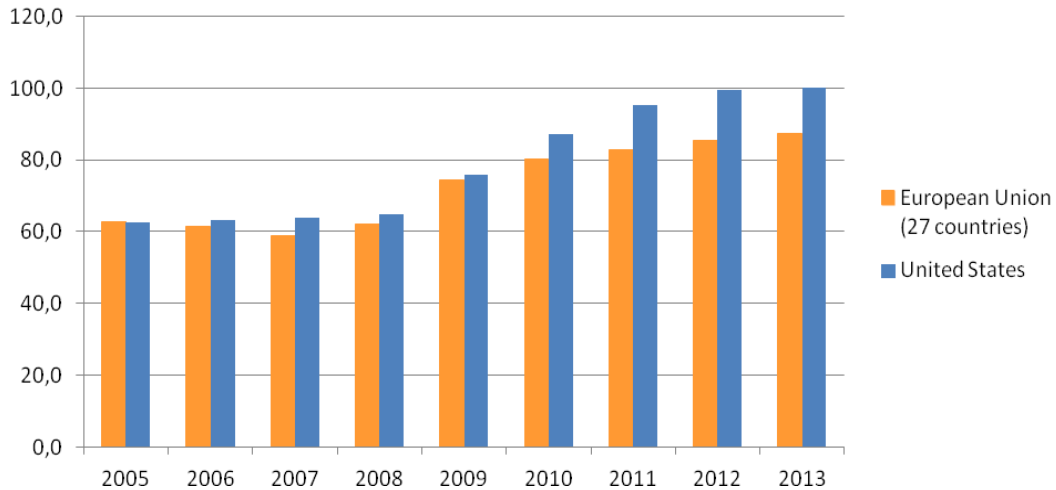
From this point of view, the European model failed not only to prevent the crisis, but also to address its effects and put things back on track. This can be explained by considering the fact that the European Union in its present form of administration (since Maastricht – 1993) has never seen a crisis of such a great magnitude. Things happened slowly not only because the Europeans were not united, but also due to the fact that EU simply didn't had the institutions and mechanisms to quickly intervene. In the absence of those mechanisms, the 27 leaders had to meet and reach to a consensus.

Also, the European Union is an economic union not too much homogeneous. With Croatia joining EU in 2013, there are now 28 Member States. Many are old members and some are new, some countries are a lot more developed than others, some EU members have a common monetary policy and others have their own policy and the list can continue. Any response to an economic crisis must take into account the particularities of the economy in which they are adopted. Even the countries that were in the most need of help were too be reluctant to accept the international aid, feeling they are punished unfairly by having to take some drastic measures to limit their own reckless public spending.

Eventually the European Union agrees to help the countries (especially the Euro Area ones) in need of urgent financing, together and in close cooperation with the International Monetary Fund and the World Bank. This was a good idea considering the fact that EU simply didn't have experts prepared to assess the macroeconomic prospects of countries, lay down concrete solutions and follow their implementation closely. IMF was more experienced in this area.

Solutions were found more or less easy but the biggest common mistake in Europe, as in the US, was the glaring underestimate of the magnitude of the crisis.

Chart 2: Government consolidated gross debt %GDP



Sources: Eurostat, U.S. Bureau of Public Debt.

Chart 2 above illustrates an additional problems that, mainly for the US. If at the crisis debut, in 2008, the public debt was just little over 60% of GDP in both continents, at the present the same indicator is about 87% in EU and 100% in the United States. This is making the economies to be more vulnerable the next similar event. From this perspective the Europe seems to have spent less money to help its countries financial systems and this can be considered an achievement.

In the following chapter we propose an in depth analysis of two European economies that were mostly affected by the financial crisis: Greece and Cyprus.

3. The Greek and Cyprus crisis developments

Greece had lots of economic problems prior to the financial crisis debuted in 2008. This was a fairly small country that joined the Euro Area, in 2002, very soon after its creation. It supposed to be one of the 12 states that founded the EA, but due to some economic issues the accession of Greece in EA postponed a few years. Soon after joining the Euro Area the Greek government started to borrow more and more money, especially form foreign markets, benefitting from their current status of member in the Eurozone. This translated in the fact that when the crisis came, Greece

already had a problem with the government debt and a highly fragile budgetary system.

Greece asked everybody for help and initially the problem was considered an internal issue of the Euro Area. In 2009 the country recognized the unsustainability of its budgetary system, both on the collection part and the spending part, and agree to a plan for correcting this in the near future. In order to do so, they even asked for IMF technical support and expertise. However, on the background of the crisis, things didn't improve too much in this area and Greece keep borrow money at interests higher and higher. Finally, all parts involved decided in the spring of 2010 for a formal rescue of Greece. The total financing amounted to 110 billion Euros, of which the Fund committed 30 billion Euros, the rest of the money coming from ECB and the European Commission. This help was exceptionally for many reasons: it was the largest aid program ever funded by the IMF and it was the first aid program supported by the IMF to a country from Euro Area. It's worth mentioning that a political decision was generally adopted in the EU that Greece shouldn't exit the Euro Area. This program had 3 pillars¹:

- The first pillar of the program was to drastically shrink the fiscal deficit;
- The second pillar of the program consisted of structural reforms;
- The third pillar of the program was to preserve financial stability.

In a public report published by the IMF in June 2013, the Fund admits that mistakes were made in the case of Greece by underestimating the magnitude of the problems.² The outcome of the program was not what the Fund expected. The only thing that was managed by this program was to lower the budgetary deficits of Greece, effectively stopping the reckless spending. Also it can be argued that this program helped to limit the spillovers brought by the Greece financial system. The public debt remained an issue and other macroeconomic indicators didn't improve too much.

The public debt had to be restructured, and after a program of about 200 billion Euros (about 50% debt relief) in the spring of 2012, the Greece public debt finally became more manageable. The cost of this action for Greece and for the entire Euro Zone is that future creditors will be very reluctant to borrow the players involved.

Another European country that was highly affected by the financial crisis was Cyprus. Cyprus is a very different country form Greece in the

¹ IMF Country Report No. 13/156, Greece: Ex Post Evaluation of Exceptional Access under the 2010 Stand-By Arrangement, June 2013, p. 11

² *Idem*

sense that it's a lot smaller and didn't have so many problems in the fiscal and budgetary area. However, the Cyprus problems came from their financial system that was several times bigger than their own GDP. Cyprus is considered an offshore center and, prior to the crisis, their commercial banks had lost of liabilities with foreigners in the form of attracted deposits or current accounts. Confronted with this situation, it was virtually impossible for Cypriot banks to place their liquidities in the national economy. Therefore it was only logical to look for external opportunities of investments, including investments in securities in the form of debt obligations issued by other and larger Euro Area countries (considered some of the safest prior to the crisis). One country from the Euro Area that was issuing lots of this type of securities was Greece. Debt restructuring of Greece hit Cyprus pretty hard. This, together with the general feeling of mistrust of foreign investors in the Cypriot banking system (translated in an important withdrawals of liquidities), was what seriously crippled the Cyprus financial system and led to the closings of important banks. ECB and other European institutions and countries were a lot more reluctant to help Cyprus than Greece, probably due to the fact that the spillovers on their banking systems were estimated to be a lot less painful.

There are two things that can emerge from the facts presented above. First, it's clear that a double standard applied. EU and the Euro Zone didn't act as a united front against the crisis. Secondly, this will affect the future credibility of all the Euro Area together both in government bonds and in banking systems.

4. Conclusions

It's clear for everybody that the financial crisis originated in the US but, today, at about 6 years from its debut we can affirm that overall the United States handled the crisis better than the Europeans. Although the US public debt is slightly bigger than the EU 27 (about 100% GDP vs. 87% GDP), no one can deny the steady pace of economic growth. The US public debt has not been restructured and any a few banks which were more specialized in risky investments than in classical financial intermediation failed. If things continue on this path, the US can gradually even lower its public debt. Trust in the US dollar remains to be high in financial and commercial markets.

By contrast, although smaller, the 87% GDP public debt of the European Union countries might be an even bigger problem for the EU simply due to the fact that in the Maastricht Treaty, the level considered to

be optimal and ideally followed by everyone is only 60%. This added to the other issues related with the general public and the investors mistrust in the European model provides an explanation for the fact that EU is still struggling to have sustainable growth.

In EU, apart from the obvious underestimation of the magnitude of the crisis, another striking mistake was the inability to provide a common and united response to the crisis. The newly created European institutions (especially European Stability Mechanism) and the changeover in the area of regulation are meant to address exactly this issue. Only a future similar crisis can show us if these institution will do their job. Of course, we all hope this will not happen again.

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ENTERPRISE ARCHITECTURE AS A TOOL TO SUPPORT THE STRATEGIC MANAGEMENT PROCESSES IN AN ORGANIZATION

Michał BIJATA, Kazimierz PIOTRKOWSKI*

Abstract. *The publication provides analysis and characteristics of whether and how enterprise architecture can support strategic management processes in an organization.*

Strategic management is conducted at a number of levels in organizations, including operational ones. Strategies for those lowest levels, which also include the area of information technology strategy, focus on delivery to higher levels of properly organized resources and processes enabling effective implementation of their strategy.

Enterprise architecture understood as – a formal description of the structure and function of components of the corporation (including people, processes, information and technology), the interrelationships between these components, principles and guidelines governing their creation and development over time – by virtue of their nature, consisting of high - level recognition of all levels of IT technology and combining them with the whole organization can be considered as a tool for the definition of the IT strategy of the organization.

The study provides a comparative analysis in terms of the usefulness of the application of the concept of enterprise architecture in the processes of strategic management, which also includes the area of information technology strategy. One of the major challenges in developing the IT strategy is an effective translation of higher level strategies to IT strategy simultaneously ensuring consistency and verification of its execution. Therefore, due to the limited scope, this publication focuses on 2 key aspects of IT strategic management, which are (in terms of enterprise architecture) enterprise architecture requirements defining and verification control of their fulfillment.

Taking into account those 2 aspects, all available frameworks have been analyzed and the EAS enterprise architecture framework proposed by J.W Ross, P. Weill and C. Robertson (EAS stands for Enterprise Architecture as Strategy) was chosen as the most developed one in these areas. The framework proposes a concept of enterprise foundation consisting of three elements – operating model, enterprise architecture and an IT cooperation

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model. The major inputs into the development process of this concept are the strategies of higher levels.

In the case of translation higher level strategies into an IT strategy, the process of enterprise architecture requirements definition should be considered. In this area EAS framework focuses on 2 aspects – standardization and integration. The definition of requirements for these two areas is translated into one of four types of operational models – diversification, coordination, replication or unification. Such an approach decreases the level of difficulty of IT strategy communication and what's more important assures consistency of enterprise architecture principles with higher level strategies levels.

Addressing area of architectural requirements fulfillment verification, the EAS framework defines four levels of maturity of the organization – business silos architecture, technology standardization architecture, core business optimization architecture and business modularity architecture. Depending on the degree of fulfillment of requirements for the enterprise architecture one of the four above-mentioned levels of maturity is assigned. This approach provides an easy to use, transparent assessment model, which especially enables verification of previously defined architectural principles. To sum up, enterprise architecture and a concept of enterprise architecture framework can be treated as an effective tool for supporting strategic management processes in the organization. It can be successfully used in order to determine the strategy at the level of information technology area, which depending on its role defined in the higher-level strategies, can effectively provide one of the competitive advantages of the whole organization.

Keywords: *enterprise architecture, enterprise architecture as strategy, strategic management.*

1. Introduction

In today's world increasing dynamic changes in the business environment of every organization, regardless of the market, set up new challenges for management personnel forced to be in control over increasing complexity. Achieving even satisfactory results in such conditions requires effective strategic management – in general, based on setting an organization's long-term development direction. The main business objective of that activity is to achieve a competitive advantage over other organizations by properly organized resources and competencies within the organization.

Strategic management is executed at different levels of an organization, including operational levels. Strategies of the lowest – organizational levels, in particular including an IT strategy, provide higher

levels with properly organized resources and processes enabling effective implementation of their strategies.

Advanced technology, especially informational technology, provides new business opportunities. Furthermore it often becomes a base of many successful business models. Financial institutions may be an example how the business can be boosted this way. As their character requires processing large amounts of data, it provides a broad picture of their customers. In this area, IT support enables an effective analysis of data resulting in significantly increased results of realized marketing campaigns than using a traditional, non-personalized, approach. This is why strategic IT management is one of the key areas in an organization's management.

Enterprise architecture is understood as a formal description of the structure and functions of corporation's components (including people, processes, information and technology), interrelations between these components, principles and guidelines governing their creation and development over time. Enterprise architecture, by virtue of those components nature, consists of high level recognition of all IT levels and combining them with the whole organization. That is why it can be considered as a tool of IT strategy definition consistent with higher levels strategies.

One of the main challenges in creating the IT strategy is an effective translation of higher level strategies into an IT strategy to provide consistency and control over its performance. Taking into consideration its' limited scope, this publication will focus on the above mentioned aspects of strategic IT management, which is (in terms of enterprise architecture) a definition of requirements for enterprise architecture and control over their fulfillment. The analysis shall in particular cover the approach proposed by J.W. Ross, P. Weill and C. Robertson representing EAS framework – *Enterprise Architecture as Strategy*.

2. The criteria of choosing the framework for analysis

At present there are several dozen¹ of different enterprise architecture frameworks concepts in the world. In order to choose the most suitable framework for the analysis, a criterion of the most developed tools assuring architectural organizational fitness was used.

Based on the above criterion, the EAS framework was chosen due to the fact that this framework was in majority dedicated to assurance of

¹ According to authors' own analysis there is 57 different framework concepts

enterprise architecture fit to an organization's strategy. What is more, it was also created based on the observation of the way the IT area was organized and if they were successful (or not) in chosen worldwide organizations.

3. Key definitions

There are many definitions of the term "architecture". According to PWN Encyclopaedia it is gr. Architektōn "architect/builder", art of designing and building². However more accurate in the area of IT is the definition concept of architecture proposed by IEEE Inc. in their ISO/IEC 42010:2007 standard, according to which, it is a fundamental organization of a system including: its' elements, interrelations between them and their environment, design principles and evolution of that organization³. In terms of enterprise architecture that term can have two meanings depending on the context:

1. A formal description of the system or its' detailed design on the level of components used for its' implementation.
2. The fundamental organization of the system containing its elements, inter-relations between them and their environment, designing principles and evolutions of the organization.

The second term is "enterprise". According to *Foreign Words Dictionary* this is the business activity typical for large companies such as stock-sharing ones⁴. Although in the described case this term should be considered in a boarder scope. According to The Open Group definition, enterprise is a group of units having the same objectives and one common reporting centre⁵. A corporation, in the context of the presented definition could also include a public administration unit or a whole country.

Defining terms: "Architecture" and "cooperation" allows considering the concept of "enterprise architecture". In literature there are many definitions of that concept. According to the authors, the closest to their understanding is the following: "**enterprise architecture** is a formal

² PWN SA, Encyklopedia Internetowa PWN <http://encyklopedia.pwn.pl/> (date: 01.10.2013).

³ The Institute of Electrical and Electronics Engineers Inc., *Recommended practice for architectural description of software-intensive systems, IEEE Standard 1471-2000*, New York, USA, 2000.

⁴ Multiple authors' publication under the lead of Prof. Irena Kamińska-Szmaj, *Foreign Words Dictionary*, Wydawnictwo Europa, 2001.

⁵ The Open Group, *The Open Group The Open Group Architecture Framework Version 9*, The Open Group, San Francisco, USA, 2009.

description of the structure and functions of the components of a enterprise (including people, processes, information and technologies) the inter-relations between these components and principles and the guidelines governing their creation and development over time”⁶.

The concept of **framework** from English, in Polish language is not consistent with the semantic intuition behind that word. The Open Group defines it as “a structure for the contents or process, which can be utilized as a tool for structuring mental process, providing integrity and completeness”⁷.

Architecture framework – are “tools for supporting the creation of architectures specific to a particular organization”⁸.

Architecture requirement – is “an expression of a need fulfilled by a particular architecture or a group/set of tasks”⁹.

Architectural requirements – is a set of actions for:

- gathering identified requirements into a common repository,
- requirements analysis,
- planning an implementation order and time-frames.

Assessment/Evaluation of the architectural requirements fulfillment – focuses on defining the level of realization of selected architectural requirements.

4. Analysis and characteristic of EAS enterprise architecture framework in terms of supporting organization’s strategy

Jeanne W. Ross, Peter Weill and David C. Robertson are authors of one of the concepts of enterprise architectural frameworks originating from the famous publication – *Enterprise architecture as a strategy*¹⁰. The authors included in it a complete concept of architectural requirements definition calling it the “foundation for business execution” and the criteria of their fulfillment – “level of maturity of the organization”.

⁶ The Open Group, *The Open Group The Open Group Architecture Framework Version 9*, The Open Group, San Francisco, USA, 2009, p. 9

⁷ The Open Group, *The Open Group TOGAF 9 Translation Glossary: English – Polish*, The Open Group, Berkshire, UK, 2011, p. 15

⁸ The Open Group, *The Open Group TOGAF 9 Translation Glossary: English – Polish*, The Open Group, Berkshire, UK, 2011, p. 10.

⁹ The Open Group, *The Open Group Architecture Framework Version 9*, The Open Group, San Francisco, USA, 2009.

¹⁰ Jeanne W. Ross Peter Weill, David C. Robertson, *Enterprise Architecture as Strategy (Architektura korporacyjna jako strategia)*, Studio EMKA , Warszawa, 2010

In this context, translation of business strategies into the IT area is based on the foundation for business execution, which consists of three elements:

- Operating model – an adequate level of standardization and integration of organization processes being an implementation of adopted higher level organization strategies,
- Enterprise architecture – in this context, understood as structured business processes and IT infrastructure according to a logic, which reflects requirements regarding integration and standardization (which are the requirements of higher level strategies).
- IT cooperation model – a system of supervision ensuring that targets of business and technological projects are achieved.

The image below presents location and dependences between enterprise architecture and the rest of foundation for business execution elements, as well as the whole organization strategy.

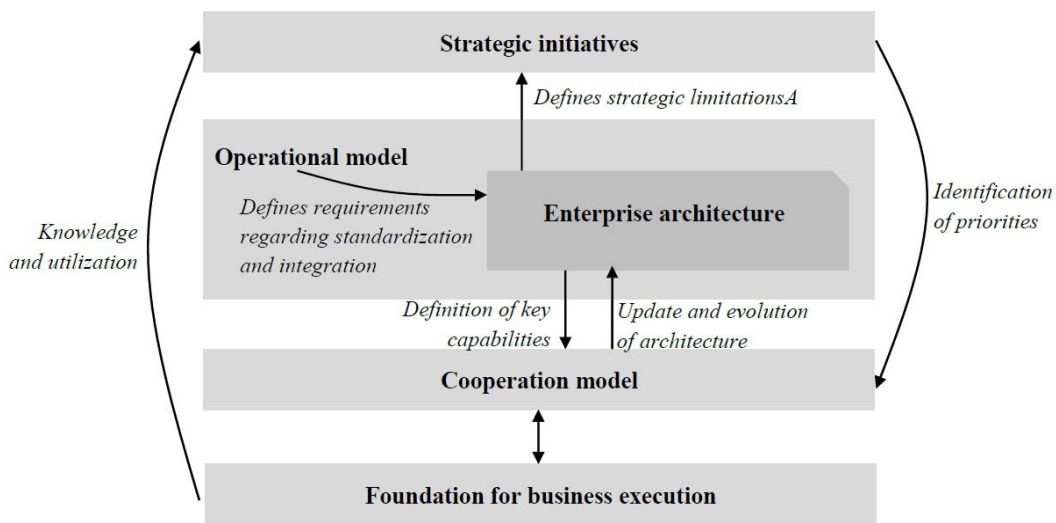


Figure 1. Location of enterprise architecture in general-organizational context.

4.1. Definition of architectural requirements as a tool for translating business strategy into an IT strategy

The main input element to the definition process of architectural requirements is the business strategy originating from higher than IT organization levels.

It should be translated into requirements in two fields:

- standardization – defined as a way of performing business processes regardless of who is performing them, where and when,
- integration – defined as a process of combining the efforts of different business units to perform shared or independent processes by sharing their data.

Depending on the scope of applied standardization and integration level, four types of operational models are formed:

1. Diversification (low level of standardization, low level of integration).
2. Coordination (low level of standardization, high level of integration).
3. Replication (high level of standardization, low level of integration).
4. Unification (high level of standardization, high level of integration).

The below table describes characteristics of the above models:

Table 1. Description of operational models: diversification, coordination, replication, unification.

		Coordination	Unification
Level of integration of business processes	High	<ul style="list-style-type: none"> • Shared customers/clients, products, or suppliers. • Impact on transactions of other business units. • Operationally unique business units or functions. • Autonomous management. • Control of business units is more important than planning/designing business processes. • Shared customers/ suppliers / products / data. • IT decisions made based on consensus within business units. 	<ul style="list-style-type: none"> • Local and global customers and suppliers (in terms of organizational scale). • Business processes integrated globally within the organization's scale in major way supported by IT systems. • Business units with similar or analogical operations. • Centralized management, using functional / procedural / business metrics. • High level owners of processes responsible for planning/designing standardized business processes. • Centrally managed databases. • Centralized IT decision making.

	Diversification	Replication
Low	<ul style="list-style-type: none"> • Small number or lack of shared customers and suppliers. • Independent transactions within business units. • Autonomous business units and their management. • Control of business units is more important than planning/designing of processes. • Low data standardization on the organization level. • IT decisions made within business units. 	<ul style="list-style-type: none"> • Small number or lack of shared customers. • Independent transactions within business units. • Business units operationally alike/similar. • Autonomous leaders of business units with restricted freedom with regards to processes on a general-organization level. • Centralized or federal control over business processes. • Data standardization on the organization level, most data stored independently by business units. • Centralized IT service.
	Low	High
	Level of standardization of business processes	

When defining current and target operational model, organizational level on which it is created (strategies of different organization levels) should be considered as on each level (for example general-organizational, business units, geographical departments) this activity should be carried separately.

Next, the definition of the operational model (current and targeted) should be converted into an “enterprise architecture base diagram” (which is an input diagram for all architectural work). Depending on the operational model, that diagram can include all or some of the below areas:

- clients,
- major processes,
- shared data,
- integrating and automating technologies,
- infrastructure.

An example of the metamodel of base diagram for the unification model is presented in the image below:

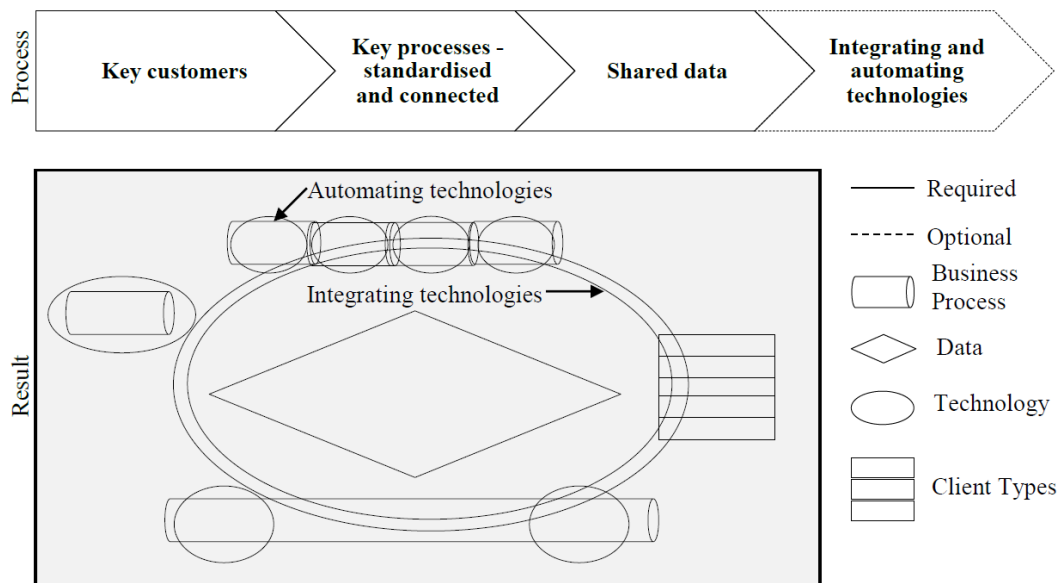


Figure 2. Metamodel of diagram of basis unification model.

4.2. Control of the architectural requirements fulfillment

There are four levels of maturity of the enterprise architecture (also defined as enterprise foundation for business development building stages): Business Silos Architecture, Technology Standardization Architecture, Core Business Optimization Architecture and Business Modularity Architecture. Depending on the degree of fulfillment of the requirements set out in front for the enterprise architecture, one of the four above-mentioned levels of maturity is assigned.

4.2.1. Business Silos Architecture

On this level, most of the IT strategy is focused on business units utilising locally stored data, locally used applications are not integrated (or integrated to a small degree) with the rest of the systems within the rest of the business units. Infrastructure is not shared at all or its' sharing was a result of many independently existing similar technological requirements of business units.

People who drive IT investments are business leaders of each unit and investments are focused on fulfilling local requirements and automating local business processes.

The synergy effect is possible to achieve only on the local level. Because architecture does not dictate any restrictions to the organization, the possibilities of innovation are greater at the local level than at other levels.

4.2.2. Architecture of Technology Standardization

At this level, there is conscious technology standardization (infrastructure) within the whole organization. Applications used are still on the local unit level, as well as most data (in particular transactional), although there may appear cases of sharing data between units.

People who drive IT investments are the business leaders and IT leaders of each unit. Investments into infrastructure are focused on fulfilling requirements of all units in the organization.

The synergy effect is achieved on the infrastructure level. The architecture dictates some restrictions on that level; therefore the possibilities of innovation on the local level are lower than on the Business Silos level.

4.2.3. Core Business Optimization Architecture

At this level, conscious standardization of technology, applications and data takes place within the whole organization. Applications and stored data are implemented and used in the way to support general-organization processes (ex. by using standardized interfaces).

People driving IT investments are the top management and process leaders. IT investments are mainly focused on core organization requirements.

The synergy effect is achieved on the infrastructure, data and applications level. Although, because of the restrictions dictated by broader standardization, the possibilities of innovations at a local level are decreased. Although there are available possibilities of innovations at the core organization level, which were difficult to achieve in previously mentioned levels.

4.2.4. Business Modularity Architecture

A conscious standardization of technology, applications and data is taking place within the whole organization on this level. Applications are built in a modular way – so that they can provide fulfillment of individual requirements, however basing on common standards defined on an organizational level.

People driving IT investments are business leaders, IT leaders and specific area leaders. IT investments are based on core-business requirements with consideration of local requirements.

The synergy effect is achieved on the infrastructure, data and application level. As a result of such modularity allowing for both – individualization on the local business unit level and cross-organizational standardization, possibilities of innovation are much greater on both levels.

4.2.5. Maturity levels comparison

The table below presents a synthetic comparison of above described organization maturity levels in foundation for business development implementation.

Table 2. Comparison of organization maturity in implementing foundation for business development.

	Business Silos Architecture	Technology Standardization Architecture	Core – Business Optimization Architecture	Business Modularity Architecture
Infrastructure Standardization	On the local level	On the organization level	On the organization level	On the organization level
Data standardization	On the local level	On the local level	On the organization level	On the organization level
Application standardization	On the local level	On the local level	On the organization level	Individual modules based on core-organization standards
Decision makers	Business leaders of local units	Business leaders and IT leaders of local units	Top management and leaders of processes	IT leaders, business and specific area leaders
Innovation possibilities on local level	Very high	High	Limited	High
Innovation possibilities on cross-organization level	Limited	Limited	High	Very high

5. Summary and conclusions of analysis

While analyzing enterprise architecture as a tool supporting strategic management of an organization, it must be noted that on the IT level (being operational IT services supplier, supporting other, higher organizational levels) the concept provides effective methods in this area.

One of the most important challenges in creating an IT strategy is an effective translation of higher level strategies into IT area strategy and control over its execution. In both of these aspects, the EAS framework presents mature concepts.

The framework proposes a concept of foundation for business execution consisting of three elements – an operating model, an enterprise's architecture and an IT cooperation model. The main input documents into the development process of this concept are the strategies of higher level. This provides integrity of the created foundation with higher level strategies. Additionally, from the IT area itself, an input into the processes of defining higher level strategies is also anticipated, in such a way so as to use all potential capabilities of an IT technology.

In case of translation of higher level strategies into an IT strategy, the process of enterprise architecture requirements definition should be considered. EAS framework focuses on two aspects – standardization and integration. Definition of requirements for these two areas is translated into four operational models: diversification, coordination, replication and unification. Such an approach decreases the level of difficulty of IT strategy communication and what is more important, ensures consistency of principles within higher level strategies for enterprise architecture.

Addressing the area of architectural requirements fulfillment, the EAS framework defines four levels of maturity of the organization – Business Silos Architecture, Technology Standardization Architecture, Core Business Optimization Architecture and Business Modularity Architecture. Depending on the degree of fulfillment of requirements for the enterprise architecture, one of the four above mentioned levels of maturity is assigned. This approach provides an easy to use transparent assessment model, which in particular enables verification of previously defined architectural principles.

To sum up, enterprise architecture and a concept of architecture framework can be treated as an effective tool for supporting strategic management processes in the organization. It can be successfully used in order to determine the strategy for the area of IT, which depending on its role – as defined in the higher-level strategies, can provide one of the competitive advantages for the whole organization or its' part.

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OPTIMUM CURRENCY AREA: THE STORY OF THINKING ABOUT

Liviu Cătalin ANDREI*, Dalina ANDREI**

Abstract. *In 1961, in the earlier stage of the European integration, Bela Balassa proposed a five successive phase model about it as a foresight. Today, the half century experience on integration and corresponding literature issued just lets us see rather two big phases (instead of five). The one would be the incipient integration, that came to enlarge the economic openness and internationalization and shaped on: (i) free trade area (FTA) and (ii) customs union; the other would be the advanced integration, in which internationalization would be replaced by the unique-common market and other two commandments would replace or just reshape the older FTA and customs union into: (iii) economic convergence and (iv) optimal currency area. This paper limits its focus on the optimum currency area (OCA), its current description-analysis in the literature and condition inside the EU.*

Keywords: *Integration; European type integration; incipient & advanced integration phases; customs union; economic convergence; monetary union; fiscal union; optimum currency area.*

JEL classification: A10; B15; B25.

In 2002 the OCA theory had its own 40th anniversary, for a period during which four phases were claimed to have succeeded and marked this subject: 1/ ‘*pioneering*’ phase – with the basic OCA theory and properties revealed; 2/ ‘*reconciliation*’ phase – combining diverse facets of the theory; 3/ ‘*reassessment*’ phase – that leads to the ‘new OCA theory’; 4/ ‘*empirical*’ phase – in which the theory was subject to due empirical scrutiny[1](p. 4).

1. The ‘pioneering’ phase

The ‘pioneering’ phase developed between 1960s and early 1970s. Actually, debate started and the OCA properties were drawn on appropriate

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issues – mobility of factors of production within the area; price and wage flexibility; economic openness; diversified production and consumption; similarity in inflation rates; fiscal and political integration; financial integration. The similarity of shocks and the income correlation “were added later” (IBIDEM, the same page). This first phase of the OCA theory developing was started by [2] – who is recognized as the parent of the concept –, then [3], [4] and [5] joined the debate not much later on, whilst [6] and [7] had expressed earlier than Mundell and the others, the previous one on a principled price flexibility and the latter about the balance of payments of the region in way to become the later EU.

1.1. Basic definition of OCA

Once more, Mundell drew the common OCA definition:

(i) A ‘domain *within which the exchange rates are fixed*’ [2] (pp. 657);

(ii) The region (not the nation) with a high degree of internal production factors mobility (i.e. capital and labor), versus external immobility (IBIDEM, pp. 661);

(iii) Finally, Mundell sees a world of currency regions, rather than nations with their own monies.

In reality, the first and third components of the Mundell’s definition of OCA relate to money and currencies, so OCA, on the one hand, retorts the older theory of *international monetary systems* (IMS/[8]) and on the other will come to be completed by [9] – actually by the last’s theory of the *nominal anchor*. This is the order in which [1] (p. 8) notices the concomitance of this phase with either the IMS shaping in the Bretton Woods Agreement (1944)’s way and process, with its specific *capital control*, or the inception of the European integration. In other words, the OCA theory came up directly into the *debate about fixed, versus flexible exchange rates*.

Pelkmans [10] believes that the (above) OCA’s definition might actually be simplified or adjusted as: ‘the region in / for which the cost of giving up floating exchange rates – i.e. the alignment of the national currencies’ rates within the region – is overwhelmed by benefits of the unique-common currency in use’. The second component of the OCA’s definition prolongs the above one related to the intra-region currency-exchange rate regime, but then more aspects here attach to these two and come to be mentioned here below.

1.2. Properties of OCA

1.2.1. Mobility of factors

Mundell [2], was ending his analysis by reiterating for OCA the picture of the ‘region with perfect (production) factors’ mobility’. As for this component, *mobility of factors of production* counteracts price variability (see the next sub-paragraph) *within the region* [2]. Labor could be less mobile on the short periods, but the aspect might change in the long run [11].

[12] notices that the Mundell’s ‘region’ is portrayed as neither geographical, nor political, and for the ‘factors’ mobility’, Mundell had insisted more on labor, than on capital [5]. And this labor *mobility* needs a prior *employment* mobility and labor *homogeneity* in a formula that rather conducts to mono-industrial type regions. [13] explains that the Mundell’s description reclaims ‘*perfect internal labor mobility*, versus *perfect external labor immobility*’, whereas in reality there is to debate about a real graduality (different levels) of labor mobility. [14] here wonders, in context, about whether an irreversible by definition process that *migration* is would be able to imbalance the external equilibria on the long term. [11] here answers that mobility of labor might prove a rather lower capacity of fighting *asymmetrical shocks*.

1.2.2. Price flexibility

As continuing the introductory idea of the precedent sub-paragraph, when flexible prices and wages – says the “last neoclassic” that Milton Friedman was, as together with all his ‘classics’ and neoclassic predecessors – it is less likely for unemployment in one country and inflation in another, plus exchange rate adjustments between [6].

1.2.3. Financial market integration

And since the incomplete Mundell’s discourse about factors’ mobility, [15] argues that this part of integration cannot substitute the capital’s mobility, but just smoothen it – i.e. fighting its shock aspects. In other words, *financial market integration* cushions temporary adverse disturbances through capital inflows. Later on, [16] reinforces the role of financial integration, in context.

1.2.4. Degree of economic openness

McKinnon [3] says that the more open the economy, the easier the *transmission mechanism* of exchange rate mobility into prices' and wages' movements; plus similarity between economic activity structures.

1.2.5. Diversification in production and consumption

According to [12], this OCA item also smoothens the exchange rate changes shocks; the same for impacts of individual sectors' mutations, and for settling, jobs portfolios within the region.

1.2.6. Similarities of inflation rates

[17] observes that inflation might be caused by diverse disequilibria of sectors, their developments, policies promoted etc.¹ Similarity in inflation rates equally might reduce inter-country shocks and their impacts. [18] points on the need for narrowing fluctuations between countries and the '*Balassa-Samuelson*' effect could allow the 'catching-up' part of integration processes.

1.2.7. Fiscal integration

This aspect is for the *union of countries* to be able to redistribute resources among – i.e. to countries that need them, when the case, in order to free the exchange rate from such a task, once more [12].

1.2.8. Political integration

This is, finally, the will of the countries involved to join commitments, to share costs of processes amongst and to encourage institutional linkages and cooperation on some activities etc. [19].

*

Synthetically, these above properties would make the money exchange rate less adjustable (usable) within the region to adjust (temper) presumable shocks [1] (p. 5).

¹ See the 'Mundell-Fleming model'.

1.3. Criticism on the 'pioneering' phase

Mongelli [1] (pp. 5; 11) indicates what the author calls the 'pioneering phase's drawbacks', meaning there were not yet for OCA: (i) a 'comprehensive framework' defined, so some properties were yet contradicting one-another; (ii) an empirical content for most of its properties. There also were for [20] difficulties for measuring properties; ambiguity of characteristics and of differences amongst. As for Tavlas, [21] "OCA points to different directions", meaning a "problem of inconclusiveness" – e.g. small economies are more likely to be open, but less capable of production diversification, so more likely to accept the unique currency, but with more propensity to flexible (than to stable) exchange rates. [22] here adds that more differentiated economies have less trade. Then, how the OCA above requirements can be ranked amongst?

2. The 'reconciliation phase'

That was during the 1970s. There were both a deepening of some properties (i.e. 'meta-properties') of OCA and an adding of more ones (i.e. *similarity* of shocks/ [1] (p. 5). For this phase there is to be understood the above 'pioneering' reuniting points of view, but equally what a presumable OCA brings for countries joining it. Concretely, [3] views that country A might be supposed as interested in a currency union with a price and cost stable country B, in order to ensure its own stability, but some shocks are always expected. Or, this is the same with [23], for whom OCA is limited by the interest of each country to join or stay out of the union, and [11], who imagines joining a currency union by any presumable country as basing on a prior *cost-benefit analysis*. And actually, the exchange rate flexibility would be in place on both alternatives, together with the one of prices and wages - the exchange rate would be able to insulate a country from asymmetric shocks in any way; the question which remains is whether that would be outside or inside the union. And as for the *cost-benefit analysis* of the monetary integration of individual countries, see the rectangular graph in Figure 1.

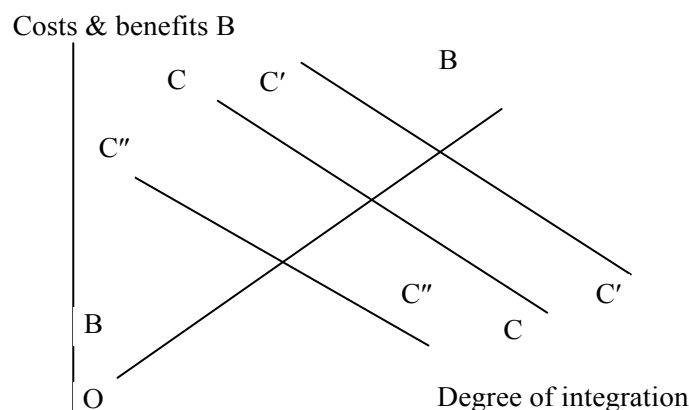


Figure 1. Cost-benefit analysis of the monetary integration of individual countries.

This is illustrated by [24] (p. 16) for ‘a country facing option of joining with a partner or group of countries in a currency union’ (IBIDEM, pp. 2). *Benefits* here mean loss of: (i) transaction costs and (ii) currency risk – the (B) curve is upward sloping: the higher the economic integration degree, the higher the benefits from the monetary integration. *Costs*, as correspondingly, mean: (i) loss of the country’s (independent) monetary policy; (ii) loss of the shock absorbing of exchange rate movements... – the (C) curve is downward sloping: both monetary and exchange rate policies decline, as values, in the open and interacted economies of such an area.

There are three cost curves (C, C’ and C’’), of which’s meaning gets related to different economists’ view on approaching integration – see also the corresponding intersectional points. The intersectional costs-benefits points express economic states in which a country starts taking advantages of joining a currency area.

In such an order, it is the *monetarist* view (C’’) – for which integration costs are assumed to be low and even a reduced integration degree is enough for attending the crossed cost-benefit point of joining integration; versus the *Keynesian* view (C’) – for a significantly higher cost level of assuming integration. [25] has, in this context, a two columns list of possible costs-benefits of OCA. And apart from these, two ways of efficiency increase in the OCA context are derived from this view: (1) rising the economic integration (i.e. convergence) degree between countries in the area; (2) reducing rigidity of the integration costs – i.e. flexible production factors’ movement around.

Despite all these above developments, this new ‘reconciliation’ phase proves the same drawback as its previous ‘pioneering’ one: still no empirical content [1] (p. 5).

3. The ‘reassessment’ phase

Then, in early 1980s, there came a kind of ‘stagnation’ for the OCA theory’s developments or a ‘*lost momentum*’ in the aftermath of the second phase. Despite that, then there were: (a) some advancing on empirical approaches; (b) conceptually reconsidering the monetary (currency) union; (c) reinterpretations of some properties, as previously formulated – and this was the ‘*reassessment*’ phase: between 1980s and early 1990s [1](p. 5). Not to be equally here omitted for the late 1980s, parallel preoccupations for building the EMU on the ‘*one market-one money*’ principle, that did push approaches through the ‘new OCA theory’. Or, “the ... EMU question is, possibly, more complex than the OCA question” (IBIDEM, p. 14). [26] remarks that the ‘new’ OCA theory here started emerging vis-a-vis the ‘old’ OCA theory after revisions have been made [27].

Then, see *empirical studies* that did start in context since the 1980s: low wage flexibility behind low price flexibility [28] (real wages are still low flexibility across European countries and employment does some adjustment to wage flexibility [29]; some significant asymmetries of the European labor markets [30]; the relationship between centralization of wage bargaining and labor market outcome is not linear – countries with differences in labor market institutions make find it costly to form a monetary union [31]. Besides, it is for this phase that [32] conclude that countries with large co-movements of outputs and prices have lost costs from abandoning monetary independence vis-a-vis their partners, but [33] appreciate the lost of monetary independence as ‘not a substantial cost’. Last, but not least, [34] argue that in the long run, high inflation does not yield any macroeconomic benefit in terms of growth and unemployment.

4. The ‘empirical’ phase

This final phase started in 1987, as complex approaches and analyses [1] (p. 5), of which sizes overpass the previous studies drawn in early 1980s. Issues that came one by one under study in this time interval were: price and wage flexibility (IBIDEM, p. 18), labor market integration

(p. 19)², factors market integration (i.e. foreign direct investments/p. 20), financial market integration (pp. 20-21), the degree of economic openness (p. 21), diversification in production and consumption (pp. 21-22), similarities in inflation rates (p. 22), fiscal integration (pp. 22-23) and political integration (pp. 23-25).

The general critical remark that can be made on this final and intellectually productive phase is that all these studies look backwards by definition (IBIDEM, p. 26), whereas the opposite '*looking ahead*' stays a more delicate issue – it is supposed to answer some questions raised. The one is the *question-paradigm* between the old and classic *country specialization* in the inter-member countries' trade contest and the *endogeneity of OCA* that is the real integration (IBIDEM, pp. 27-31).

As for the previous (*country specialization*), the '*Krugman specialization hypothesis*' [36] (with the so called "lesson of Massachusetts") relates to a US development-experience over the last century: the single currency removes barriers of increasing returns to scale and even in integration fostering conditions the comparative advantage will work as classically and countries will specialize (see also [37], [38] and [39]). But so member countries of a currency area will reduce production diversification and become vulnerable to asymmetric shocks. [40] so opines that the solution will be enlarging the OCA's area – i.e. the *Frankel's paradox*. Otherwise, the former OCA will turn into a small group of countries with proper currencies floating among each other: 'the OCA's dissolution' [1] (p. 28). Finally, on the one hand, the European integration is a process of evidence, but on the other specialization among the EU member countries plays its (other) role: destruct(ur)ing production diversity, as required by OCA (IBIDEM, p. 32).

As for the latter (*endogeneity of OCA*), a preliminary answer comes from [40]: member States will be more attracted by sharing a common currency when the trade-off and/or correlation between *incomes* and *economic openness* towards the (other) member States. The question whether income correlation rises or falls following the monetary integration doesn't make unanimous answer [1] (pp. 27-28). In which conditions, [39] also adds that '*OCA varies over time*'.

The hypothesis of positive correlation between income and inter-member countries trade rising consists in that increasing integration would so be assumed to lower transaction costs and eliminate currency risks. [40]

² Here to be exemplified about labor market integration in Europe [18] concluding that variation of unemployment was twice in Europe than in the US and [35] for different responses in Europe and US of the unemployment rate to unemployment shocks.

specifies that the common currency is supposed to be a “serious commitment”; no competitive devaluations, incentive for FDI and future political integration encouraged.

But *what does the empirical evidence tell us...?* [42] and [43] conclude on results like: (i) increasing specialization and (ii) lowering industrial concentration for both Europe and US. Another important response comes from [44]: countries trade on the same currency (with other countries) three times more than with countries with other currencies³.

The other relevant *question-paradigm* of the last and current phase is: “do countries form currency unions because they tread a lot, or start trading more because they form a currency union?” Or, do both positions reconcile? [1] (pp.6; 31).

5. Concluding remarks on OCA and an enlarged conclusion

Mongelli [1] (p. 31-32) finds the appropriate question raised for the 40th anniversary of the OCA theory was: “was that made simpler?” And the author answers “yes and no.” For the ‘better position’: studies are much deeper and OCA can be viewed in many more positions and situations. For the opposite ‘harder position’: it is still hard to reconcile all the OCA’s properties and to assess the agents’ reactions.

*

Just let us suppose the impossible alternative in which both *convergence* and *OCA* debates wouldn’t limit to regions, as *multi-country-regions* defined as above. Then, what would our approach become? The answer is simple: (a) the debate on *convergence* would go back to its primary neoclassical approach of growth-development, with its double aspect, (i) trend towards self-balancing and (ii) ‘*catching-up*’ developed economies by the less developed ones, in the international context; (b) the debate on *OCA* would search for inter-country trade and all the other flows equilibrium able to fight real and even presumable asymmetric shocks.

So, actually, such an extremely simplifying hypothesis is enough for re-positioning research onto basic *growth-development* and general *equilibrium*. Also note that the two concepts keep in common issues like: equilibrium growth, international economics, symmetry-asymmetry of shocks, common currencies – i.e. common value references for the common market – ‘but equally regionalization, as areas-zones for OCA

³ 186 countries were taken in this model.

and countries' clubs' for convergence. Despite these, the two defined concepts on the advanced integration are obviously distinct from each other.

Last, but not least, recall that the *convergence-OCA* couple of concepts look different issue than the *free trade area-customs union* corresponding association. The last are just phases of an earlier moment of the integration and the relation between is defined clearly and simply by specific differences. Convergence and OCA stay different from free trade area and customs union meaning a paradox of more knowledge of the past for what was developing at that time, than it is the case of an *advanced integration* on which theoretical debate sees itself forced to recall primary economic theories and analyses and/or to adapt them to a reality that is... just Europe.

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