The Dynamic Modelling as A Financial Audit Procedure

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This new procedure of financial audit is based on the requirement that the model should be conceived in such a way that it can reflect in a simplified and accurate manner the approached economic reality.
***Key words**: procedure of financial audit, dynamic modelling, hyperbola, indices, financial results.*

Introduction

The financial auditor's knowledge and understanding of the approached economic segment, the accurate analysis of the relations between incomes and results, all depending on time other factors, motivate as to use the dynamic modelling procedure and include it among the procedures of financial audit.

The use of the dynamic modelling offers us a clear and detailed image of the analyzed relation. This procedure helps us to identify the cyclic on periodical aspects of the studied phenomenon and implicitly the period of time.

We shall further make use of a dynamic model with the help of which we are determining the patterns of the income and of the financial results in time and also the relation between the two variables. Thus we have possibility to analyze in details the economic evolution. Using traditional methods we can obtain incorrect results.

Thus, the models of economic evolution roles emphasize the between the main indices /ratios and reveal their transformations concerning the changing of certain variables.

A very important role of dynamic modelling is to establish the best intervals for the main financial rations so that the accomplishment of economic objectives should not raise any problems.

Actually, the dynamic modelling made according to the objective necessities of the financial auditor represents the simplified expression of the phenomenon.

The dynamic modelling is a modern technique especially used in the prevision of the economic activities of patrimonial entities, but, which, in our opinion, can be useful to financial auditors as a procedure for information processing. The theoretical elements related to this procedure are numerous, but they are not the topic of this research paper so we decided to adapt a dynamic model in order to use it as a new procedure of financial audit.

The dynamic model

We considered useful dynamic model from the economic literature[1] in which the income is considered a linear function of assets and capitals and financial result varies according to the excess of liquidities.

$$\begin{cases} \dot{Y} = h_1(I - S), \\ \dot{R} = h_2(L(Y,R) - M). \end{cases}$$

The function which has as variables the income and financial result, L (Y, R) is exogenously determined by the flow of liquidities M.

In other words, we have used in this model all the positions of the balance shut considered in this way:

- M - The liquidities represent the total assets (from the balance sheets rd.37+38-62);
- S - The capitals represent the total own capitals (from the balance sheet rd. 82);
- G - The credits represent the debts, which must be paid in more than a year (from the balance sheet rd. 58);
- T - The taxes represent the debts, which must be paid in less than a year (from the balance sheet rd. 47).

[1] Tu N.P.V. – Dynamical systems, Ed. Springer – Verlag, Berlin, 1993, p. 108.

The capitals can be written this way:

$$S = s(Y - T) + (T - G)$$

- T - Represent the credits and the loans on the short term, as well as the revenue debts;
- G - Represent the commercial credits and debts;
- The constants **s** is a rate of adjustment within the interval (0,2).

The function of liquidities is writhen as being the difference between the demand of transactions and the profit:

The constant values h1 and h2 which represent types of speed of adjustment and can be considered as unitary h1= h2 = 1. In the case that they are different from 1, transformations of variables can be made so that they disappear.

Replacing all we have mentioned above in the first system we will obtain:

$$\begin{cases} \dot{Y} = -sY - R - (1-s)T + G, \\ \dot{R} = Y - \beta R - M. \end{cases}$$

This is a relative dynamic system which depends on two parameters s and β.

If $s\beta + 1 \neq 0$, a possible situation from the economic point of view, the system admits a single point of balance:

$$\bar{u}_0 = \left(\frac{M - \beta[G + (1-s)T]}{s\beta + 1}, -\frac{sM + G + (1-s)T}{s\beta + 1} \right)$$

the solution of the algebraic system:

$$\begin{cases} -sY - R - (1-s)T + G = 0, \\ Y - \beta R - M = 0. \end{cases}$$

which is

Analyzing the system:

$$\begin{cases} \dot{Y} = -sY - R - (1-s)T + G, \\ \dot{R} = Y - \beta R - M. \end{cases}$$

we consider that $\beta s \neq -1$. In this situation the system admits a single point of balance,

$$\bar{u} = (y_0, R_0) = \left(\frac{M - \beta(G + (1-s)T)}{\beta s + 1}, -\frac{sM + G + (1-s)T}{\beta s + 1}\right)$$

The system round of this point is:

$$\begin{cases} \dot{Y} = -sY - R, \\ \dot{R} = Y - \beta R. \end{cases}$$

and the associated matrix is $A = \begin{pmatrix} -s & -1 \\ 1 & -\beta \end{pmatrix}$ with the characteristic equation $\lambda^2 + (s+\beta)\lambda - s\beta + 1 = 0$, for which the sum, respectively the product of the radicals are $S = \lambda_1 + \lambda_2 = -(s - \beta)$, $P = \lambda_1\lambda_2 = 1 - s\beta$.

The discriminator of the equation is $\lambda\Delta = (s-\beta)^2 - 4 = (s - \beta - 2)(s - \beta + 2)$.

This is annulled when the parameters s and β go over the straight lines of equations $d_1 : s - \beta - 2 = 0$, $d_2 : s - \beta + 2 = 0$ from the space of the parameters (red).

The product P is annulled or hyperbola $H : s\beta = 1$ (blue).

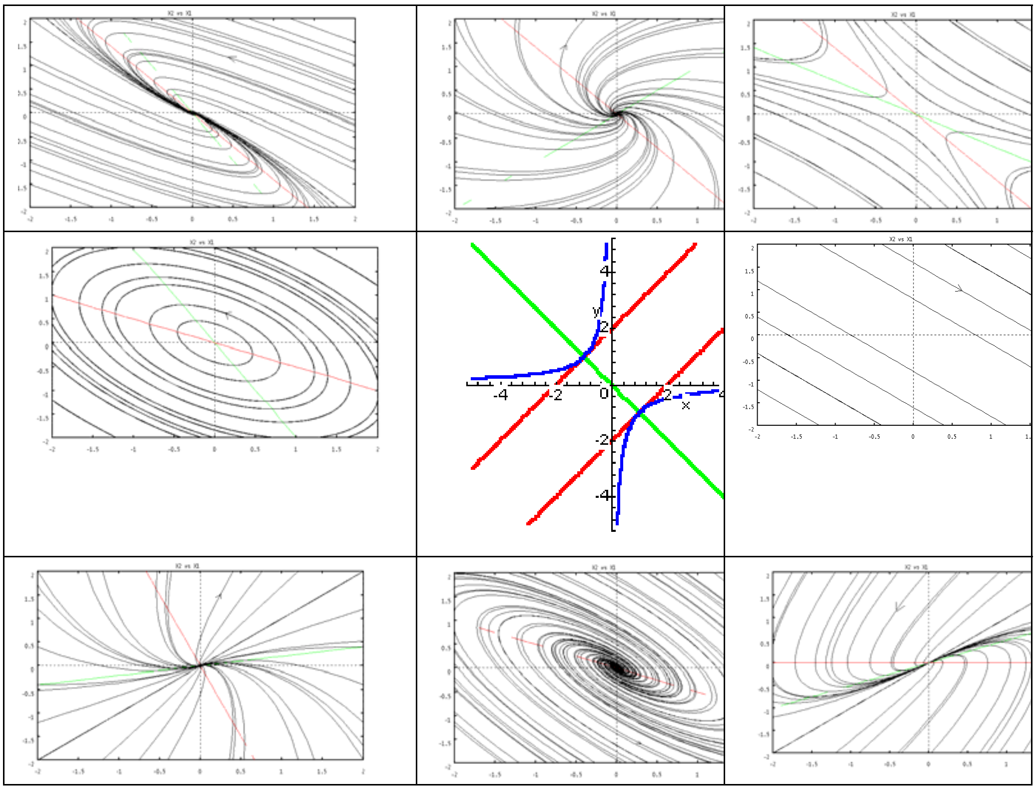
We also have, on the straight line of equation $d : s + \beta = 0$ (green), $\Delta < 0, S = 0, P > 0$, which means that here the point of balance is unhyperbolic, centre, the system admitting a periodical solution.

This balance/equilibrium can be stable or unstable, the trajectory of phase can be convergent or not. A complete characterization of the system is given in the following table.

Table 1

	Region	Proper values	The type of the point of balance equilibrium
	B	$\lambda_1, \lambda_2 \in R$, $\lambda_1 > 0$, $\lambda_2 > 0$	repulsive (instable) knot
	C, D	$\lambda_1, \lambda_2 \in R$, $\lambda_1 > 0$, $\lambda_2 < 0$	saddle (instable)
	3	$\lambda_1, \lambda_2 \in R$, $\lambda_1 + \lambda_2 = 0$	neutral saddle (instable)

$\Delta > 0$	2, 4	$\lambda_1 = 0$, $\lambda_2 = \beta - \dfrac{1}{\beta}$	saddle-knot (instable)
	G	$\lambda_1, \lambda_2 \in R$, $\lambda_1 > 0$, $\lambda_2 > 0$	repulsive (instable) knot repulsive (instable) knot
	7	$\lambda_1, \lambda_2 \in R$, $\lambda_1 = \lambda_2 = 0$	double unhyperbolic degenerate
	E	$\lambda_1, \lambda_2 \in R$, $\lambda_1 < 0$, $\lambda_2 < 0$	attractive knot (stable)
$\Delta = 0$	1, 8	$\lambda_1, \lambda_2 \in R$, $\lambda_1 = \lambda_2 > 0$	repulsive degenerate knot (instable)
	5	$\lambda_1, \lambda_2 \in R$, $\lambda_1 = \lambda_2 < 0$	attractive degenerate knot (stable)
$\Delta < 0$	A	$\lambda_1, \lambda_2 \notin R$, $\mathrm{Re}\,\lambda > 0$	repulsive focus (instable)
	6	$\lambda_1, \lambda_2 \notin R$, $\mathrm{Re}\,\lambda = 0$,	centre (periodical solution)
	F	$\lambda_1, \lambda_2 \notin R$, $\mathrm{Re}\,\lambda < 0$	attractive focus (stable)



a) Income versus financial result
b) Income versus financial result versus time
c) Income versus time
d) Financial result versus time

Using a computer program for dynamic systems we can visualize the evolution of the system, varying the parameters and settling the initial data.

Thus we consider it useful to further present some relevant cases:

1. For the values of parameters $s = 1{,}5$ and $\beta = 1$, considering as on initial data, income $Y_0 = 2{,}1$ u.m., and final financial results $Y_0 = 2{,}1$ u.m., in 1999, the system has on unstable behaviour evolving from the equilibrium state to a state of explosive variation.
2. When $s = 0{,}5$ and $\beta = -0{,}5$, with initial conditions $Y_0 = 6{,}7$ u.m., $R_0 = -1{,}38$ u.m., obtained in 2004 when the patrimonial entity introduced the International Accounting Standards, the system admits a periodical situation, being in a continuers state of variation.

Analyzing the situation presented in Figure 2, the following aspects can be noticed:
a) In the first stage, both variables increase, this leads the entity to prosperity.
b) The second stage corresponds to a period of saturation when the income decreases, but the profit increases;
c) A stage of crisis, of economic depressive occurs in the third stage, when both variables decrease;
d) In the fourth stage the firm is brought to an efficient state since incomes increase, but the profit decreases (losses occur).

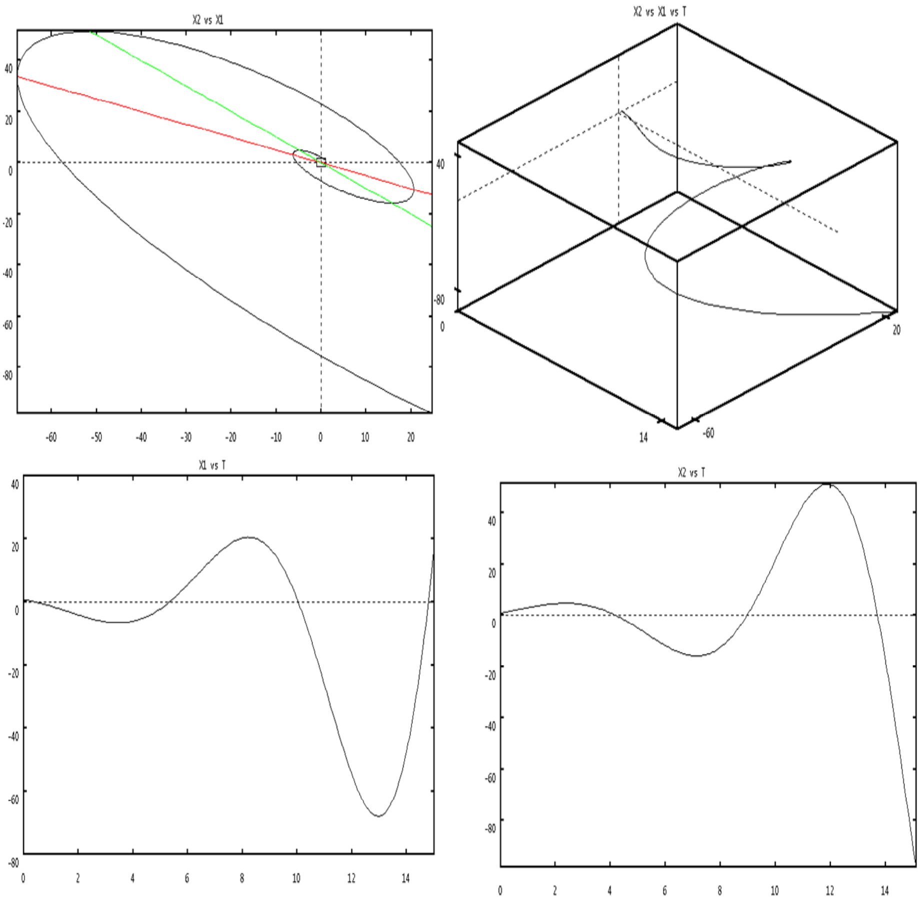


Fig.1. The evolution from the equilibrium/balance to the explosive variation

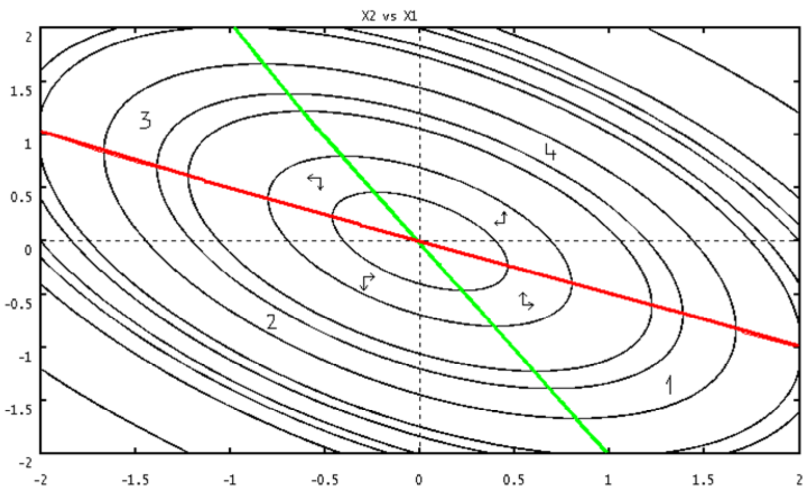


Fig.2. The periodical orbit with 4 phases/stages

In the next figure, we can notice the evolution of the income in time, and also the financial result, in the considered situation.

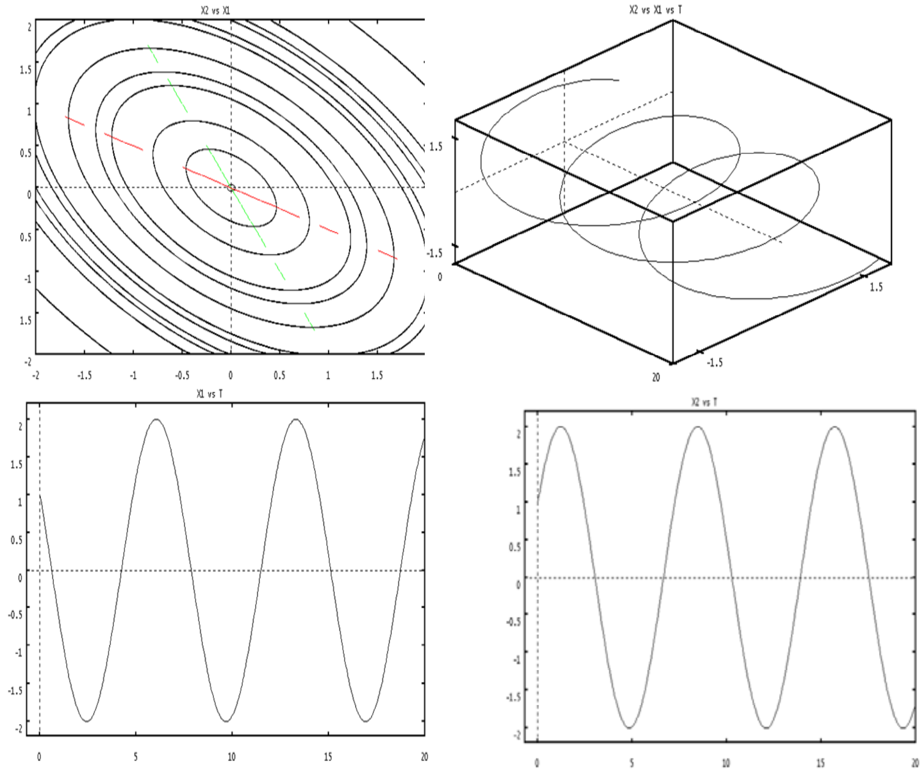


Fig.3. The state of continuous variation

a) Income versus financial result
b) Income versus financial result versus time
c) Income versus time
d) Financial result versus time

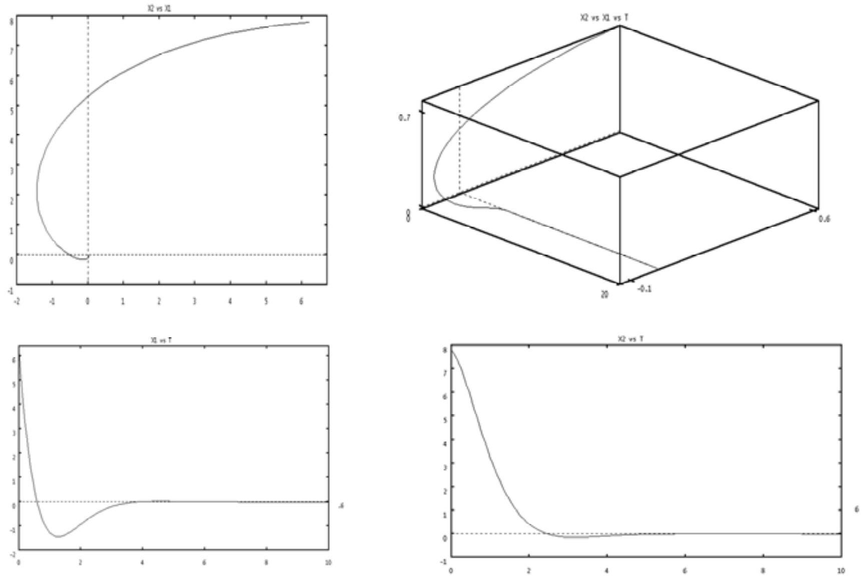


Fig.4. The system converges to the equilibrium state

3. When $s = 0{,}5$ and $\beta = -1$, with initial data $Y_0 = 7{,}8\,\text{u.m.}$, $R_0 = -1{,}11\,\text{u.m.}$ in 2005, the point of balance of the system in an attractive focus, that system is stable, its trajectories evolving towards equilibrium point.

Further or introducing the numerical results is the studied system and using an adequate computer programs, the following numerical results are obtained.

We consider the numerical data corresponding to 2004.

- ➢ G the debits which must be paid in more than a year, with the corresponding value to 2004, G=3,34;
- ➢ T the debits which must be paid in less than a year with the corresponding value to 2004, T=5,37;
- ➢ M total assets with the corresponding value to 2004, M=2,24;
- ➢ Y the incomes with the corresponding value to 2004,Y(2)=6,7;
- ➢ R the financial results with the corresponding value to 2004, R(2)=-1,38.

Introducing these data in the computer programs corresponding to the dynamic system, we get the following numerical results:

For 2006, we get the following numerical results:

Y(6) =7.527667983899726;

R(6) =-0.873185592180263.

For 2007, we get the following numerical results:

Y(7) =8.182884604019016;

R(7) =-0.3153880974491396.

In 2010, we will have:

Y(8) =12.59417543721213;

R(8) = 1.477564799533792.

Conclusions

The use of the dynamic modelling as a new procedure financial audit has the advantage of a very well elaborate mathematic system studying both the existence and the stability of the equilibrium solutions, since a solution of instable equilibrium cannot notice in reality.

In the study of the practical efficiency of this procedure we were inspired by the English saying: “Time is money”, this presenting /reflecting on of the advantages of using this method by financial auditors, that is to reduce the time of understanding the economic and financial situation of their client, as well as the obtaining of a useful prevision.

Another advantage, equally important is the fact the new procedure could replace the calculation of all financial and economic ratios, a difficult method that requires more time. The last and maybe the must important advantage is that this procedure of dynamic modelling, helps us to identify the cyclic on periodical aspects of the patrimonial entities and implicitly the time which is referred to.

Still, there is a possible risk to not determine the mistakes of accounts. Practically this risk is not a disadvantage specific for this procedure, because, on the one hand the calculation of the economic and financial ratios presents the same risk and on the other hand using the other procedures of financial audit as well eliminates this risk.

In the end taking into account all the presented aspects, we consider that the advantages of using this procedure surpass the possible disadvantages which encourages us to recommend this new method of financial audit and to persuade the financial auditors that best results are obtained in short time.

References

[1] Bogdan, A. M. – The financial audit harmonized with the International Accounting Standards, Edition Universitaria, Craiova, 2005.

[2] Ciurlău, C.; Tomiţă, I. – Macroeconomic prevision, Edition Dova, Craiova, 1996.

[3] Defliese, P.L., Jaemicke,H.R., Sullivan, J.D., Gnospelius, R.A.- Montgomery's auditing, New York,1986.

[4] Holmes, A.W.; Burns, D.C. - Auditing – Standards and procedures, Ontario, 1979.

[5] Raffegeau, J.;Dufils, P.; Lopater, C.; Arfaoui, F. - Mémento Pratique Comptable, Édition Francis Lefebvre, France,1997.

[6] Tu N.P.V. – Dynamical systems, Ed. Springer – Verlag, Berlin, 1993.

[7] Ungureanu, L.; Popescu, I.; Comşa, M .- Prevision a premise of lasting development, vol. II, Edition "România de Mâine", Bucharest, 2003.