MODELING THE FRAGILE ECONOMIC SITUATIONS

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Abstract: The development of the modern society is dependent on its economic growth. In the given logistic theory, a uniform system of the scientific statements, calculations and estimations has been maintained. An automatic computer model for fragile economic situations has already been worked out. Yet better results in the comprehension of the model are achieved when all the calculations are done manually, with the help of the MS Excel. Therefore the paper introduces the teaching method that might be helpful in understanding how to operate with the model in a non-automatic way.

1 INTRODUCTION

The world seems to have been enchained by the constantly appearing financial problems that alarm both the ordinary people and scientists who get more and more involved in the analysis of the causes of the crises. Research is carried out each year with the goal of discovering the crisis prediction mechanisms. That is why it is essential to start teaching the students to understand the causes determining the fragile economic situations and show how should be modeled.

Relevance of the Topic. The difficulties in the economic crisis prediction, the frequent misunderstanding of the fundamental basics of the reasons and development of such crises, as well as the real possibility of the financial shocks create the assumptions for an uneven economic development thus causing an appearance of the threat of social convulsions.

In 2002–2006, an original theory of the capital management was worked out at Vilnius University (Lithuania). It has been discovered that the logistic growth seems to be based on the idea so well expressed by an American author Flannery O'Connor in the very title of her short story collection "Everything That Rises Must Converge" (1965). In economics, however, this principle has started to be applied only recently (Girdzijauskas S., Streimikiene D., Dubnikovas M., 2009).

The discussed logistic analysis is based on the fundamental principles developed in the classical financial theory. (Merkevicius E. et al., 2007). Based on the mentioned theory of logistic growth, the special curricula have been structured, which more and more often are found as urgent and therefore are successfully developed. Today, since the consistent patterns of economics still do astonish the mankind, the university students of the appropriate study programs should be taught to recognize and model various economic situations.

The logistic theory is much more complex than the classical financial analysis, and no doubt, its mastery requires the specific resources for learning.

The objective of the paper is to comprehensively and visually demonstrate the algorithm of the economic heat and bubble formation.

The main tasks of the paper are:

- to present how the fragile economic situations are formed and to give an example, graphically and comprehensively demonstrating the process of the bubble formation;

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- to help the students in understanding the effectiveness of the logistic model in analyzing the fragile economic situations.

2 LOGISTIC MODELING

The logistic model is applied for the growing populations. Moreover, it should be stressed that growth itself is proportional to the size of the same population and has a determined growth limit. The paper aims to reveal how the comprehension process can be simplified by visualizing the modeling (Girdzijauskas S., Pikturna A., et al., 2008).

In order to employ the principle of logistic growth in calculations, one should have the general understanding of the phenomenon of the exponential change, that may be conveniently expressed by a differential Equation 1 (Girdzijauskas S., 2006, p. 65).

$$\int \frac{dK}{K} = \int k \cdot dt \tag{1}$$

here K is accumulated capital (the amount of the product at the time t); k is the coefficient of proportionality (constant quantity); $K_0 = K(t=0)$ (ibid.).

Modeling the growth of the capital on the basis of this equation, the growth is found to be infinite. In other words, it is obvious that the equation cannot be used to predict the long term capital growth (Girdzijauskas S., 2008).

Already in the 19th century, while studying the alterations in the biological systems, P. F. Verhülst suggested to add a multiplier to the differential equation which has the character of a linearly decreasing function. Let's apply a similar growth-limiting multiplier to the differential product alteration equation (Girdzijauskas S., 2006, p. 277):

$$\frac{dK}{dt} = \left(1 - \frac{K}{K_p}\right) \cdot \ln r \cdot K \tag{2}$$

$$K = \frac{K_p \cdot K_0 \cdot (1+i)^n}{K_p + K_0\left((1+i)^n - 1\right)} \tag{3}$$

here K_0 is initial capital; K_p points to potential capital expressed in the capital amount estimating units; i is the rate of interest; n is the number of the periods of accumulation.

The method of the internal rate of return is one of the essential means in project estimation. When calculating the internal rate of return by using the logistic method, it is necessary to know the potential capital K_p of each member of the payment chain (Moskaliova V., Girdzijauskas S., 2006, p. 91). Then the following equation is worked out:

$$K_0 + \sum_{j=1}^{n} \frac{K_p \cdot K_j}{K_j + (K_p - K_j) \cdot (1+i)^j} = 0 \,. \tag{4}$$

The analysis of the logistic net present value of the money flows and of the internal rate of return show that the effectiveness of an investment (in other words, internal return) depends on the degree of the market filling by the investment capital. (Girdzijauskas S., Streimikiene D. et al, 2009, p.267). Thus, the estimation of the growth resources within the frame of the logistic capital theory turns to be one of the most important tasks in solving the problems of rational capital management.

By adapting the particular software tools and performing the logistic analysis, the economic bubbles and other economic phenomena that make the cause of recessions and crises might be discovered.

For precision, let's explore the heat (growth of the bubble) model within the following example table 1:

The investment project is determined to be realized within 5 years. The net present value (in complex and logistic percentage) with the rate of return: a) 10 %; b) 20 % should be calculated as well as the internal rate of. To perform the logistic calculations it is necessary to take the following: $K_p \in [1; \infty)$ *of the conditional monetary unit.*

Table 1: Money investment flows.

Year	Monetary flows at the end of the year		
	Expenses	Income	Total
0	-1	0	-1
1	-0.5	0	-0.5
2	-0.5	1	0.5
3	-0.5	1	0.5
4	-0.5	1	0.5
5	0	1	1
Total:	-3	4	1

Source: worked out by the authors

Let's explore the profitability of an investment in two ways: (a) by using the complex percentage rule (when the capacity of the market is unlimited); (b) by employing the logistic analysis (when the capacity of the market is limited).

Under the initial condition, we have the following: $K_0 = -1, \ldots, K_5 = 1$; $i = 8\ \%$ (case *a*)) and $i = 12\ \%$ (case *b)*).

Further steps will show the ordinary or **typical calculations.** With the help of the *Microsoft Excel* programme it has been discovered that the *IRR* (internal rate of return) of the project is as follows: IRR = 16.32 %.

Let's calculate the net present value on the basis of the complex percentage, with the internal rate of return making: a) *10%*, b) *20%*. The following values have been obtained: NPV(0.1) = 0.297, NPV(0.2) = -0.137.

In order to understand the essence of the estimation of the project better, let's calculate the approximate internal rate of return on the basis of the complex percentage when the rate of return makes: a) *10 %*, b) *20 %*. The obtained results are as follow:

$$IRR = i_1 + (i_2 - i_1) \cdot \frac{NPV_1}{NPV_1 - NPV_2} \quad (5)$$

here *IRR* is internal rate of return; i_1 is the lower rate of discount; i_2 is the higher rate of discount; NPV_1 is net present value adequate to the lower rate of discount; NPV_2 is net present value adequate to the higher rate of discount. After inserting all the necessary values into Equation 5 the following results have been obtained: IRR = 0.1684; (16.84 %). Having compared the approximate internal rate of return with the actual rate we see that the difference is rather insignificant.

2.1 The Calculation of the Logistic Internal Rate of Return (*LIRR*)

The *LIRR* is calculated with the use of the LNVP equation (Formula 4). It is calculated manually for a better understanding of the essence of the relation between the variables. By means of approximation we find out that *LIRR = 0*. With the help of the MS Excel programme the calculation sequence is as shown in Table 2: we write the chosen *Kp* value in one of the cells; in another one we write a presumed initial value of the rate of interest *i* until the *LNPV* becomes low enough (close to zero). In fact, the obtained rate of interest is the *LIRR* value that we wanted to know. Further on, it will be written into Table 3.

Table 2.

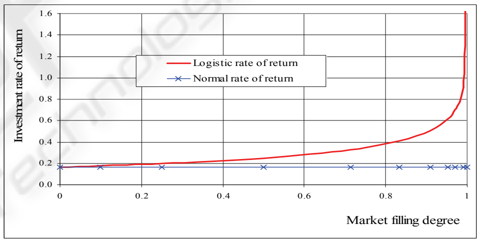
K0	***K1***	***K2***	***K3***	***K4***	***K5***
- 1	- 0.5	0.5	0.5	0.5	1
i	***Kp***	***LNPV =***		- 0.000000738711	
0.700993	1.03				

2.2 The Sequence of Filling in Table 3

To structure a chart of the acceptable quality it is necessary to have at least 10-12 chart points. It should be stressed that the curve zone of the chart is especially significant. Here the density of the chart points should be higher. Having this in mind, let's select the *Kp* value line, recalculate the K / K_p values and write them into the next line. In our case, *K = 1*; it is a member of the largest flow. The logistic values, or the *LIRR* line is filled in as mentioned before: for each K_p value an *i* value is introduced, which makes the *LNPV* to be extremely low: < 10^{-4}. Figure 1 shows the graphical presentation of the solution of the equations (Girdzijauskas S., Moskaliova V., 2005, p. 26).

Table 3.

Kp	100000		10	4	2	1.4
K/Kp	0.00001		0.1	0.25	0.5	0.71
LIRR	0.1632		0.18	0.20	0.25	0.33
Kp	1.2	1.1	1.05	1.03	1.01	1
K/Kp	0.83	0.91	0.95	0.97	0.99	1.00
LIRR	0.41	0.50	0.61	0.70	0.91	2.49



Source: worked out by the authors with the data from Table 2.

Figure 1: Graph of investment heat (or of the growth of internal rate of return).

The economic stability is strongly influenced by the financial bubbles. The classical definition of a financial bubble was introduced by Ch. Kindleberger in 1978. Figure 1 clearly demonstrates that when the investment is approaching the limit, i. e., reaching the K_p value, the threat of the bubble formation appears (Streimikiene D., Girdzijauskas S., 2009, 2008).

The bubble is an exponentially growing increase in price of an asset or a set of assets in a continuous process when the initial increase in price is determined by the vanishing decrease of the capital niche, and the following growth of the internal rate of return. It creates false expectations for a further continuous growth in profitability and hence attracts the new members of the market – in most cases, profiteers who are interested in the profit brought by the asset trade rather than in the assets' capacity to generate income.

3 CONCLUSIONS

- The possibilities for the application of the logistic models in solving the economic problems provide the opportunity to study the formation of the financial bubbles.
- The practical modeling of the economic bubbles allows to understand the assumptions for the formation of the fragile economic situations. Experts in economics should improve their qualification by developing new competences in the market estimation.
- The explored example of the logistic or limited model should help to work out the effective means for the prediction of the economic situations.

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