



# Identification, Analysis, Modeling and Prediction of Time Series Characterizing the Indicators of Asset Structure in the Credit Institutions Operating in Romania

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## ABSTRACT

This paper aims to accurately characterize the dynamics of the structural indicators of the assets in the credit institutions operating in Romania through an empirical mathematical model of dual function: regulation and control. The model can be used to predict the future evolution of the economic processes involved, or to study how to act upon them (management) in case of changes in the environment around them (e.g. the impact of reducing the minimum compulsory reserve requirements on credit, etc.).

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## 1. Introduction

The mathematical model associated to a system is a theoretical concept describing the essential aspects of a representation of the knowledge about that system in a usable form, fit for the purpose for which the model is necessary. The process model can be obtained either analytically (knowledge model) or experimentally (dynamic order model).

The knowledge models (based on physical, chemical etc. laws) allow for fairly complete description of the systems which are used in practice, for process simulation and modeling. These models are generally very complex and rarely directly usable in practice.

The dynamic order models (empirical models) which establish relations between the variations of the input-output values of the system, are necessary for the design or adjustment of the control systems. Although the experimentally derived dynamic order models have a narrower validity range, they allow for the mathematical description of processes that are based on insufficiently known regularities. Such a model can be used for the structure analysis of the assets in the credit institutions operating in Romania.

## 2. Working mode

Generally, the functional description of a system is based on the concepts of input data  $u(t)$ , output data  $y(t)$  and possibly state data  $x(t)$  where  $t$  is time. Unlike most mechanical, physical, chemical, etc. processes, where the mechanism generating the input-output data is clearly visible, there are processes where this generating mechanism takes an abstract form, difficult to represented, such as, for example, the evolution of an economic indicator.

Such processes, as is the case for the time evolution of the structure of assets in the credit institutions operating in Romania, are characterized either by unobservable inputs or extremely difficult to specify or measure. Inputs, the outputs can be observed and measured, even if (internal and external) data that have stimulated the system and made them react are not known. The analysis of a series of measurements made only on the output can provide relevant information on the process that generated it. Therefore, the mathematical model associated with the evolution of the structure indicators used in this paper will be determined only based on the information supplied to output through a set of special identification and modeling techniques of low difficulty.

A first step is to study the inertia of processes. Consequently, it will be seen how the dynamics of the analyzed economic indicators was in the period 2004-2010 in order to establish its evolution law.

A number of observation data, ordered in time, is called time series or dynamic range. In this case, time series are generated by time evolution of the indicators that make up the structure of assets of the credit institutions operating in Romania, whose values are presented in Table 1.

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**Table 1. Assets of the credit institutions operating in Romania (percent of total assets)**

Assets/Year	2004	2005	2006	2007	2008	2009	2010 june
I. Domestic assets, of which:	94,3	96,5	97,4	98,3	98,5	96,9	98,0
Claims on BNR and credit institutions, of wich Claims on the BNR	36,5 28,5	40,0 37,5	34,9 31,3	28,8 24,9	23,8 21,8	18,6 15,7	16,2 13,8
Claims on domestic non-bank sector, of wich:	48,1	48,5	54,8	61,2	63,4	67,5	71,1
• Claims on government sector	2,4	1,9	1,6	3,7	5,0	12,7	14,1
• Claims on corporations	32,7	30,2	30,8	29,9	29,2	27,3	28,8
• Claims on household	13	16,4	22,4	27,6	29,2	27,5	28,2
Other assets	9,6	8,0	7,7	8,3	11,3	10,8	10,7
II. External assets	5,7	3,5	2,6	1,7	1,5	3,1	2,0

To develop a predictive mathematical model, our reasoning will include a series of observations, assumptions and limitations of the data generating mechanism.

The synthetic analysis of the indicators that make up the credit institution assets gives us valuable information about their structure dynamics. The most important information that can be obtained from reading Table 1 are related to the significant variation of some indicators, while other indicators have had a more modest variation.

In the period 2004-2010, the largest variations in the month of June are of the following indicators:

- Claims on BNR/central bank and credit institutions from a maximum of 40% to a minimum of 16.2%;
- Claims on government sector, from a minimum of 1.6% to a maximum of 14.2%;
- Claims on households, from a minimum of 13% to a maximum of 29.3%.

Indicators whose share of the variation in the total assets was modest are the following:

- Foreign assets, with a share of the variation in total assets of 4.2%;
- Other assets, with a share of the variation in total assets of 3.6%;
- Claims on corporations, with a share of the variation in total assets of 5.4%.

**Observation 1.** Above, we identified two groups of indicators, the first consisting of indicators whose share of the variation in total assets exceeds 12% and the second group consists of indicators whose variation in total assets is less than 5.5%. Based on this observation we shall impose a first limitation.

**Limitation 1.** We develop a composite indicator ( $A_c$ ) as the sum of the weights of indicators of little variation, in order to restrict the number of indicators and to simplify the mathematical modeling process:

$$A_c = \Sigma(A_a + A_e + C_c) \quad (1)$$

Where :  $A_a$  = other assets

$A_e$  = external assets

$C_c$  = Claims on corporations

Thus, we have limited to 4 the number of indicators in table 1 and denoted them  $A_1, A_2, A_3, A_4$  as shown in the table below (table 2).

**Table 2. Evolution of the indicators  $A_1, A_2, A_3, A_4$** 

Assets/Year	2004	2005	2006	2007	2008	2009	2010 june
$A_1 = A_c =$ Foreign assets + Other assets + Claims on corporations	48,1	41,7	41,1	39,9	42	41,2	41,5
$A_2 =$ Claims on BNR and credit institutions	36,5	40	34,9	28,8	23,8	18,6	16,2
$A_3 =$ Claims on government sector	2,4	1,9	1,6	3,7	5,0	12,7	14,1
$A_4 =$ Claims on household	13	16,4	22,4	27,6	29,2	27,5	28,2
TOTAL	100	100	100	100	100	100	100

The statistical methodology used in the data sequence numerical analysis and processing described above will be characteristic to the time series analysis or, in other words, the analysis of dynamic series.

The quality of mathematical models is dependent on the quality and accuracy of the available data and the credibility of sources from which such data were obtained. From this point of view, we consider that data accuracy and source reliability are at the highest level (central bank source).

Time-series modeling requires the identification of mathematical functions describing the evolution of the process output (time-series type models). Since the ultimate goal is to obtain an optimal predictor, able to

provide a forecast of future evolution on a certain time horizon of the process which provides measured data, we will go through several steps to allow its proper modeling:

**a). Identification of the time-series generating mechanism.** Because the process being analyzed has unknown or insufficiently known causes, we can not talk about an analytical modeling of the event. In this case one can not establish a strict functional dependence and the choice of a model based only on a theoretical analysis is impossible.

**b). Experimenting protocol.** For the time series in the economic field, experiment planning is possible only to a small extent. Designing the present experiment was reduced to a proper observation of the values taken by the economic indicators concerned, in correlation with their variation dynamics.

**c). Analysis of the identified time series and their description using mathematical equations that characterize the dynamics of the signal analyzed as accurately as possible.**

For the modeling of the time series associated to indicators A1, A2, A3, A4, we see fit a parametric mathematical model. Thus, we considered the following two major steps:

- selection of the general form of the model analytical expression;
- determination of the most probable values of the model parameters.

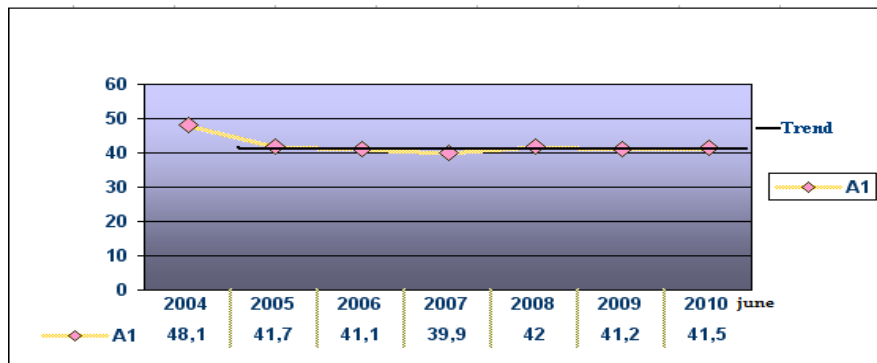
The general guideline for choosing the form of the mathematical expressions used to shape the available data series was provided by the graphical representation of the time evolution of indicators A1, A2, A3 and A4.

Graphical representation of a time series highlights the most important features of its data: presence or absence of trend, the existence of discontinuities, etc. A form of analysis of time series is represented by the decomposition of the series evolution based on three components. Under the action of a complex system of factors, within a time series, the following components can be identified:

- $y [t] t$  - general trend (non-periodic component / trend): it is a variation onto a specific direction which is maintained for a long period of time. Isolated from other parts, it shows the evolution of the process.
- $y [t] c$  - cyclical component: it consists of regular variations that occur throughout the development of the process. This component may consist of a sum of periodic variations of different periods.
- $y [t] a$  - stationary component (random): it consists of high frequency fluctuations which cause the random nature of the time series.

For the conceptual modeling of the non-stationary time-series generating mechanism, A1, A2, A3 and A4, we believe that the most important component is the non-periodic one (trend). In conclusion, the mathematical model chosen will be a system of parametric equations associated with the trends of the four indicators.

**Figure 1. Trend of indicator A1 = foreign assets + other assets + receivable claims on corporations**



As expected, the composite indicator  $A_c$  has a very small variation (if we exclude year 2004).

$$V_{med} = 41,7 + 41,1 + 39,9 + 42 + 41,2 = 41,18$$

According to the algorithm used for studying charts, an aberrant (random) maximum is found in 2004, due to unique circumstances (not to be repeated). Therefore we removed the random value and plotted the trend of the indicator (fig. 1).

The average value of the indicator A1 calculated by adding multi-annual values (less the value in 2004) and divided by the number of measurements taken into account (i.e. 5) is:

$$V_{med} = 41,7 + 41,1 + 39,9 + 42 + 41,2 = 41,18$$

Scattering of the annual time-series A1 values around  $V_{med}$  value is within the range  $[-1,28; 0,82]$ , which is small. As such, we must impose a first condition to the mathematical model:

**Condition 1:**  $V_{2005} = V_{2006} = V_{2007} = V_{2008} = V_{2009} = V_{med}$ .

Mathematical modeling of the trend will be achieved by a 1st order polynomial of a parametric equation form:

$$Y [t] = m \cdot t + n$$

where:

t is time [years];

$m = tg\alpha$  is the parameter;

$n = y(i)$  is the indicator value at the initial moment of the period concerned;

$$YA1(t) = t \cdot \text{tg}\alpha + n; \quad \text{tg}\alpha = [y(f) - y(i)] / [t(f) - t(i)] = 0 \text{ because } y(f) = y(i) = V_{\text{med}}$$

The equation becomes:  $YA1(t) = n = V_{\text{med}}$

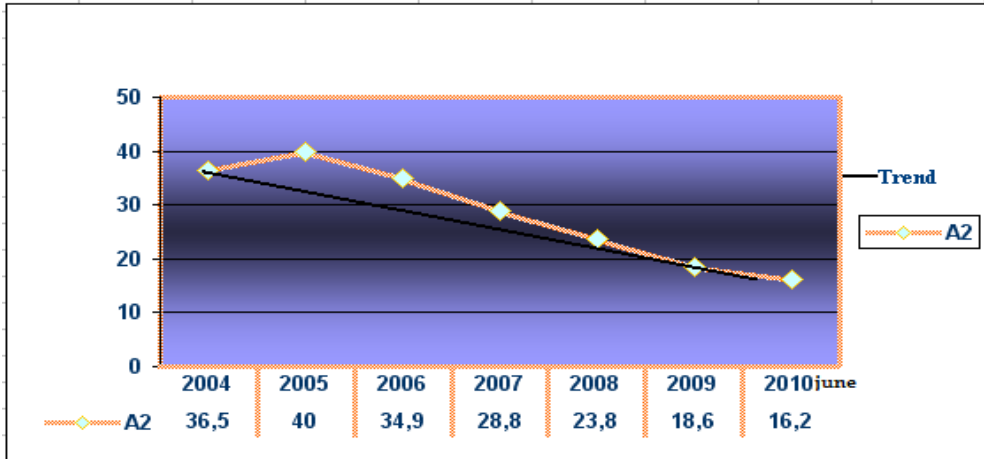
$$YA1(t) = 41,18 \quad (1)$$

Therefore, condition 1 above may be rewritten as :

**Condition 1:**  $YA1(t) = 41,1 = \text{constant}$

It is noted that we did not take into account the value recorded in June 2010 in order to comply with the terms of homogeneity rule, which requires that the data series values that define the content of the analyzed process be calculated using the same methodology and be expressed in the same unit of measure throughout the time period of the series. The value recorded in June 2010 does not comply with one-year measurement period valid to all other series of data values characteristic of the process (they could be seasonal)

**Figure 2. A2-trend indicator - Claims on central bank and credit institutions**



A first observation that can be done by studying the chart/graphic above is that the maximum amplitude of the indicator evolution was reported in 2005, while the minimum amplitude occurred in the crisis year 2009. Since reaching the maximum amplitude in the second year of the time series, the evolution was relatively uniformly downward until the last year of the time series, when the minimum amplitude was reached. This decrease could be accounted for by the central bank policy of continuous reduction of the minimum compulsory reserves.

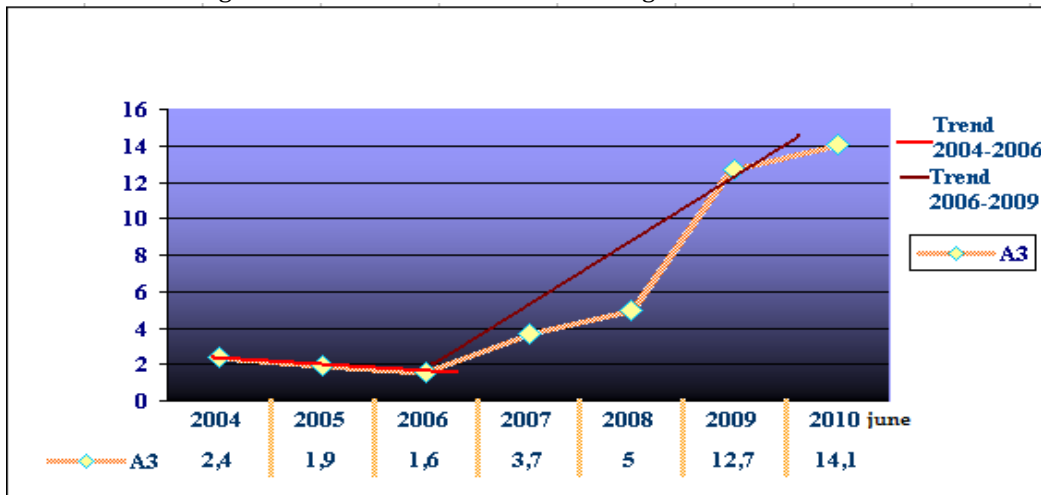
We believe the mechanism generating such a nonstationary time series and the nonperiodic trend are determined by the simultaneous action of deterministic (e.g. central bank policies) and random (e.g. chaotic financial markets reaction to various external stimuli) factors.

Mathematical modeling of the trend will be made with the same 1st order polynomial, of the form of a parametric equation as for indicator A1:  $Y[t] = m \cdot t + n$

When calculating the parameter  $m$ , we will not take into account the value recorded in June 2010 to comply with the terms homogeneity rule. Parametric equation of the trend becomes:

$$YA2(t) = [(18,6 - 36,5) / 5]t + 36,5 \quad \text{or} \quad YA2(t) = -3,5t + 36,5 \quad (2)$$

**Fig. 3. Trend of indicator A3- claims on government sector.**



The graph shows in the increasing subperiod an abrupt stage in 2008-2009. This event coincides with the moment of maximum intensity with the financial crisis, and reflects the government urgent need for funding at that delicate moment. We believe the mechanism generating such a nonstationary time series and nonperiodic trend is determined by the simultaneous action of deterministic (eg government policy) and random (the manifestation of all forms of financial crisis) factors.

Parametric equation of the trend in the downward sub-period is:

$$YA3(t) = [(1,6-2,4) / 2]t + 2,4 \text{ or:}$$

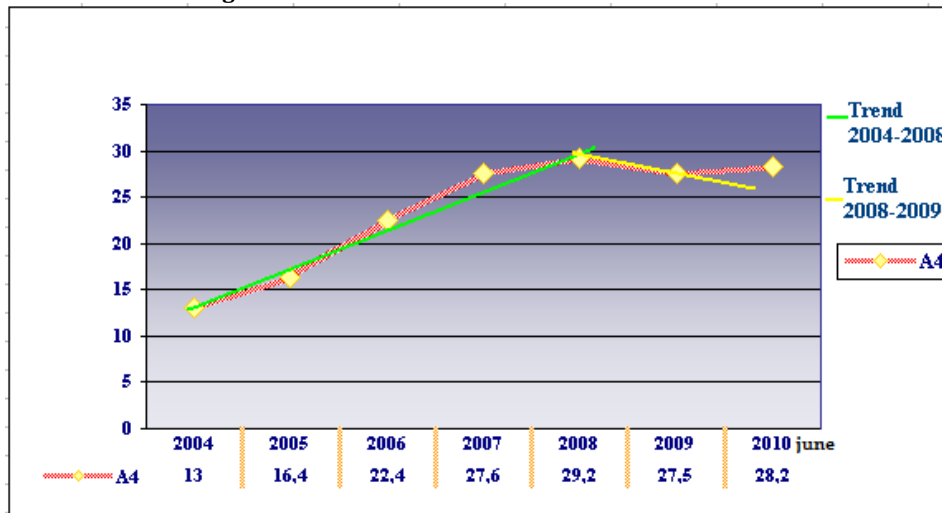
$$YA3(t) = -0,4t + 2,4 \text{ for } t=0;1;2$$

Parametric equation of the trend in the upward sub-period is:

$$YA3(t) = [(12,7-1,6) / (5-2)](t-2) + 1,6 \text{ or:}$$

$$YA3(t) = 3,7(t-2) + 1,6 \text{ for } t=2;3;4 \dots n \quad (3)$$

Figure 4. A4-trend indicator- Claims on households



A first observation that can be done by studying the graph above is that this indicator has two sub-periods: an ascending one in 2004-2008 and a descending one during 2008-2009.

The mechanism generating such a nonstationary time series and nonperiodic trend is determined by the simultaneous and combined action of the deterministic (banks chase after high yield) and random (aberrant evolution of the real estate market, chaotic behavior of participants on this market) factors.

Parametric equation of the trend in the upward sub-period is:

$$YA4(t) = [(29,2-13) / 4]t + 13 \text{ or:}$$

$$YA4(t) = 4t + 13 \text{ for } t=0;1;2;3;4$$

Parametric equation of the trend in the downward sub-period is:

$$YA4(t) = [(27,5-29,2) / (5-4)](t-4) + 29,2 \text{ or:}$$

$$YA4(t) = -1,7(t-4) + 29,2 \text{ for } t=4;5;6 \dots n \quad (4)$$

#### Prediction of future values for indicators A1, A2, A3, A4

In most cases, time-series analysis and modeling are performed for prediction purpose. In a general, to provide - to develop a forecast (prediction) - it is necessary to know and be able to assess in time the likely mode of development of events or phenomena. In this case, predictive mathematical model is an equation system consisting of the four parametric equations of the time series trends A1, A2, A3 and A4, in the period 2008-2009:

- (1)  $YA1(t) = 41,1$
- (2)  $YA2(t) = -3,5t + 36,5$
- (3)  $YA3(t) = 3,7(t-2) + 1,6 \text{ for } t=2;3;4 \dots n$
- (4)  $YA4(t) = -1,7(t-4) + 29,2 \text{ for } t=4;5;6 \dots n$

To eliminate mathematical errors due to approximations (trends are approximations of the evolution of the indicators being analyzed) we shall impose a new condition to the predictive model, called the **condition of homogeneity**.

**Condition 2 (homogeneity):** The sum of increases and decreases in the indicators A1, A2, A3, A4 should be null.

This condition derives from the known fact (Table 1) that the sum of percentage values of the indicators is always 100%. We call this value deviation the deviation (error) of non-linearity and, although the prediction for the year 1 is small, it should be corrected to avoid aberrant values for prediction horizons of order 2,3,4, etc. ... Linearity deviation calculation, denoted  $Q_i$ , is made by the formula:

$Q_i = 100 - \Sigma(\text{Values predicted in the prediction year „i”})$  where:

Qi is the deviation of nonlinearity for prediction year „i”

It will be used a simple algorithm, namely, the functions associated with the evolution of indicators will be summed up and the non-linearity deviation will be then added, knowing that their sum must always be 100.

$$YA1(t) = 41,1$$

$$YA2(t) = -3,5t + 36,5$$

$$YA3(t) = 3,7(t-2) + 1,6$$

$$YA4(t) = -1,7(t-4) + 29,2 \quad t \geq 4$$

$$\Sigma YAn(t) = \Sigma [YA1(t) + YA2(t) + YA3(t) + YA4(t)] = 41,8 - 3,5t + 36,5 + 3,7(t-2) + 1,6 - 1,7(t-4) + 29,2$$

$$\Sigma YAn(t) = -1,5t + 107,8$$

But, as shown above,  $\Sigma YAn(t) + Qi = 100$  where:

(Qi) is the deviation of linearity for predictors of order "i"

$$n = 1, 2, 3, 4$$

The equation becomes:  $-1,5t + 107,8 + Qi = 100$ , namely:

$$\text{Condition 2 becomes: } Qi = 1,5t - 7,8$$

The correction factors Ci(A1), Ci(A2), Ci(A3), Ci(A4) (for the prediction horizon of order "i"), which we will apply to each nonlinear indicator will be calculated as a percentage of Qi depending on the weight of each of them in their total sum in 2009 (the last values made known):

Ci (A1) = 0 because indicator A1 is constant (**condition 1**). **If A1d were given a correction factor Ci different from 0, then YA1 (t) would become a time-dependent function.**

Sum of indicators A2, A3, A4, in 2009 is 26,6+15,8+16,5=58,9

$$Ci(A2) = (16,5/58,9)Qi = 0,28Qi$$

$$Ci(A3) = (15,8/58,9)Qi = 0,27Qi$$

$$Ci(A4) = (26,6/58,9)Qi = 0,45Qi$$

The predictive mathematical model is:

**Table 3. Predictive mathematical model**

Assets	SYSTEM PARAMETERS EQUATIONS t is time (t=6 for 2010; t=7 for 2011; t=8,9,...) <b>t ≥ 4</b>
A1=AC=Foreign assets+Other assets + Claims on corporations	<b>YA1(t) = 41,1</b>
A2=Claims on BNR and credit institutions	<b>YA2(t) = -3,5t + 36,5 + 0,28Qi</b>
A3=Claims on government sector	<b>YA3(t) = 3,7(t-2) + 1,6 + 0,27Qi</b>
A4=Claims on household	<b>YA4(t) = -1,7(t-4) + 29,2 + 0,45Qi</b>
<b>Nonlinearity deviation</b>	<b>Qi = 1,5t - 7,8</b>

If the nonlinearity deviation Qi is introduced in the system of equations, the final form of the predictive model (corrected by the nonlinearity deviation) is obtained:

**Table 5. Static predictive mathematical model**

Assets	SYSTEM PARAMETERS EQUATIONS t is time (t=6 for 2010; t=7 for 2011; t=8,9,...) <b>t ≥ 4</b>
A1=AC=Foreign assets+Other assets + Claims on corporations	<b>YA1(t) = 41,1</b>
A2=Claims on BNR and credit institutions	<b>YA2(t) = -3,08·t + 34,316</b>
A3=Claims on government sector	<b>YA3(t) = 4,105·t - 7,906</b>
A4=Claims on household	<b>YA4(t) = -1,025·t + 32,49</b>
<b>Condition of homogeneity</b> <b>Σ YAi(t)=100</b> is fulfilled	<b>Σ YAi(t) = 0·t + 100 = 100</b>

As seen in the table above, homogeneity condition is fulfilled 100%. As such, we can say that the mathematical model accuracy is maximum, or, in other words, the prediction error due to mathematical modeling is zero.

But the static model is only an intermediary step in achieving a dynamic model. In the last part of this paperwork we shall transform the linear (static) model, dependent on a single variable (time) into a dynamic control and command model. More precisely, we shall introduce a new variable into the mathematical model that allows the introduction of values assumed for a horizon "k" (a future horizon, randomly, for example k = 5) in order to simulate what might happen to a horizon "k + n" (eg horizon 7). This is the function of command. But the most important feature of the model will be able to permanently adjust the mathematical

model, as new data are achieved. Therefore, by updating the mathematical model with new achieved data, predictions will be adjusted as well so that the predictive model was not quickly become invalid.

The linear (static) made presents fairly accurately the evolution trends of the indicators on a time-limited horizon. But it is possible that these trends undergo major changes, in which case, predictions would lose quality.

The possibility to change the trend is the very starting point in choosing the control mechanism. The changing trend is, from a mathematical point of view, changing the slope of the trend. In order to solve the trend equation we shall impose the following conditions:

**Condition 3: In the trend equations presented in the mathematical model, the initial values shall not be changed (yi).**

**Condition 4: it shall only be changed the parameter m of the equations (m= tgα).**

$$tg\alpha = [y(f) - y(i)] / [t(f) - t(i)]$$

In the system of equations, the number of time intervals counted by the year 2009 was  $[t(f) - t(i)] = 5$

Therefore : parameter becomes  $tg\alpha = [y(f) - y(i)] / [t(f) - t(i)] = [y(f) - y(i)] / 5$

where

y (f), are the values recorded in 2009;

y (i) - equation initial values that we find in our mathematical model.

But at a future moment "k" we shall have for y (f) a future value that we denote "Wk".

In this case, the number of intervals used in calculating the parameter will be:

$$[t(f) - t(i)] = 5 + k$$

The expression of the parameter becomes:

$$tg\alpha = [Wk - y(i)] / [5 + k]$$

The mathematical model becomes:

**Table 6. Dynamic predictive mathematical model**

Assets	SYSTEM PARAMETERS EQUATIONS (t=6;k=1 for 2010; t=7;k=2 for 2011; etc,...) Wk -are the latest values which are made known or fictitious values used for simulations; $t \geq 4$
A1=AC=Foreign assets+Other assets + Claims on corporations	$y(A1) = 41,1$
A2=Claims on BNR and credit institutions	$y(A2) = [(Wk2 - 34,316) / (5 + k)] \cdot t + 34,316$
A3=Claims on government sector	$y(A3) = [(Wk3 + 7,906) / (5 + k)] \cdot t - 7,906$
A4=Claims on household	$y(A4) = [(Wk4 - 32,49) / (5 + k)] \cdot t + 32,49$
<b>Condition of homogeneity</b> $\Sigma YAi(t) = 100$ is fulfilled	$\Sigma y(Ai) = 0 \cdot t + 100 = 100$

As we can see, the command and / or adjustment button is Wk and k is the step (or beat).

To highlight the effect of adjusting the predictive model "refreshing" with data taken in 2010 (data published by the central bank in September 2011) we shall make predictions for 2011 by the two (static and dynamic) models and we introduce the data obtained in a comparative table (Table 7)

**Table 7. Achieved and predicted values for 2010 and predicted values for 2011 with static and dynamic models**

Prediction horizon	2010 BNR data values made	2010 STATIC MODEL predicted values	2011 STATIC MODEL predicted values	2011 DYNAMIC MODEL predicted values
<b>Assets</b>				
A1=AC=Foreign assets+Other assets + Claims on corporations	41,1	41,1	41,1	41,1
A2=Claims on BNR and credit institutions	16,5	15,9	12,8	13,533
A3=Claims on government sector	15,8	16,7	20,8	19,751
A4=Claims on household	26,6	26,3	25,3	25,618
TOTAL	100	100	100	100

### 3. Conclusions

1. Graphic representations of time series analyzed above and identification of the parametric equations of the nonperiodic component for each series, allow to identify the following important elements in the evolution of dynamic processes that generated the series:

- Absence of non-periodic component (trend) for time series generated by multi-annual evolution of the indicator A1, parametric equation of the trend, in this case being a constant, as confirmed by the predictive value for 2010 coincides practically with the value achieved in 2010.
- The continuous tendency of decrease of the indicator A2 (claims on BNR or claims on credit institutions) could be attributed to the central bank response to multiple challenges in the period analyzed, most of all, further reducing the level of minimum reserves.
- The existence of two distinct sub-periods in the evolution of the indicator A3 (claims on government), the first sub-period (decreasing) whose intensity is low, while the second subperiod (ascending) was carried out with maximum intensity. In addition, the second sub-period shows a steep area in 2008-2009, when the government has covered the massive deficit borrowing from banks.
- The existence of two distinct sub-periods in the evolution of indicator A4 (claims on households), the first, increasing, subperiod, is of the maximum intensity (up to 2008) and the second, decreasing, sub-period (since 2008 to present) of a lower intensity. The intensive increase in the first sub-period was due to the boom of consumer credit and real estate, supported by banks (in their fierce competition for high returns).
- The intensity of an economic phenomenon is given by the slope associated with the non-periodic component (trend). From the study of the angular coefficients of the straight lines associated with the trends for the dynamic series A2, A3 and A4 in the most intense period (2006-2008) it is observed that  $\alpha$  angle values for each series are very close ( $74^\circ$  for A2,  $74.8^\circ$  for A3,  $75.9^\circ$  for A4). This tells us that the phenomena analyzed were developed virtually at the same intensity.
- The structure of the asset of the credit institutions operating in Romania is a homogeneous structure and any mutation undergone by a component indicator causes rapid reactions and of the same intensity as the other indicators.

2. The objective of this work has been reached because:

- The maximum amount of information was extracted from the table of the values of the time series associated with the indicators and from the graphical representations, the main aspect pursued being understanding economic phenomena and the mutations produced in the structure of bank assets, and identification of key moments in their evolution in order to develop a final predictive valid model.
- A valid predictive model was developed, consisting of 4 parametric equations of the trends of the time series A1, A2, A3 and A4 and, based on the model, future values of the series were predicted using the previous values.
- The predictive mathematical model has dual function: command and control.

3. The predictive model presented in this paper can be used to make simulations and see what can happen if certain parameters of the model are changed, with the ultimate goal to identify a process control method that generated the time series associated with the indicators concerned or the establishment of an intervention policy when the process deviations relative to a certain target exceed a certain value.

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