International Conference "Risk in Contemporary Economy"
ISSN online 2344-5386 ISSN print 2067-0532
XIVth Edition, 2013, Galati, Romania,
"Dunarea de Jos" University of Galati – Faculty of Economics and Business Administration

THE TREND MODEL OF THE INFLATION RATE IN ROMANIA

Gabriela OPAIŢ
gabriela.opait@ugal.ro
Dunarea de Jos University of Galaţi

This paper presents the econometric modeling concerning the inflation rate in Romania, between 2000-2013 through by means of the „Least Squares Method". At the calculation of the inflation rate we consider all the products and services which join in the consumption of the population, including: dairy products (nutriments, gasoline, newspapers); products for long utility (clothes, LED-TV sets, cars); services (hairdresser).

Key words: inflation rate, trend, food products, non-food products, services.

JEL Code: C1, C12, C2.

1. Introduction

I presented in this research a statistical analysis of the trend concerning the inflation rate in Romania, between the years 2000-2013. The purpose of the research reflects the possibility for to anticipate the inflation rate through by means of the forecasting methods. The statistical methods used are the coefficients of variation method, the „Least Squares Method" applied for to calculate the parameters of the regression equation and the forecasting method through the „Least Squares Method". The sections 2 reflects the methodology for to achieve the trend model for the inflation rate in Romania, in the period 2000-2013, with the help of the „Least Squares Method". The section 3 expresses how we can to select the best model of trend for the inflation rate on the base of the coefficients of variation method. The section 4 presents the forecasting method through the „Least Squares Method". The state of the art in this domain is represented by the research belongs to Carl Friederich Gauss, who created the „Least Squares Method" [2].

2. The modeling of the trend concerning the inflation rate in Romania, between 2000-2013.

In the period 2000-2013, we observe the next evolution concerning the inflation rate in Romania, according to the table no. 1:

Table no. 1 The evolution of the inflation rate in Romania, in the period 2000-2013

Years	Inflation Rate in Romania (%)
2000	45,7
2001	34,5
2002	22,5
2003	15,3
2004	11,9
2005	9,00
2006	6,56
2007	4,84
2008	7,85
2009	5,59
2010	6,09
2011	5,79
2012	3,33
2013	3,50

Source: I.N.S.E.E. - I.P.C. – series of dates

On the base of the table no. 1, we want to identify the trend model for the inflation rate in Romania, in the period 2000-2013.

- if we formulate the null hypothesis H_0 *:* who mentions the assumption of the existence for the model of tendency of the factor *X = the inflation rate in Romania,* right the function $x_{t_i} = a + b \cdot t_i$, then the parametres *a* and *b* of the adjusted function of the premier degree, can to be calculated by means of the next system [2]:

$$\begin{cases} n \cdot a = \sum_{i=-m}^{m} x_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot x_i \end{cases}$$

Therefore,
$$a = \frac{\sum_{i=-m}^{m} x_i}{n}$$

and
$$b = \frac{\sum_{i=-m}^{m} t_i \cdot x_i}{\sum_{i=-m}^{m} t_i^2}$$

Table no. 2. The estimate of the value for the variation coefficient in the case of the adjusted function of the premier degree, in the hypothesis concerning the linear evolution for the inflation rate in Romania, between the years 2000-2013

Years	The Inflation Rate in Romania (%) (x_i)	*LINEAR TREND*				
		t_i	t_i^2	$t_i x_i$	$x_{t_i} = a + bt_i$	$\lvert x_i - x_{t_i} \rvert$
2000	45,7	-7	49	-319,9	28,6743	17,03
2001	34,5	-6	36	-207,0	26,4397	8,06
2002	22,5	-5	25	-112,5	24,2051	17,10
2003	15,3	-4	16	-6,21	21,9705	6,67
2004	11,9	-3	9	-35,70	19,7359	7,84
2005	9,00	-2	4	-18,00	17,5013	8,50
2006	6,56	-1	1	-6,50	15,2667	8,71
2007	4,84	1	1	4,84	10,7975	5,96
2008	7,85	2	4	15,70	8,5629	0,71
2009	5,59	3	9	16,77	6,3283	0,74
2010	6,09	4	16	24,36	4,0937	2,00
2011	5,79	5	25	28,36	1,8591	3,93
2012	3,33	6	36	19,98	-0,3755	3,71
2013	3,50	7	49	24,50	-2,6101	6,11
TOTAL	182,45	0	280	-625,70	182,4494	97,07

If we calculate the statistical dates for to adjust the liniar function, we obtain for the parametres *a* and *b* the values:

$$a = \frac{182,45}{14} = 13,0321$$

$$b = \frac{-625,70}{280} = -2,2346$$

Hence, the coeficient of variation for the adjusted function of the premier degree is:

$$v_I = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^I \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^I \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{97,07}{182,45} \cdot 100 = 53,20\%$$

- in the situation of the alternative hypothesis H_1 *:* who specifies the assumption of the existence for the model of tendency of the factor *X = the inflation rate in Romania*, right the parabolical function $x_{t_i} = a + b \cdot t_i + ct_i^2$, the parametres *a*, *b* şi *c* of the adjusted function of the second degree, can to be calculated by means of the system [2]:

$$\begin{cases} n \cdot a + c \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} x_i \\ b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot x_i \\ a \cdot \sum_{i=-m}^{m} t_i^2 + c \sum_{i=-m}^{m} t_i^4 = \sum_{i=-m}^{m} t_i^2 \cdot x_i \end{cases}$$

Consequently,

$$a = \frac{\sum_{i=-m}^{m} t_i^4 \cdot \sum_{i=-m}^{m} x_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} t_i^2 \cdot x_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

$$b = \frac{\sum_{i=-m}^{m} t_i \cdot x_i}{\sum_{i=-m}^{m} t_i^2}$$

$$c = \frac{n \cdot \sum_{i=-m}^{m} t_i^2 \cdot x_i - \sum_{i=-m}^{m} t_i^2 \cdot \sum_{i=-m}^{m} x_i}{n \cdot \sum_{i=-m}^{m} t_i^4 - (\sum_{i=-m}^{m} t_i^2)^2}$$

If we calculate the statistical dates for to adjust the second function, we obtain for the parametres *a, b* and *c* the next values:

$$a = \frac{9.352 \cdot 182,45 - 280 \cdot 5.058,38}{14 \cdot 9.352 - 78.400} = 5,5195$$

$$b = \frac{-625,7}{280} = -2,2346$$

$$c = \frac{14 \cdot 5.058,38 - 280 \cdot 182,45}{14 \cdot 9.352 - 78.400} = 0,3756$$

Table no. 3 The estimates of the value for the variation coefficient in the case of the adjusted function of the second degree, in the hypothesis concerning the parabolic evolution for the inflation rate in Romania, between the years 2000-2013

Years	The Inflation Rate in Romania (%) (x_i)	PARABOLIC TREND					
		t_i	t_i^2	t_i^4	$t_i^2 x_i$	$x_{t_i} = a + bt_i + ct_i^2$	$\lvert x_i - x_{t_i} \rvert$
2000	45,7	-7	49	2.401	2.239,3	39,5661	6,13
2001	34,5	-6	36	1.296	1.242,0	32,4487	2,05
2002	22,5	-5	25	625	562,5	26,0825	3,58
2003	15,3	-4	16	256	244,8	20,4675	5,17
2004	11,9	-3	9	81	107,1	15,6037	3,70
2005	9,00	-2	4	16	36,0	11,4911	2,49
2006	6,56	-1	1	1	6,56	8,1297	1,57
2007	4,84	1	1	1	4,84	3,6605	1,18
2008	7,85	2	4	16	31,40	2,5527	5,30
2009	5,59	3	9	81	50,31	2,1961	3,39
2010	6,09	4	16	256	97,44	2,5907	3,49
2011	5,79	5	25	625	144,75	3,7365	2,05
2012	3,33	6	36	1.296	119,88	5,6335	2,30
2013	3,50	7	49	2.401	171,50	8,2817	4,78
TOTAL	182,45	0	280	9.352	5.058,38	181,4410	47,18

So, the coeficient of variation for the adjusted function of the second degree has the value:

$$v_{II} = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{II} \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{II} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{47,18}{182,45} \cdot 100 = 25,86\%$$

- in the case of the alternative hypothesis H_2 *:* who describes the supposition the assumption of the existence for the model of tendency of the factor *X = the inflation rate in Romania*, right the exponential function $x_{t_i} = ab^{t_i}$, then the parametres *a* and *b* of the adjusted exponential function, can to be calculated by means of the next system [2]:

$$\begin{cases} n \cdot \lg a = \sum_{i=-m}^{m} \lg x_i \\ \lg b \cdot \sum_{i=-m}^{m} t_i^2 = \sum_{i=-m}^{m} t_i \cdot \lg x_i \end{cases}$$

Thus,

$$\lg a = \frac{\sum_{i=-m}^{m} \lg x_i}{n}$$

and $$\lg b = \frac{\sum_{i=-m}^{m} t_i \cdot \lg x_i}{\sum_{i=-m}^{m} t_i^2}$$

Table no. 4 The estimate of the value for the variation coefficient in the case of the adjusted exponential function, in the hypothesis concerning the exponential evolution for the inflation rate in Romania, between the years 2000-2013

Years	The Inflation Rate in Romania (%) (x_i)	EXPONENTIAL TREND					
		t_i	$\lg x_i$	$t_i \lg x_i$	$\lg x_{ti} = \lg a + t_i \lg b$	x_{ti}	$\lvert x_i - x_{t_i} \rvert$
2000	45,7	-7	1,659916200	-11,61941340	1,458029407	28,71	16,99
2001	34,5	-6	1,537819095	-9,226914570	1,387721507	24,42	10,08
2002	22,5	-5	1,352182518	-6,760912591	1,317413607	20,77	1,73
2003	15,3	-4	1,184691431	-4,738765723	1,247105707	17,66	2,36
2004	11,9	-3	1,075546961	-3,226640884	1,176797807	15,02	3,12
2005	9,00	-2	0,954242509	-1,908485019	1,106489907	12,78	3,78
2006	6,56	-1	0,816903839	-0,816903839	1,036182007	10,87	4,31
2007	4,84	1	0,684845361	0,684845361	0,895566207	7,86	3,02
2008	7,85	2	0,894869656	1,789739313	0,825258307	6,69	1,16
2009	5,59	3	0,747411807	2,242235424	0,754950407	5,69	0,10
2010	6,09	4	0,874617292	3,138469171	0,684642507	4,84	1,25
2011	5,79	5	0,762678563	3,813392819	0,614334607	4,11	1,68
2012	3,33	6	0,522444233	3,134665401	0,544026707	3,50	0,17
2013	3,50	7	0,544068044	3,808476310	0,473718807	2,98	0,52
TOTAL	182,45	0	13,52223750	-19,68621223			50,27

Consequently, if we calculate the statistical dates for to adjust the exponential function, we obtain for the parametres *a* and *b* the values:

$$\lg a = \frac{13{,}52223751}{14} = 0{,}965874107$$

$$\lg b = \frac{-19{,}68621223}{280} = -0{,}0703079$$

Accordingly, the coeficient of variation for the adjusted exponential function has the next value:

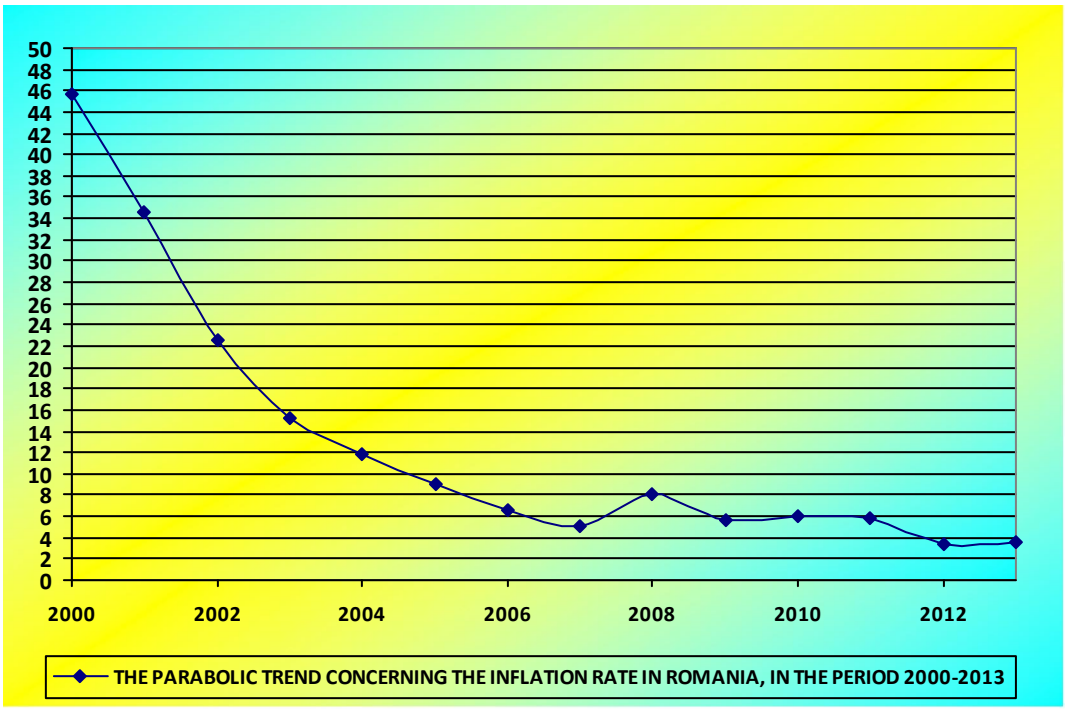
$$v_{\exp} = \left[\frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{\exp} \right|}{n} : \frac{\sum_{i=-m}^{m} x_i}{n} \right] \cdot 100 = \frac{\sum_{i=-m}^{m} \left| x_i - x_{t_i}^{\exp} \right|}{\sum_{i=-m}^{m} x_i} \cdot 100 = \frac{50{,}27}{182{,}45} \cdot 100 = 27{,}55\%$$

3. The selection of the best model of trend for the inflation rate on the base of the coefficients of variation method.

We apply the coefficients of variation method as criterion of selection for the best model of trend. We notice that:

$$v_{II} = 25{,}86\% = v_{\exp} = 27{,}55\% < v_I = 53{,}20\%$$

So, the road reflected by the X factor,which represents the inflation rate in Romania in the period 2000-2013, is a parabolic trend of the shape $x_{t_i} = a + bt_i + ct_i^2$, with other words it confirms the hypothesis H_1.



The type no. 1 The model of trend concerning the values for the inflation rate, in Romania, in the period 2000-2013

We observe that, the cloud of points which reflects the values concerning the inflation rate in Romania, in the period 2000-2013, it carrying around a parabolic model of trend, according to the type no.1.

4. The forecasting method through the „Least Squares Method"

We know that the inflation rate has a parabolic trend of the shape $x_{t_i} = a + bt_i + ct_i^2$. So, in 2014, the inflation rate will be:

$$Inflation\_Rate_{2014} = 5{,}5195 + (-2{,}2346) \cdot 8 + 0{,}3756 \cdot 8^2 = 11{,}68\%$$

5. Conclusions

We can to synthesize that the inflation is the process of significant and persistent increase of the prices. Inflation is a major obstacle in the road of the implementation concerning the politics of economic growth. The phenomenon of inflation cannot be controlled in totally, but he cans be influenced, so the countries which anticipating the evolution of the inflation using the arsenal of the statistical methods, have only won.

References

[1]. Björck A. – „Numerical Methods for Least Squares Problems", Linköping University Publishing House, Linköping, Sweden, 1996.
[2]. Gauss C. F. - „Theoria Combinationis Observationum Erroribus Minimis Obnoxiae", Apud Henricum Dieterich Publising House, Gottingae, 1823.
[3]. Kariya T., Kurata H. - „Generalized Least Squares", John Wiley&Sons Publishing House, Hoboken, 2004.
[4]. Prasada Rao D.S., Doran H.E., Selvanathan E.A. – „Estimation of General and Commodity - Specific Inflation Rates Using Linear Time - Varying Constraints", Journal of Agricultural and Applied Economics, no. 34, 2002.
[5]. Rao Radhakrishna C., Toutenburg H., Fieger A., Heuman C., Nittner T., Scheid S. - „Linear Models: Least Squares and Alternatives", Springer Series in Statistics, Springer-Verlag New York – Berlin Heidelberg Publishing House, New-York, 1999.
[6]. Verbeek M. -„A Guide to Modern Econometrics", J. Wiley & Sons. L.T.D. Publishing House, New York, 2000.
[7]. Wolberg J. - „Data Analysis Using the method of Least Squares: Extracting the Most Information from Experiments", Springer-Verlag New York – Berlin Heidelberg Publishing House, New-York, 2006.