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Method of Identification of Wave Regularities According to Statistical Data (Of Dynamics of a Rate of Inflation of US Dollar)

Mazurkin Peter Matveevich

Department of Environmental Engineering, Volga State University of Technology, Yoshkar-Ola, Republic of Mari El, Russian Federation

Email address:
kaf_po@mail.ru

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Abstract: The method of identification is shown on the example of dynamics of a rate of inflation of US dollar on months from January 2000 to May 2015. The equations of a trend and oscillatory indignations on the basis of steady laws on the generalized wave function in the form of an asymmetric wavelet signal with variables of amplitude and the period of fluctuation are received. In total are revealed 14 mega, macro and meso fluctuations of economy of the USA on a dollar rate of inflation. On the remains it is possible to receive a set of microfluctuations. Schedules of components of the generalized model of a wavelet signal allow to see a picture of dynamics of inflation visually. On the revealed equations it is possible to carry out the amplitude-frequency analysis.

Keywords: Wavelet, Identification, Us Dollar, Dynamics of Inflation, Regularity

1. Introduction

Unlike deductive approach to wavelet analysis proceeding from the equations of classical mathematics inductive approach when statistical selection is primary is offered and concerning it the structure and values of parameters of the *generalized wave function* [1-10, 12, 13] is identified.

In this article the method of identification is applied to inflation of US dollar.

Any phenomenon (time cut) or process (change in time) according to sound tabular statistical quantitative data (a numerical field) inductively can be identified the sum of asymmetric wavelet signals of a look

$$y = \sum_{i=1}^{m} y_i \, , \; y_i = A_i \cos(\pi x / p_i - a_{8i}) \, , \qquad (1)$$

$$A_i = a_{1i} x^{a_{2i}} \exp(-a_{3i} x^{a_{4i}}) \, , \; p_i = a_{5i} + a_{6i} x^{a_{7i}} \, ,$$

where y - indicator (dependent variable),

i - number of the making statistical model (1),

m - the number of members of model depending on achievement of the remains from (1) error of measurements,

x - explanatory variable,

A_i - amplitude (half) of fluctuation (ordinate),

p_i - half-cycle of fluctuation (abscissa),

$a_1 ... a_8$ - the parameters of model (1) determined in the program environment CurveExpert (URL: http://www.curveexpert.net/).

On a formula (1) with two *fundamental physical constants* e (Napier's number or number of time) and π (Archimedes's number or number of space) the *quantized wavelet signal* is formed from within the studied phenomenon and/or process.

To the USA also there is an inflation of the dollar approximately to 3.2% a year [11].

2. Model for the Period 01.2000-11.2014

The current annual rate of inflation on months since January 2000 ($i_м = 1$) till November, 2014 ($i_м = 178$) gave a trend (fig. 1) on a formula

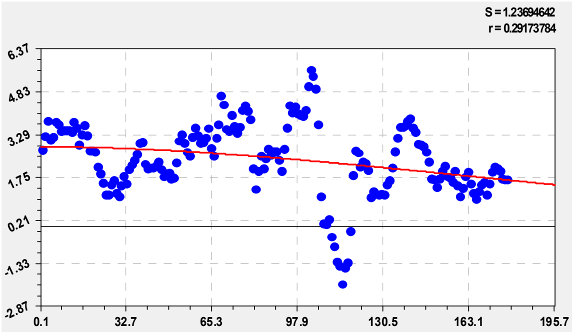
$$k = 2.86112 \exp(-3.43194 \cdot 10^{-5} i_м^{1.86557}) \, , \qquad (2)$$

where k - current monthly index of inflation, %, $i_м$ - number of month about reference marks (January 2000).

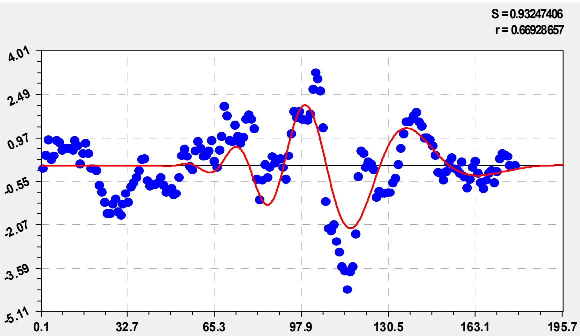
Symmetry in an arrangement of basic data that points to conscious management of inflation is visible.

The trend is classical, focused on decrease in a rate of inflation in the future under the exponential law of death.

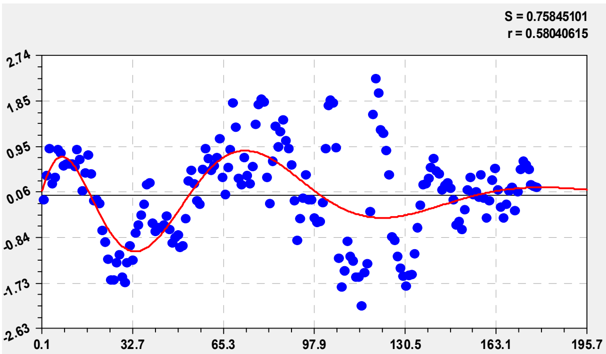
The oscillatory indignations showing wave adaptation of economy of the USA on a rate of inflation are accurately visible.



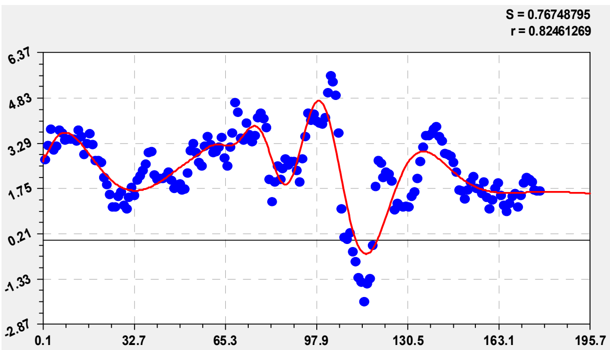
Trend under the law of exponential death (recession)



First oscillatory indignation



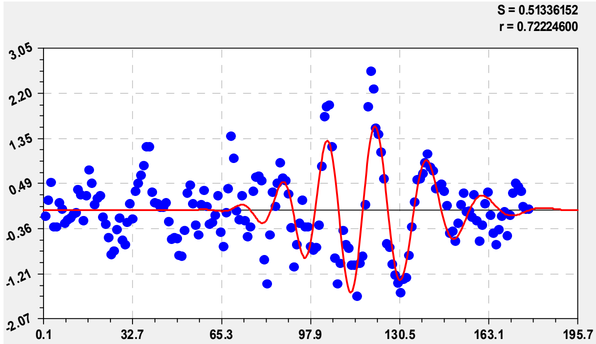
Second oscillatory indignation



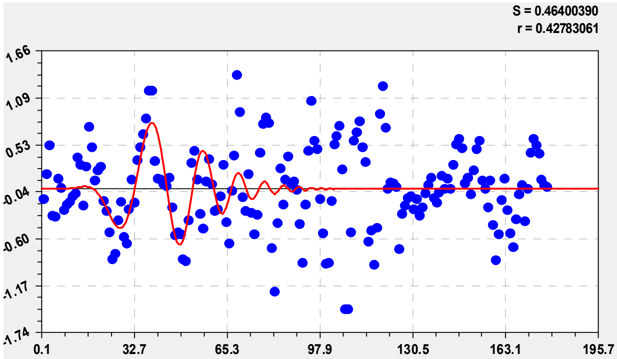
Trend and two fluctuations

Figure 1. *Schedules of wave adaptation to monthly inflation of dollar in the USA (%) for 01.2000-11.2014*

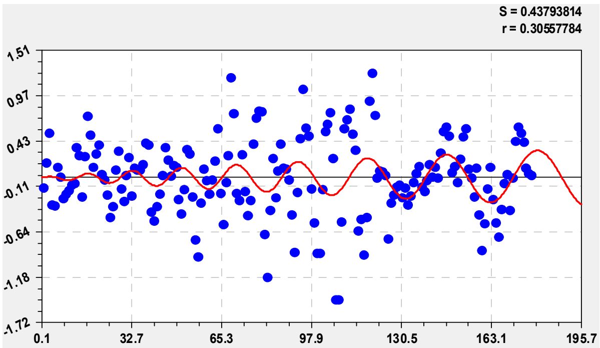
Together with a trend and two fluctuations the general equation of a look turned out (fig. 2)



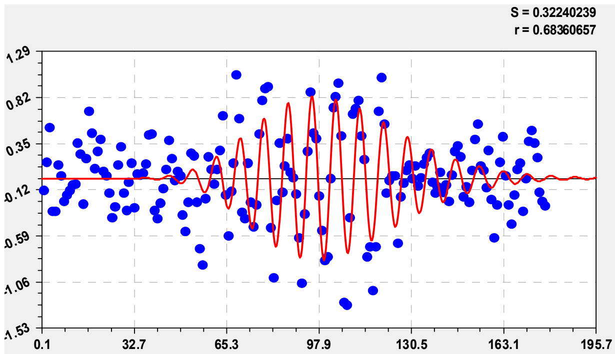
Third oscillatory indignation



Fourth oscillatory indignation



Fifth oscillatory indignation



Sixth oscillatory indignation

Figure 2. *Schedules of fluctuations of wave adaptation of the USA to monthly inflation of dollar for 01.2000-11.2014.*

$$k = k_1 + k_2 + k_3 , \qquad (3)$$

$$k_1 = 2.81483 \exp(-2.18493 \cdot 10^{-5} i_м^{1.94021}) ,$$

$$k_2 = A_1 \cos(\pi i_м / p_1 - 0.61993) ,$$

$$A_1 = 6.19441 \cdot 10^{-37} i_м^{21.78480} \exp(-0.065057 i_м^{1,19734}) ,$$

$$p_1 = 1.43819 + 0.015348 i_м^{1.12081} ,$$

$$k_3 = A_2 \cos(\pi i_м / p_2 - 0.15526) ,$$

$$A_2 = -0.51984 i_м^{0.25040} \exp(-0.00034809 i_м^{1.72564}) ,$$

$$p_2 = -1.29320 + 3.02726 i_м^{0.49842} .$$

Without display of formulas in figure 2 schedules of several more wavelets are given.

It is clear from the analysis of model (3) that in the USA there is a conscious indirect management of inflation. And the mechanism of wave adaptation can be defined if to compare the measures taken by the U.S. Government at the beginning of each wave of oscillatory indignation. Thus the correlation coefficient at strong model (3) high is also equal 0.8246.

3. Model for the period 01.2000-05.2015

In seven months according to table 1 by us it was carried out (at number of month $i_м = 178 + 7 = 185$) repeated identification of the previous statistical models.

Table 1. *Dynamics of a rate of inflation of US dollar.*

$i_м$, month	k, %	$i_м$, month	k, %	$i_м$, month	k, %	$i_м$, month	k, %	$i_м$, month	k, %
1	2.74	37	2.60	73	3.99	109	0.03	145	2.93
2	3.22	38	2.98	74	3.60	110	0.24	146	2.87
3	3.76	39	3.02	75	3.36	111	-0.38	147	2.65
4	3.07	40	2.22	76	3.55	112	-0.74	148	2.30
5	3.19	41	2.06	77	4.17	113	-1.28	149	1.70
6	3.73	42	2.11	78	4.32	114	-1.43	150	1.66
7	3.66	43	2.11	79	4.15	115	-2.10	151	1.41
8	3.41	44	2.16	80	3.82	116	-1.48	152	1.69
9	3.45	45	2.32	81	2.06	117	-1.29	153	1.99
10	3.45	46	2.04	82	1.31	118	-0.18	154	2.16
11	3.45	47	1.77	83	1.97	119	1.84	155	1.76
12	3.39	48	1.88	84	2.54	120	2.72	156	1.74
13	3.73	49	1.93	85	2.08	121	2.63	157	1.59
14	3.53	50	1.69	86	2.42	122	2.14	158	1.98
15	2.92	51	1.74	87	2.78	123	2.31	159	1.47
16	3.27	52	2.29	88	2.57	124	2.24	160	1.06
17	3.62	53	3.05	89	2.69	125	2.02	161	1.36
18	3.25	54	3.27	90	2.69	126	1.05	162	1.75
19	2.72	55	2.99	91	2.36	127	1.24	163	1.96
20	2.72	56	2.65	92	1.97	128	1.15	164	1.52
21	2.65	57	2.54	93	2.76	129	1.14	165	1.18
22	2.13	58	3.19	94	3.54	130	1.17	166	0.96
23	1.90	59	3.52	95	4.31	131	1.14	167	1.24
24	1.55	60	3.26	96	4.08	132	1.50	168	1.50
25	1.14	61	2.97	97	4.28	133	1.63	169	1.58
26	1.14	62	3.01	98	4.03	134	2.11	170	1.13
27	1.48	63	3.15	99	3.98	135	2.68	171	1.51
28	1.64	64	3.51	100	3.94	136	3.16	172	1.95
29	1.18	65	2.80	101	4.18	137	3.57	173	2.13
30	1.07	66	2.53	102	5.02	138	3.56	174	2.07
31	1.46	67	3.17	103	5.60	139	3.63	175	1.99
32	1.80	68	3.64	104	5.37	140	3.77	176	1.70
33	1.51	69	4.69	105	4.94	141	3.87	177	1.66
34	2.03	70	4.35	106	3.66	142	3.53	178	1.66
35	2.20	71	3.46	107	1.07	143	3.39	179	1.32
36	2.38	72	3.42	108	0.09	144	2.96	180	0.76
								181	-0.09
								182	-0.03
								183	-0.07
								184	-0.20
								185	-0.04

The first schedules almost didn't change (fig. 3, fig. 4) though parameters of the equations at members of model (1) quantitatively change. In the table 2 parameters of model (1) are given in compact record in a matrix form with rounding to the 5th significant figure.

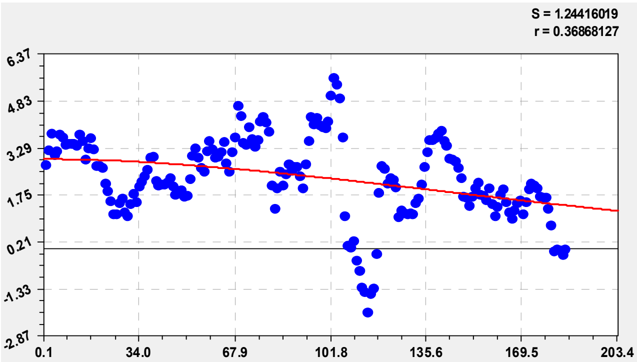
Table 2. *Parameters of model (1) on dynamics of inflation of US dollar.*

Number i	**Asymmetric wavelet** $y_i = a_{1i}x^{a_{2i}}\exp(-a_{3i}x^{a_{4i}})\cos(\pi x/(a_{5i}+a_{6i}x^{a_{7i}})-a_{8i})$								Correlation coefficient r
	amplitude (half) of fluctuation				**fluctuation half-cycle**			**shift**	
	a_{1i}	a_{2i}	a_{3i}	a_{4i}	a_{5i}	a_{6i}	a_{7i}	a_{8i}	
1	3.39051	0	0.00010189	1.75733	0	0	0	0	
2	2.15499e-54	33.10885	0.19834	1.07515	0.80763	0.015201	1.08470	2.06694	0.8249
3	0.21213	0.87554	0.034288	0.99779	48.09030	-0.00022652	2.08099	-0.86033	
4	4.95217e-14	7.48315	0.00041451	1.99144	4.37160	-0.0085723	0.52244	0.88910+	0.3969
5	2.69341e-52	28.65794	0.0083647	1.60167	2.58769	0.013492	1.06099	4.26892	0.7443
6	-4.25348e-5	4.08974	0.13670	0.99543	16.78556	-0.090146	1.00620	-0.26446	0.4851
7	1.64673e-35	15.45354	0	0	59.13445	-0.20446	0.99997	-1.86825	0.6250
8	0.22764	0	0.0014095	1	2.62174	-0.00038436	1.08161	-4.02423	0.4477
9	-1.69855e-21	12.30873	0.091973	1.02876	8.13379	-0.012445	0.98806	-2.02581	0.2884
10	-1.38136	0	0.48629	1	0	0	0	0	0.2857
11	3.71009e-31	21.34343	0.32179	0.99433	33.13995	-0.17725	0.99803	-1.85391	0.2314
12	1.66944e-32	20.41071	0.22712	0.99649	1.82720	0	0	5.62821	0.2670
13	-0.14725	0.20865	0.00052425	1.99673	1.77846	0	0	-4.47439	0.2608
14	-4.23385e-14	18.16028	0.050364	1.15179	0.82666	0.0053985	1.21963	2.72632	0.1424

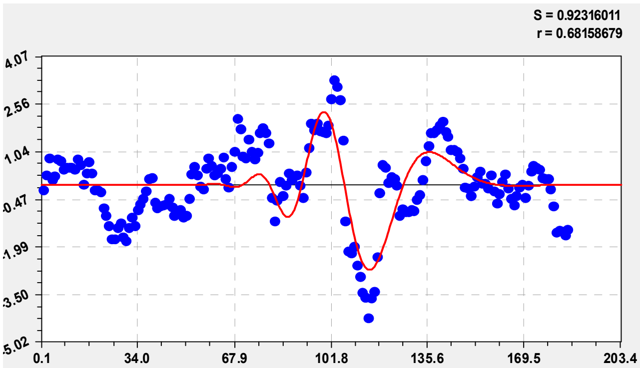
Note. Dangerous fluctuation is highlighted in bold type.

In table 2 it is allocated dangerous for future fluctuation with an amplitude increasing under the indicative law. Thus at many fluctuations the half-cycle decreases (a negative sign before parameter a_{6i}).

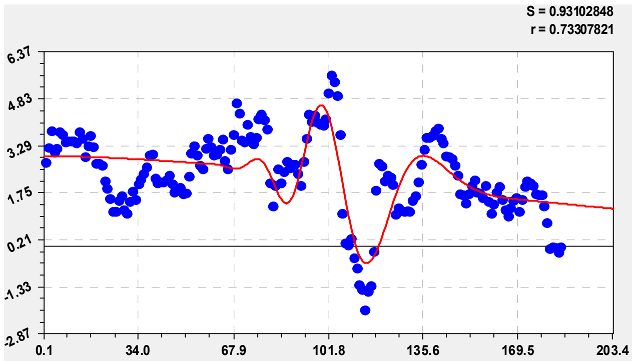
The component 10 at model (1) shows that till 2000 there was an indignation which then passed under the law of death for 2000-2015 After the 14th member statistical modeling is complicated because of emergence of noise in data. Besides, also the adequacy indicator decreases to 0.1424.



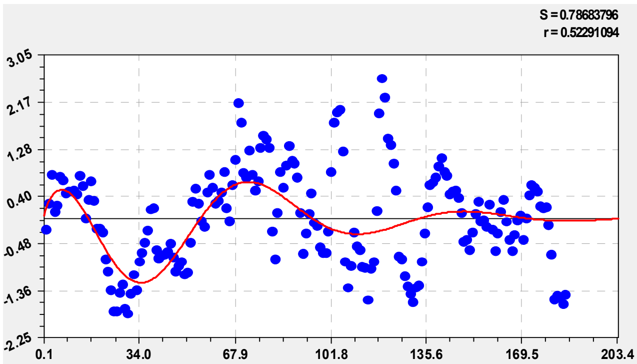
Trend under the law of exponential death (recession)



First oscillatory indignation



Trend and one fluctuation



Second oscillatory indignation

Figure 3. *Schedules mega fluctuations of wave adaptation of the USA to inflation of dollar for 01.2000-05.2015.*

If to take a dynamic row till 2000 (since 1961 or even since 1900 [2]), it appears that the trend turns into a mega fluctuation with a long period compared to those in table 2, the period of the second fluctuation $2 \times 48.09030 \approx 96.2$ months or eight years.

From the schedule in figure 4 it is visible that negative inflation in the USA already was at an abscissa $i_M = 112...118$

with a maximum of -2.10% in July, 2009.

The second time such phenomenon is observed since January, 2015 (tab. 1) with a maximum of -0.20% in April, 2015.

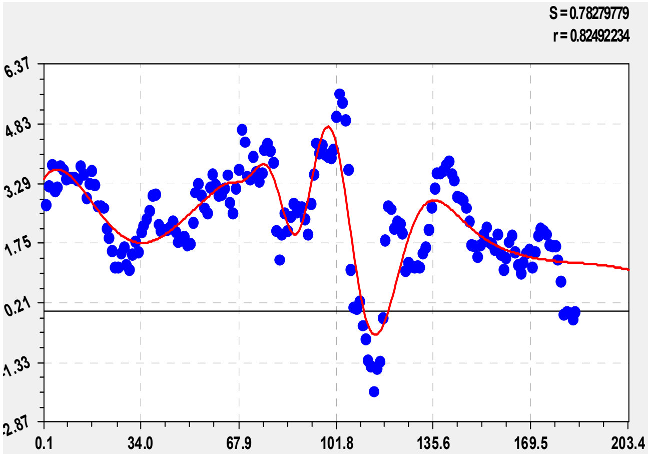
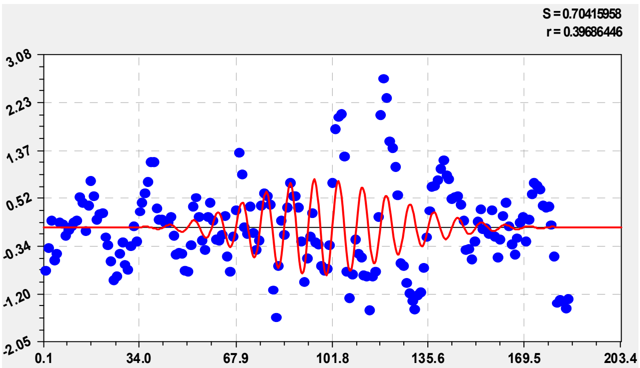
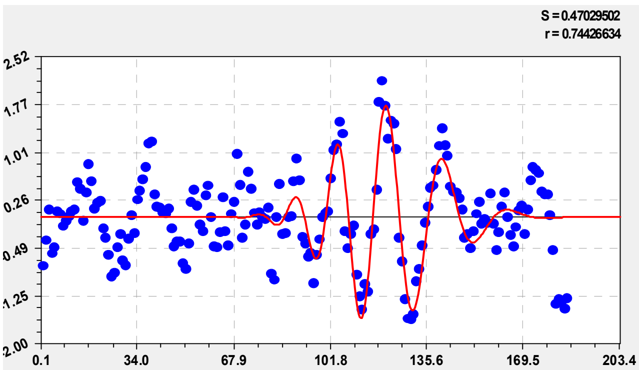


Figure 4. *Trend and two fluctuations of dynamics of a rate of inflation of US dollar.*

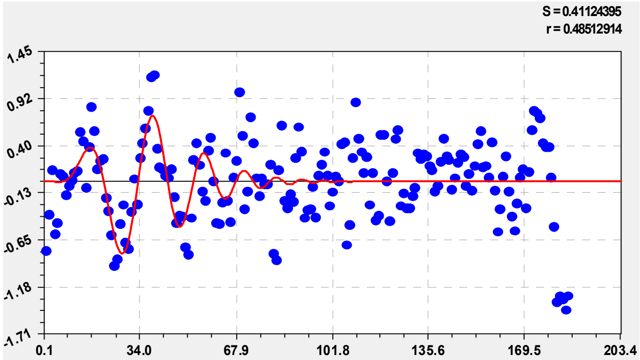
In figure 5 macrofluctuations (>1%) are given to the USA on dynamics of inflation of dollar.



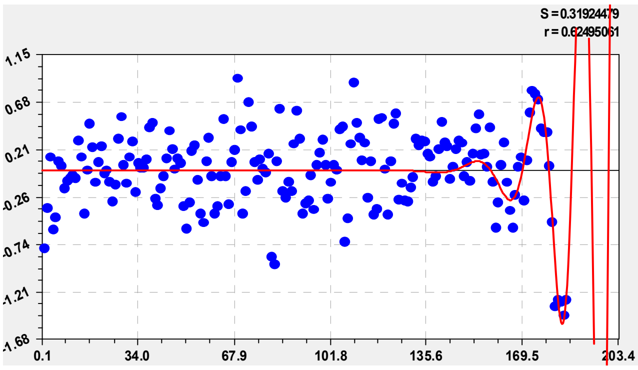
Third oscillatory indignation



Fourth oscillatory indignation



Fifth oscillatory indignation



Sixth oscillatory indignation

Figure 5. *Schedules of additional macrofluctuations of monthly inflation of dollar for 01.2000-05.2015.*

The sixth fluctuation (the seventh member according to table 2) can be dangerous on the future. Therefore monthly monitoring of inflation on the offered methodology is necessary.

Thus the 10th member of model (1) appeared transitional (fig. 6) of the past (till 2000).

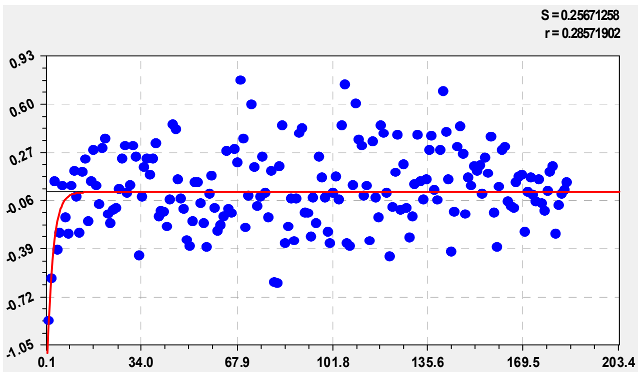
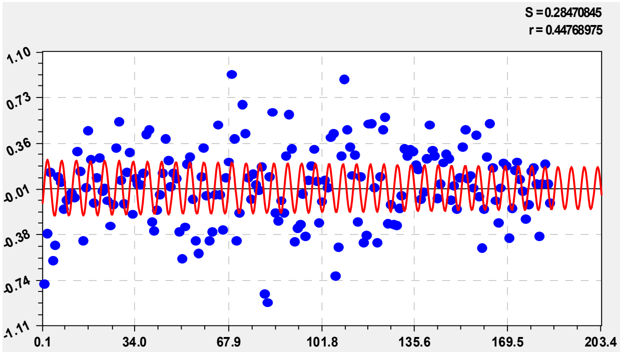


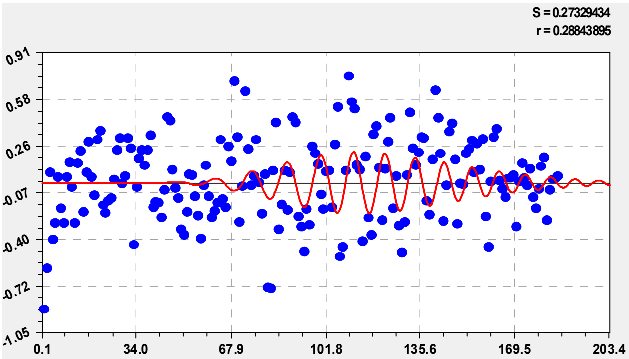
Figure 6. *The tenth component of model (1) transition of the past by the period 01.2000-05.2015.*

Apparently, this component shows peculiar "tail" from the last fluctuations which happened in the nineties the XX centuries.

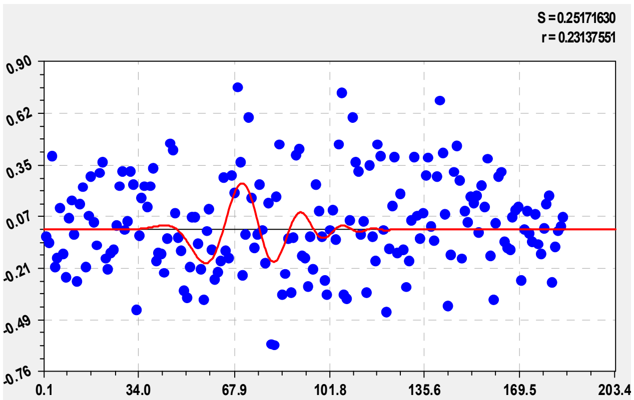
Further in figure 7 and figure 8 are given a little meso ($\leq 1\%$) fluctuations of inflation of US dollar from January 2000 till May 2015.



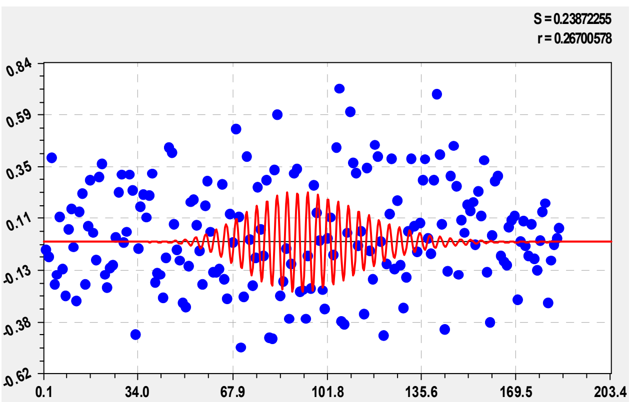
Seventh oscillatory indignation (8th member)



Eighth oscillatory indignation (9th member)

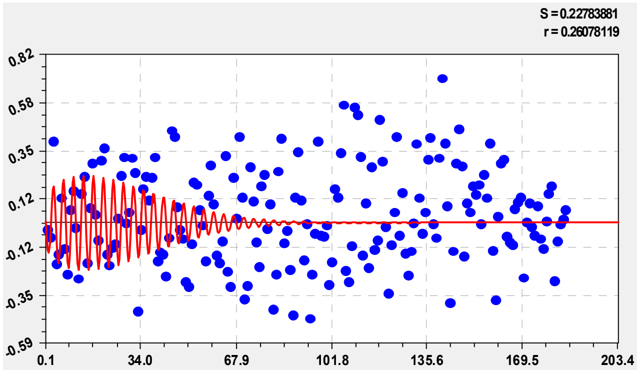


Ninth oscillatory indignation (11th member)

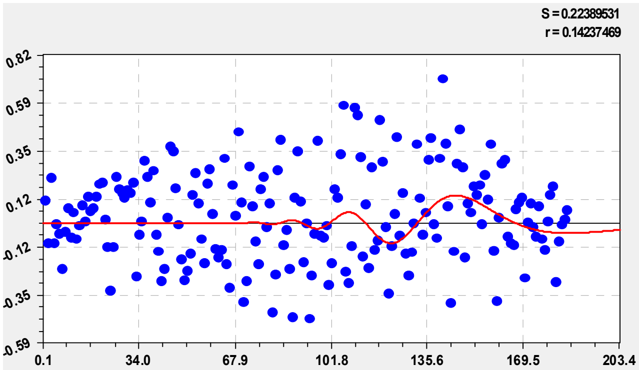


10th oscillatory indignation (12th member)

Figure 7. *Schedules of additional meso fluctuations of monthly inflation of dollar for 01.2000-05.2015.*



11th oscillatory indignation (13th member)



12th oscillatory indignation (14th member)

Figure 8. *Schedules of additional meso fluctuations of monthly inflation of dollar for 01.2000-05.2015.*

Microfluctuations are (fig. 9) in the remains after the 14th member of model (1).

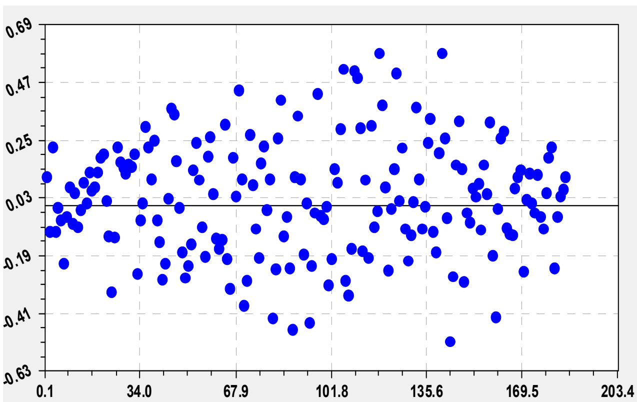


Figure 9. *The remains after the 14th member of model (1) wave adaptation of the USA to inflation of dollar where there is a set of microfluctuations.*

On the remains in figure 9 it is possible to continue the wavelet analysis.

4. Conclusions

Applicability of statistical model (1) to social and economic processes, in particular, to dynamics of inflation of US dollar is proved. This dynamics represents the tourniquet consisting of a set of lonely waves with variables amplitude and the period of fluctuations. Quality control is possible to estimate the possibility of identifying the wave patterns of reporting to the design of the same wavelet sign. The proposed identification method allows to select the last wave of historiographical analysis, as well as the components of the model (1) in the form of oscillatory perturbations affecting the future and used for forecasting by the method of extrapolation.

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