UDC 336.748.12

Monika Hadaś - Dyduch
University of Economics in Katowice
e-mail: monika.dyduch@ue.katowice.pl

Non-classical method for predicting inflation

Summary. In article presented model enabling the delimitation forces of inflation rate. It prognosis was based was on author's model integrating neuronal network and wavelet analysis. It investigation was conducted was on temporary series presenting rate of inflation of Poland in period April 1991 year - July 2012 year.

Key words: inflation, wavelet, neural network.

1. Inflation – causse and effect

The inflation is keeping by longer time the process of growth of prices in national economy, joint with large loss of value of money.

Causes of inflation:

- excessive - in comparison with supply of goods - the quantity of money in the economy,
- problems the financial states and the necessity of funding the budget deficit,
- excessive growth of pays in the economy,
- considerable growth of prices of energetistic materials, on example: growth of prices of petroleum,
- limitation the supply of goods, for example: the cereal with reason of bad crop,
- high tax burdens,
- excessive quantity of monopolies in economy.

The effects of inflation:

- decline value of unsecured savings,
- lack of stability in leadership of economic activity,
- workers' pressures on growth of pays,
- fall of value and the confidence to money,
- discrepancy between planned and real profits,
- higher nominal earnings,
- limitation of production,
- difficulty in accounting for foreign transactions.

Inflation is common in the global economy. In different countries it step out with different intensity. The low level of inflation is recognized by most economists as profitable for the economy, therefore the central banks on the world try to keep up inflation at a very low level.

Great inflationary crises:

– In Poland in draught five years the price of dollar grew up with 9 Polish marks in 1918 r. to 6,4 million.

– In the same period in German Crowd the value of German mark to dollar decreased from ok. 4,20 marks to 4,2 billion marks for dolar (the price of post mark in November 1923 year carried out 500 billion marks).

– In years 1988-1989 violently grew up at Polish People's Republic inflation. The crisis induced to conversations powers of the Polish People's Republic with opposition. It began then the constitutional transformations in Poland and in remaining countries of Block of States the People's Democracy.

– According to Central Bank in Zimbabawe, the year - old rate of inflation in Zimbawie carries out 2,2 million percentage. It is the highest on world. The local economists (not related with Central Bank of Zimbabwe) they judge that the inflation in country does not carry out 2,2 million but even 7 million the percentage. Inflation in July 2008 jumped up to 231 million percentage, during when in June she carried out 11,2 million percentage.

2. Architecture of the hybrid model

2.1 Wavelet Analysis

Due that the wavelet transform can analyze signal in different scales and extract local time-frequency character, we have distilled local fractional dimension of exchange rate fluctuation via wavelet analysis.

2.2 Neural network

As for the non-linear relation between local fractional dimension (wavelet analysis coefficient) and exchange rate future data, we obtained it via neural network. So a wavelet neural network is constructed.

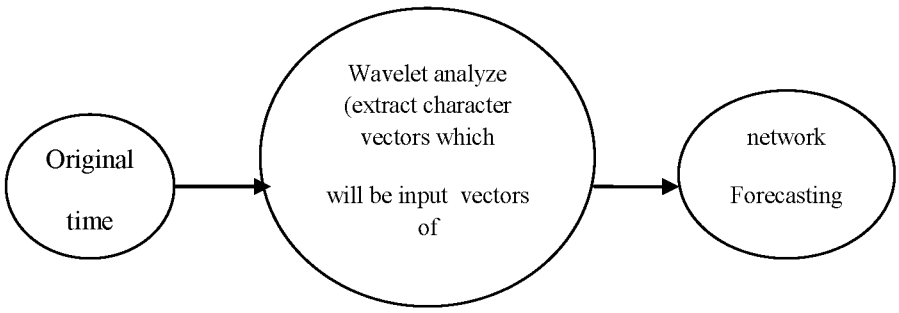

Figure 1 Wavelet neural network structure

For coupling of wavelet analysis and neural network, there are two main methods:

– Using time as benchmark. Using wavelet analysis coefficients of different scales in same

time as input character vectors of neural network to predict future data.

– Using scale as benchmark. Using wavelet analysis coefficients of different time in same scale as input character vectors of neural network to predict future data.

This paper integrates above two methods, input character vectors of neural network comprise not only wavelet analysis coefficients of different scales in same time but also wavelet analysis coefficients of different time in same scale.

2.3 Architecture framework

Based on above theory, the working flow is as follows:

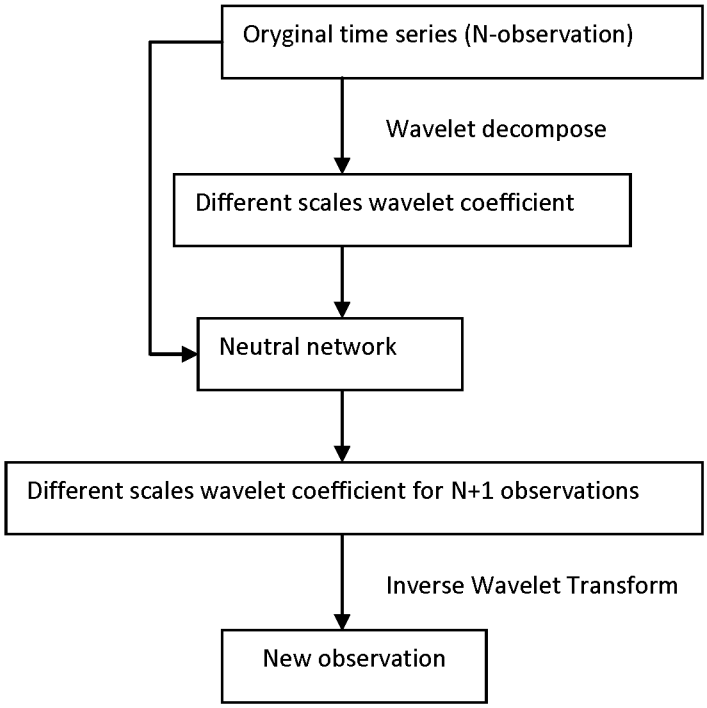

Figure 2 Working flow

3. Algorithm of the Model

In the methods of Wavelet transformation, this paper selects Wavelet quick analysis measure, which is simple and prompt without special Wavelet function involved. During this measure, there are two common methods, the Mallat algorithm and A Trous algorithm.

The Mallat algorithm requires double extraction, which makes the length of the analysis coefficients to be half. As the analysis scales increasing, the sub-wave function must be sampled by increasing dots. Thus the Wavelet coefficients are gradually decreased and the amount of calculation is greatly increased. As to the Wavelet coefficients with variable length, it makes trouble for the input of the ANN (Artificial Neural Network). So the method of Mallat is not available for the requirements in this paper.

Therefore the method of A Trous is introduced, which cancels the double extraction in the algorithm of Mallat. The formula for the analysis sequence in detail is as follows:

$$C_i(t) = \sum h(l) C_{i-1}(t + 2^i l) \qquad (1)$$

$$d_i(t) = C_{i-1}(t) - C_i(t) \qquad (2)$$

Where, $h(l)$ is discrete lowpass. Suppose the original time series data as $\mathbf{C(t)}$ and $C_0(t) = C(t)$, then define the set

$$W = \{d_1(t), d_2(t), \ldots, d_p(t), C_p(t)\}$$

the Wavelet transformation under the scale of p . The reconstruction formula of the original time series data is as follows:

$$C(t) = C_p(t) + \sum_{i=1}^{p} d_i(t) \qquad (3)$$

A Trous algorithm is quick and simple, and its key is to determine the lowpass $h(l)$. In this paper, $h_3\left(\frac{1}{16}, \frac{1}{4}, \frac{3}{8}, \frac{1}{4}, \frac{1}{16}\right)$ is adopted.

It can be seen from formula 4 that the problem of boundary prediction arises when the signal $C_i(t)$ of low frequency is calculated. The problem of boundary prediction is that given a limited time series $\mathbf{x(t), t \le T}$, according to Formula:

$$C_i(t) = \sum_{l} h(l) C_{i-1}(t + 2^i l)$$

When the Wavelet coefficient $C_i(\tau)$ is calculated at the time of τ, the data at the time of $\tau + 2^i l$ are required. And when the time of τ is exactly at the boundary or close to the boundary, the calculation of $C_i(\tau)$ will use the data outside the boundary, that is, $x(t)$ with $t \succ T$. As for the Wavelet analysis which takes aim at the prediction, the $x(t)$ with $t \succ T$ is an unknown value to be predicted.

To reduce the effect of the boundary, the measure of Enantiomorphous Delay Development is used, which is the most common in the field of signal processing. That means we suppose

$$x(N + t) = x(N - t), \; t = 1, 2, \ldots, N$$

and N is the length of the sequence. This method has been adopted by Aussum Alex (Aussum, 1997) to analyze the effect of the prediction and validate its feasibility. Thereby it is also adopted in this thesis.

4. Empirical model and result analysis

Aim of this study was obtainment the prognosis of rate of inflation Poland, burdened minimum error, based on the model outlined above, integrating neural networks and wavelet

analysis.

The study was conducted on time series, presenting the Polish inflation rate in period: the April 1991 year - July 2012 year.

In the first stage divided initial series on 8-elements series. Then every from distinguished 8-elements series proposed wavelet transform, A Trous algorithm. Received wavelet coefficients for respective 8-elements series. Wavelet coefficients for first and second of 8-elements series present graphs contained in Figure 3.

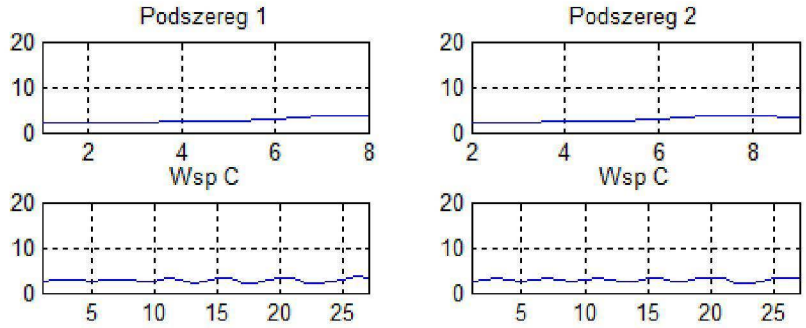

Figure 3 *The coefficients C obtained after wavelet transform for first and second of 8-elements series.*

Source: On basis own calculations.

In the next stage, was applied inverse transform wavelet to received earlier 8-elements series. In the effect, we received wavelet coefficients appointed as C^*. For first and second 8-elements series obtained with inverse transform wavelet coefficient C^* present graphs contained in Figure 4.

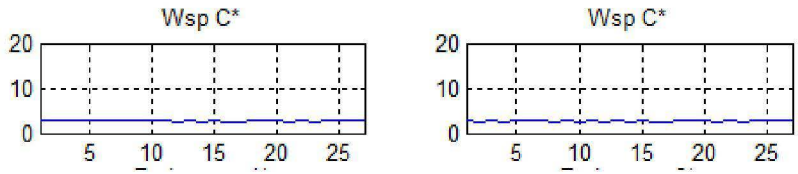

Figure 4 The value of wavelet coefficients C^*.

Source: On basis own calculations

In next step we started artificial neuronal net about introduced on figure 5 structure. Received new coefficients C of wavelets transforms in form of matrix, that is, coefficients for determinig the value of inflation rate for prognose period.

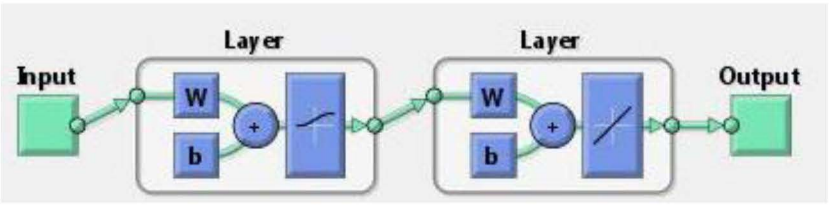

Figure 5 Structure of artificial neural network used in the algorithm.

Using wavelet coefficient generated by artificial neuronal network, were constructed across inverse wavelet transform, the value of rate inflation for chosen of period of prognosis. Received 8 - elements series presents Polish inflation for period December 20012 year - July 2013 year (table 1).

Table 1 The value of coefficient of inflation in period December 2009 year - July 2010 year on basis of introduced model

The real values of rate inflation in period December 2012- July 2013 year	1,1	0,2	0,5	0,8	1	1,3	1,7	1,1
The value of rate inflation in period December 2012 - received July 2013 year on basis of introduced model.	1,2018	0,219	0,5482	0,9025	1,0694	1,351	1,8685	1,2018

Obtained on the basis of the presented model results (forecast of inflation) are burdened some error. Scale of deviation real values from value rexeived on basis of model present following figure 6.

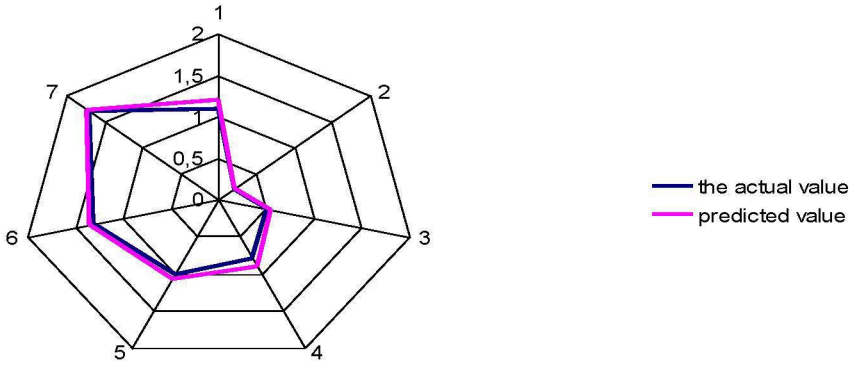

Figure 6 The composition of deviation of real values with received from model values.

Comparing received on basis of model of value inflation with of value rate inflation have noted down in reality (schedule 2) was can affirm, that the generated by algorithm series with error e^{-12} , it is good the reflection the real series. Therefore introduced algorithm is effective tool in predicing the inflation rate.

Bibliography

Aussum.et al. Combing neural network forecast on wavelet-transformed series [J]. Connection Science.1997.