ADAPTIVE METHODS FOR FORECASTING CURRENCY COURSES

L.A. Soshnikova
Belarus State Economic University
Minsk, BELARUS
e-mail: ludmila sosh@mail.ru

Abstract

The paper discusses the use of adaptive models for short-term forecasting of currency rates. As a criterion for the randomness of the movement of the levels of the dynamic range of currency rates, the criterion of turning points was used.
Keywords: data science, adaptive method, currency course

1 Introduction

One of the objectives of a statistical study of macroeconomic indicators is to analyze the dynamics of the rates of major foreign currencies. This is due, first of all, that the valuation of assets in the corresponding period of time, the indicators of their dynamics depend on the emerging exchange rates. This paper discusses the methodology and main results of the analysis and prediction of market fluctuations in exchange rates using adaptive methods [1].

The work was performed on the basis of the data of the National Bank of the Republic of Belarus for 2016–2017. about the daily exchange rates of the US dollar, euro and Russian ruble to the Belarusian denominated ruble. At first glance, the dynamics of national currencies seems to the researcher a chaotic process, in which there is no regularity In such conditions, it is very important to find statistical methods and forecasting methods that, if they do not quantify the foreign currency exchange rate for the upcoming period (for example, a day), then at least indicate the direction of its dynamics (growth, decrease or stabilization). As the analytical practice in this area shows, the use of traditional approaches to modeling the dynamics does not give good results.

Before embarking on the mechanism of the relationship between successive values of the exchange rate, an attempt was made to find out if the original series are not completely random. As criteria of randomness, the criterion of turning points was used. The number of turning points in the test row is compared with their number in a completely random row, and on this basis it is concluded whether the row is random or not.

2 Techniques for building a predictive model

There were 124 turning points in the range of the Belarusian ruble / euro exchange rate under study from July 1, 2016 to September 13, 2017. The test showed that for

all the considered rows the observed number of turning points is significantly less than it should theoretically be for a random series. Criterion for turning points:

$$P_{forecasted}(n) = 2(n - 2/3 - 1.96\sqrt{(16n - 29)/90},$$
$$P_{forecasted}(440) = 274 > P_{real} = 124.$$

Consequently, the random nature of changes in the levels of this series is not confirmed. For a number of dynamics of the Belarusian ruble exchange rate, there were 113 turning points for the same period against the dollar, and 120 turning points for the Russian ruble. In other words, this criterion indicates that these series are not entirely random: they can conceal some pattern of movement forward. When building a predictive model, the choice was made in favor of the class of adaptive models. In this connection, we will make some transformations of the initial series. First, from the initial levels of the dynamic series we move on to their first differences. Secondly, we replace the differences by the values $k_t = \text{sign}(\Delta y_t)$ according to [2].

Further analysis of the series is reduced to the analysis of alternation or preservation of characters. Three options are possible:

- supply and demand contribute to the preservation of the mark of the growth rate;
- expectation of a change in the direction of movement of the course causes a change in the sign of growth;
- future course direction is completely random.

The model should catch which of the three situations prevails recently, and give a forecast for the next moment. To build a model, we use the values $M_t = k_t k_{t-1}$. In order to find out which situation is more often encountered recently, one can apply the exponential smoothing method of the series M_t:

$$S_t = \alpha M_t + (1 - \alpha)S_{t-1} = S_{t-1} + \alpha(M_t - S_{t-1}).$$

Here, S_t can be considered as a forecast one step further, i.e. as a prediction of the value of M_t made at time $t-1$, then the value of $M_t - S_(t-1)$ is a prediction error, and the new forecast S_t is obtained by adjusting the previous forecast taking into account its error. This is the adaptation of the predictive model.

The value of $M_t = \Delta y_t \Delta y_{t-1}/|\Delta y_t \Delta y_{t-1}|$ is a modified correlation coefficient, so S_t is an adaptive correlation coefficient [2]. Therefore, the value of S_t resulting from the averaging of ones and zeros will be a fractional number from the interval $[-1, 1]$, therefore, the value M_t at the moment $t + 1$ will be defined as $M_{t+1} = \text{sign}(S_t)$. A positive M_{t+1} means the preservation of the sign of the increment that occurred at time t, and the negative one means a change. The forecast of the sign of the currency exchange rate increase at the moment $t + 1$ is defined as $\text{sign}(\Delta y_{t+1}) = \text{sign}(M_{t+1} k_t)$. This model is capable at different times to reflect either positive or negative correlation of neighboring increments. It from time to time adapting to the observations, as if changes its properties to the opposite.

3 Evaluation of forecast results

If the prediction turned out to be correct, the payoff is equal to the difference $|x_{t+1}-x_t|$, and if the prediction is wrong, then $|x_{t+1}-x_t|$ will be the size of the damage.

The criterion for estimating the results of forecasting is the average gain (or loss) from currency operations per unit of time (that is, per day) per dollar or cumulative gain for a certain period of model operation. In addition, a series of absolute and relative indicators are calculated:

- L is the number of the winnings (predictions of the sign of a currency rate increase);
- M is the number of erroneous predictions of the growth sign, i.e. the number of losses;
- $PL = L/(L+M)$ is the portion of the predictions of the growth mark that came true;
- $PM = M/(L+M)$ is the portion of erroneous predictions of the growth sign;
- SPR is the sum of winnings (i.e., only winnings are summed up) in foreign exchange transactions for the entire study period of the forecast model functioning, which will be denoted by T (measured in national currency);
- $SLOS$ is the amount of losses in foreign exchange transactions for the period T (in national currency);
- $SPR - SLOS$ is balance, net winnings (in national currency);
- $R = SPR/SLOS$ is the ratio of the amount of winnings to the amount of losses;
- $REL = SPR/(SPR+SLOS)$ is the portion of the realized opportunities ($SPR+SLOS$ is the maximum possible gain).

4 Findings

Thus, we showed that even the simplest statistical model can be useful for solving such a difficult task as forecasting currency rates. The proposed approach to short-term forecasting allows you to quickly make a decision on current currency transactions.

References

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