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THEORETICAL ASPECTS OF PREDICTION OF FIRM'S CAPITAL STRUCTURAL CHARACTERISTICS

Problem's formulation. The problem of high-quality prediction of firm's capital characteristics in a market economy is relevant, since its resolution makes it possible to improve the quality of managerial decisions at different stages of capital management; to make timely analysis and assessment of the imbalance of firm's capital structure; to form a variety of financial reserves to stabilize the financial situation of the company.

Analysis of recent research and publications. The theoretical bases of issues related to the description of the firm's capital structure characteristics and forecasting improvement, studied in the works of many local and foreign economists such as L. Basovskyi, J. Wilson, V. Ivanov, T. Klebanova, N. Kostina, T. Morozova and others.

However, the impact of cyclical and seasonal factors on the firm's capital characteristics formation needs deeper research and refinement.

Task's formulation. Firm's capital management under conditions of incompleteness, insufficiency and polysemy of baseline information makes necessary the improvement of the stability, reliability and invariance towards perturbations of the external and internal environment, financial system maneuverability. These requirements can be realized during the development of effective methods of firm's capital characteristics prediction.

This article focuses on the issues of firm's capital characteristics forecasting based on time series decomposition model of its condition's comprehensive assessment.

The presentation of the study's main material. Value of the dynamics of the external and internal environments of businesses suggests that financial threat to businesses can be localized both by internal reserves and by applying more aggressive strategies for their market behavior. The mechanism of predicting the firm's capital characteristics is appropriate for testing the hypothesis about the company's ability to maintain the positive trend of financial processes [6]. This mechanism involves the following:

the dominant trends analysis in the firm's financial system;

the impact assessment of cyclical and seasonal factors on the capital characteristics formation;

analysis of feasibility of attracting and efficiency of placement and use of the capital in view of the random factors' impact;

forming predictive characteristics of firm's capital usage efficiency and assessment of the effects of each of the possible options for its financial system development;

assessment of firm's financial maneuverability and the measurement of financial reserves necessary to support its sustainable operational mode.

The prediction problems are proposed to solve by using extrapolation methods based on the information about the predicting object and its past development. These methods are well represented and include a variety of techniques such as correlation and regression analysis, time series smoothing using moving averages, time series analytical smoothing, time series decomposition methods, methods of assessing the seasonality level, spectral analysis methods, adaptive forecasting methods [1; 2; 3; 4; 5; 9; 10; 11; 13]. The choice of method is caused primarily by the nature of the processes under study. If one's aim is to build short-term forecasts one typically uses time series smoothing using moving averages or adaptive forecasting methods. Methods of correlation and regression analysis, time series analytical smoothing, time series decomposition methods, spectral analysis methods are used for the construction of medium and long-term forecasts. Time series analytical leveling methods, dynamic regression and lag models are applied for the analysis of the time series with stable trends. Time series decomposition methods, spectral analysis methods are used to research the time series with a heterogeneous structure containing the step and pulse changes.

Since the time series of integrated indicators of firm's capital and its external environment have a complex wave nature [7], the methods and models of time series decomposition are proposed to use for their research. Those methods allow trend, periodic and random components selection and impact evaluation on the characteristics of firm's capital. The proposed prediction method of the firm's capital characteristics is shown in Fig. 1.

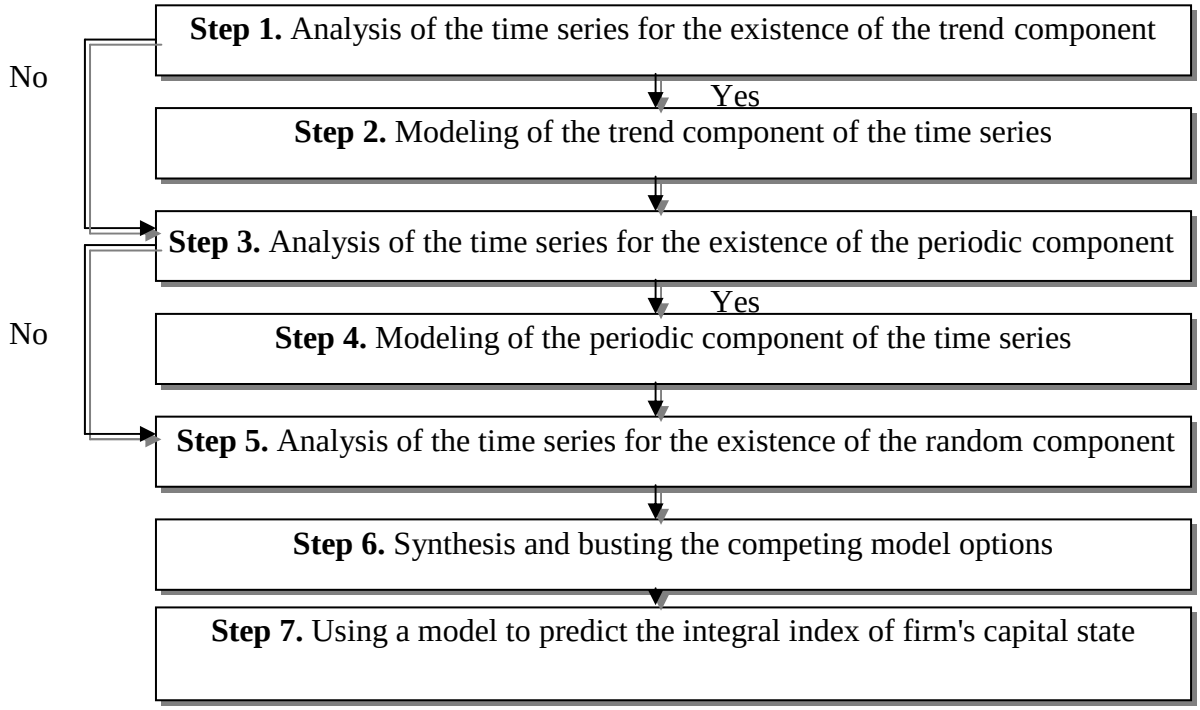

Fig. 1. The steps of prediction method of firm's capital characteristics [8]

Let's describe the steps of this method.

The analyzed time series of the firm's capital indicators is tested for the presence of a trend in mean and variance in the first step of a shown method.

The method of determining the presence of a trend in the variance based on Fisher criterion [3]. For this time series values of the integral parameter of firm's capital state $y_1, y_2, ..., y_n$ is divided into two levels I_1 and I_2 of the amount n_1 and n_2. For each set the medium $\overline{y_1}, \overline{y_2}$ and unbiased variances S_1^2, S_2^2 are defined.

Estimated value of the Fisher criterion calculated by the formula:

$$F = \begin{cases} \dfrac{S_1^2}{S_2^2}, \ if \ \ S_1^2 > S_2^2 \\ \dfrac{S_2^2}{S_1^2}, \ if \ \ S_2^2 > S_1^2 \end{cases}. \quad (1)$$

This value is compared with the critical Fisher criterion value $F_{cr}(\alpha, \kappa_1, \kappa_2)$, where the number of degrees of greater variance freedom is κ_1, the number of degrees of smaller variance freedom is κ_2. If $F < F_{cr}$ then the hypothesis of no trend in the dispersion is proven. Otherwise, it is necessary to assume its existence. If there is no trend in variance, it is necessary to check its presence in average by using the Student's criterion, determined by the formula [4]:

$$t = \frac{\left|\overline{y_1} - \overline{y_2}\right|}{\sqrt{S_1^2(n_1 - 1) + S_2^2(n_2 - 1)}} \sqrt{\frac{n_1 n_2 (n_1 + n_2 - 2)}{n_1 + n_2}}. \quad (2)$$

Calculated value is compared with the critical value of Student's criterion $t_{cr}(\alpha, k)$ for a given level of significance and the number of freedom degrees $k = n_1 + n_2 - 2$. If $t < t_{cr}$ then the hypothesis of no trend in average is confirmed. Otherwise, it is necessary to assume its existence. In this case, if $\overline{y_1} > \overline{y_2}$ then the trend is decreasing; otherwise its nature is upward.

If the time series testing results showed no trend component then it is necessary to study the

periodic component which is the 3rd step of the method; otherwise with a trend component found in the time series starts its modeling which is the second step.

Building a time series trend component model $f(t, a)$ includes: selection of the type of function which describes the trend; estimation of model parameters; model quality assessment [10].

Selection of the type of function goes empirically in most cases. If the selection of the type of function is complicated, i.e. the trend is not expressed then it is necessary to study the variability of the time series characteristics such as the first and the second difference, the growth rate, the growth rate of first increases, etc. [3], which corresponds to the following growth curves:

linear function - $f = a_0 + a_1 t$;
polynomial of m-th degree - $f = a_0 + a_1 t + ... + a_m t^m$;
exponential curve - $f = a_0 a_1^t$;
modified exponent - $f = k + a_0 a_1^t$;
exponential function - $f = a_0 t^{a1}$;
inverse dependence - $f = k/(1+a_0 t)$;
logarithmic function - $f = a_0 + a_1 ln(t)$;
logistic curve - $f = k/(1+a_0 e^{a1t})$;
Gompertz function - $f = a_0 \cdot a_1^{a_2^t}$.

The estimation of model parameters starts after the identification of trend's type. The method of least squares is used to estimate the parameters of the linear model [2; 3; 4]. If the trend component is described with the nonlinear models then it is necessary to use either the method of three points, or the method of bringing the nonlinear model to linear form using logarithmic transformations, or the method of weighted least squares, etc. [3; 9].

Correlation coefficient, determination coefficient, Student's criterion, Fisher's criterion are used for the evaluation of the quality and selection of the best variant of the trend's model [3; 4].

Building a trend's model of satisfactory quality makes it possible to move to the third step of the method.

The elimination of the trend component and the research of the residual members of the time series are performed on the 3rd step of the method. The implementation of this step requires specifying the type of time series decomposition model as its various components can be represented in the model in additive or multiplicative form. In general, the additive and multiplicative models of decomposition of time series can be represented as follows:

$$y(t) = f(t) + h(t) + u(t), \quad (3)$$

$$y(t) = f(t) \cdot g(t) \cdot \varepsilon(t), \quad (4)$$

where $y(t)$ - modeled levels of time series;

$f(t)$ - the trend component of time series;

$h(t)$ - additive periodic component;

$g(t)$ - multiplicative periodic component;

$u(t)$ - additive random component;

$\varepsilon(t)$ - multiplicative random component.

The choice of model is made on the basis of visual analysis of the original time series integrated coefficient of firm's capital. In the additive nature of the periodic component its oscillation amplitude is constant over the time and is independent of the average range. If the periodic component changes over time in proportion to the trend's level then its model is multiplicative [2].

The adopted model of decomposition of time series determines the procedures of calculating the remaining members of the time series $s(t)$, which reflect the cumulative effect of periodic and random components. For the additive and multiplicative models the elimination of trend components goes in accordance with equations (5) and (6):

$$s(t) = y(t) - f(t), \quad (5)$$

$$s(t) = \frac{y(t)}{f(t)}. \quad (6)$$

The transition to 4th step of method (the modeling of periodic component of the time series) is made in case $s(t)$ has a wave nature; otherwise to 5th step, the meaning of which is to study the random component of the time series.

Spectral analysis methods which have several advantages over traditional methods of research of

the cyclical and seasonal components are used to study the periodic component of the time series reflecting the impact of cyclical and seasonal factors. Specifically, spectral analysis allows determining the period of oscillation of various periodic components and their intensity (amplitude), while the traditional methods of analysis are based on the assumption that the oscillation parameters are already known [3; 10]. Since the periodic component describes the various wave processes, the decomposition in Fourier series (7) must be used in its modeling:

$$S(t) = \sum_k a_k \cos\left(\frac{2\pi}{T_k}(t-1)\right) + \sum_k b_k \sin\left(\frac{2\pi}{T_k}(t-1)\right) \quad (7)$$

where T - period of separate periodic component.

The number of harmonics is determined based on their statistical significance. Decomposition in Fourier series includes only those summands for which the harmonics are significant.

The values of trend and periodic components are the basis for calculating the values of the random component, which is the meaning of the 5th step of the proposed method. Herewith, as already noted, the additive model has the random component in the form of a summand, and the multiplicative model has the random component in the form of a multiplier.

The study of the random component is based on the analysis of the values of the autocorrelation function and the derivative autocorrelation function. The Box-Pierce test statistic is used to assess the significance of autocorrelation coefficients [2]. The transition to the 6th step of method is made in case the hypothesis of no autocorrelation is proven. Otherwise, autoregressive models are used for the simulation of the random component. The choice of the autoregressive model is determined by analyzing the "emission" values of the autocorrelation function.

The synthesis of the models of various components of the time series with the assessment of the quality of the "fit" of the combined model is made on the sixth step of the method. The busting of competing options and the selection of the best of them are based on the coefficient of determination, Akaike information criterion (AIC), Schwarz Bayesian criterion (SBC) [2; 10; 12].

The prediction of values of the integral index of firm's capital state based on the best combined model is made on the seventh step of method. Herewith the point and interval predictions are made, which reflect an optimistic (including the positive impact of random factors) and a pessimistic (including their adverse effects) variants of the financial situation development.

Conclusions and further research. In this manner, the mechanism of predicting the characteristics of firm's capital allows the analysis of development trends of the integral index of firm's capital state, the assessment of the impact of cyclical and seasonal factors on the formation of its characteristics, the evaluation of the raise expedience and use efficiency of capital in view of random factors. The different scenarios of the financial situation development, which assess the firm's ability to maintain positive development trends, are the result of the proposed prediction method of the firm's capital characteristics.

One of the key issues of the perspectives of predicting structural characteristics of the firm's capital relates to automatic selection of forecasting methods depending on the nature and character of the studied processes, and depending on the period for which the forecast is made.

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Kochkodan V.B. THEORETICAL ASPECTS OF PREDICTION OF FIRM'S CAPITAL STRUCTURAL CHARACTERISTICS.

Purpose: to develop a method of predicting the characteristics of a firm's capital.

Methodology of research. The study used time series decomposition methods, methods of spectral

analysis - to study the time series with diverse structure and which contain step and pulse changes; analytical alignment methods of a time series, dynamic and lagged regression models - for the study of time series with stable trends of development; extrapolation techniques - for predicting the firm's capital integral index.

Findings. The method of predicting the firm's capital characteristics mechanism is given. Established that the first steps of the method are to study the time series for the trend, periodic and random components and, if discovered, to construct the corresponding component models. The last steps of the method are to synthesize models of various components of the time series, to evaluate the quality combined model and to forecast values of firm's capital integral index.

Originality lies in the development of theoretical principles of firm's capital forecasting methods using a variety of econometric methods to determine the effect of cyclical and seasonal factors on the integral indicator of capital.

Practical value. The practical significance of the results is the possibility of using the proposed method for constructing different scenarios for the financial situation of the company, allowing an assessment of its ability to maintain positive trends in its development.

Key words: firm's capital; mechanism for predicting the firm's capital characteristics; integral indicator of capital; trend, periodic, random components of the time series.