ECONOMETRIC MODELS OF THE IMPACT OF MACROECONOMIC PROCESSES ON THE STOCK MARKET IN THE BALTIC COUNTRIES

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Abstract

The paper is meant for econometric modeling and prediction of sector indice variation regularities of stock prices in the OMX exchange of the Baltic countries' companies.To develop regression models, quarterly time series of 2000 - 2011 years are used.Regression equations, obtained in the work, allow us to name the basic macroeconomic indicators that significantly influence stock market fluctuations and to quantitatively estimate their various impact on stock indices corresponding to individual economy sectors.A comparative analysis made shows that, on the basis of the developed regression models, there is a possibility to predict the tendencies of stock market variation more exactly than by applying the Vector autoregression model of stock price sector indices, considered by the authors, which contains no variables that define macroeconomics.

1 Introduction

If stock prices reflect the basic economic factors rather exactly, then a strong link should be between share price indices and economic activity indicators (Fama and Schwert, 1977; Nelson, 1977; Jaffe and Mandelker, 1976).Fabozzi and Mann, Hafer and Hein, Wang and Lim, Pyeman and Ahmad, Maysami suggest to assess not only dynamics of separate state indices, but also changes of a certain region or sector.Authors Gitman, Joehnk, Bodie, Kane and Marcus stress that the greatest influence on stock indices representing different economic branches with regard to the respective specificity of activities can be made by different economic indicators, the impact of which also depends on the country's fiscal and monetary policy (Chatziantoniou and Duffy and Filis (2012), Maysami and Sim (2001a, 2001b, 2002)), exchange and on the level of state development, and other important parameters.The research, aimed at the assessment of the impact of macroeconomic indicators on separate stock price indices of economic sectors of the Baltic countries, is really topical, - there are no published articles of this kind, to authors' knowledge.Thus, the research objective of this work is sector indices of the OMX Baltic stock prices in the securities market, that quite widely reflect the stock market state and its change tendencies.Since the available quarterly data series are a little short, when simulating the evolution of these indices we have restricted ourselves to linear and log-linear models.This research was seeking to answer a

question whether it is expedient to describe each stock price sector index considered by the same sets of significant regressors and to assess the suitability of this type models for a short-time market prognosis.

2 Econometric modeling assumptions of the stock prices

With a view to assess the influence of the country's macroeconomic processes on stock indice changes using the intuitive finance theory (Chen and others, 1986; Fama, 1981), hypotheses on dependencies of the above economic processes are raised in various articles: ⋆ A negative connection between the rate of interest and stock price; ⋆ A negative relation between inflation and stock price; ⋆ A relation among exchange rates, export and stock price; ⋆ A positive relation between industrial production volume and stock price; ⋆ Relation between monetary supply and stock price; ⋆ A positive relation between GDP and stock price; ⋆ A negative relation between gold price and stock prices; ⋆ A negative relation between unemployment and stock prices; ⋆ A negative connection between oil price and stock price.
The results of the abovementioned researches of conjugate relations in different financial markets of the world are very helpful when specifying more complex vector regression models of the Baltic countries' stock markets.

3 Econometric model selection and primary specification of share price sector indices

Statistical data. The research objectives of this work are sector indices:I_1-*Energy,* I_2-*Materials,* I_3-*Industrials,* I_4-*Consumer Discretionary,* I_5-*Consumer Staples,* I_6-*Health Care,* I_7-*Financials,* I_8-*Information Technology,* I_9-*Telecommunication Services,* $I_1$0-*Utilities* of the OMX Baltic stock prices in the securities market.Modeling was performed out using the quarterly data of 2000 - 2011 years.23 factors were selected in order to form regression models, the quarterly data for their calculation were taken from Eurostat and financial terminal of the Web bases.To avoid seasonal effect, under the present possibilities, seasonally adjusted series were used (*seasonally adjusted observations of those indicators are submitted by the official statistics*).Percentage of quarterly changes of several common macroeconomic indicators (X_1 - X_{20}) of the Baltic countries (Lithuania, Latvia and Estonia) as well as of some indicators that illustrate global markets (X_{21} - X_{23}) have been analyzed as independent variables.

Integrity queue of economic processes. Regression analysis abilities grow up, if the investigated time series are stationary, therefore a data stationarity study was performed first at all by extended *Dickey-Fuller* test.It was found that the present economic series are integrated by the first row (*checked with a 5 percent significance level*).For this reason, variations of sectoral stock price indices during a quarter were

modelled, which are treated as stationary sequences:

$$\Delta Y_i(t) = \frac{I_i(t) - I_i(t-1)}{I_i(t-1)} * 100, t = \{1, 2, ..., 48\}; i = \{1, 2, ..., 10\}. \quad (1)$$

Stationary changes ΔX_j(t), j = {1, 2, ..., 23} of the indicators that define factors are determined respectively (1).

Formation of a linear regression model. Due to the sheer number of factors and shortness of the existing time series, statistical model development involved three stages.

Initially, an exploratory analysis was made, which aims to select the most informative factors and their lags.At this stage, the contacts with each factor separately are investigated and the significance of the linear regression model is evaluated:

$$\Delta Y_k(t) = \alpha + \sum_{i=0}^{4} \beta_{ij} \Delta X_j(t-i) + \varepsilon(t), t = \{1, 2, ..., 48\}; k = \{1, 2, ..., 10\}; j = \{1, 2, ..., 23\}. \quad (2)$$

In the next stage, a general model is composed for each group index change:

$$\Delta Y_k(t) = \alpha + \sum_{i=0}^{4} \sum_{j=1}^{23} \beta_{ij} \Delta X_j(t-i) + \varepsilon(t), t = \{1, 2, ..., 48\}; k = \{1, 2, ..., 10\}. \quad (3)$$

When identifying it by the least squares method, we evaluate only these coefficients at those factors which were recognized statistically significant in the first stage of modeling (*p-value does not exceed 0.05*), while the rest coefficients are equalized to zero.Afterwards, the significance of regressors in the general model was defined and insignificant factors were successively eliminated one-by-one from the model.Here ε(t) - are random variables which describe ΔY(t) deviations from the regression line.As usual in the regression analysis, it is assumed that they are normal and satisfy the White noise conditions.After testing the abovementioned random errors by statistical hypotheses verification, these hypotheses were not rejected, maybe due to the shortness of the series, because visually you can see a certain heteroskedasticity of the errors.However, after leaving only statistically important factors, large number of parameters remained in equations in terms of having in index the length of the series (48).In order to increase the stability of models, *forward* and *backward* procedures were applied in the third stage.With their help we strove to select the most informative factors and to reduce the number of coefficients, estimated in model up to 7.

4 Conclussions

The studies have corroborated a large impact of macroeconomic factors on the stock price sectoral indices of all the Baltic countries.The comparison of the regression model accuracy with the autoregressive modeling results, obtained in the paper [5], testifies about that the values of model statistics R^2 in the latter work did not archive 0.5, while the values of statistics amounted to 0.77-0.97: ${R_1}^2$=0.8019, ${R_2}^2$=0.8695, ${R_3}^2$=0.9663,

$R_4{}^2$=0.9396, $R_5{}^2$=0.8842, $R_6{}^2$=0.8695, $R_7{}^2$=0.8370, $R_8{}^2$=0.8596, $R_9{}^2$=0.8517, $R_10{}^2$=0.7687. The linear regression models have a fairly high level of precision and in practice can be used to obtain short-term predictions. The developed models accurately described the index behaviour of the particular Industrials and Consumer Discretionary sectors, which are most numerous.It was expected, because the operation results of individual companies, not reflected in the models, have a lower impact on the average prices of sector companies, if the sectors are more numerous.The most significant factors of the Industrials sector price index are the volume of imports, exports, the price of gold, dollar exchange rate and the inflation rate. Also we got that the impact of the factors considered on price indices of individual sectors is quite different: the same indicators in one model is very important and in another it is statistically insignificant.In the variation of stock indices in Telecomunication and Utilities sectors we can observe a greater influence of warning indicators in a quarter.The influence of global indicators indicators (dollar / euro exchange rate, the price of gold and oil) is most observed in the Utilities, Financial, Health Care, and Industrials sectors, while in the rest of them macroeconomic indicators of the Baltic countries are of particular interest.Due to the shortness of the available time series, the influence of a part of factors was not reflected in the models.In view of the new data accumulated, the models should be expanded and updated.One of the ways of improving them is to consider not only macroeconomic indicators as factors that affect sectoral indices, but also statistical data of the respective economic activities.
More detailed results of this research will be submitted in the report of Conference.

References

[1] Bodie, Z., Kane, A., Marcus, A. J. Investments (5 ed.). 2005. p. 1015.

[2] Gitman, L. J., Joehnk, M. D. Fundamentals of investing (9 ed.). 2005. p. 718.

[3] Lim, C., Wang, G. Effects of macroeconomic factors on share prices. Journal of international finance and economics. 2010, nr. 2 p. 12.

[4] Pyeman, J., Ahmad, I. Dynamic relationship between sector-specific indices and macroeconomic fundamentals. Malaysian accounting review. 2009. nr. 1. p. 81-100.

[5] Uzdanavičiūtė, R.; Rudzkis, R. The Baltic countries sectoral share price indexes VAR model. Lietuvos matematikos rinkinys : Lietuvos matematikų draugijos darbai Vilnius : VU Matematikos ir informatikos institutas. ISSN 0132-2818. T. 52 (2011), p. 332-337.

[6] Rudzkis, R.; Uzdanavičiūtė, R. Econometric models of the impact of macroeconomic processes on the stock market in the Baltic countries.Technological and Economic Development of Economy. (per review)