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The impact of sectoral economy indicators on the stock market in the Baltic countries

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Abstract. The article examines the dependencies of individual sectoral stock price indices of OMX Baltic security market on sectoral indicators of Lithuania economy, using econometric methods. Regression models are constructed using quarterly time series of 2005–2013 years. VAR models obtained in the [3] paper have been extended to verify if the inclusion of sectoral economy indicators improves the ability to provide a higher level of accuracy in estimating the growth of sectoral price index. These indicators significantly improve the predictive power compared with the benchmark VAR model. The short-term forecasts of the investigated models are obtained. Econometric analysis of OMX Baltic security market proves the hypothesis that the set of sectoral regressors may vary considerably depending on the individual sector's price indices.

Keywords: sectoral indices of stock prices, OMX Baltic security market, econometric analysis, vector autoregressive model VAR with exogenous variables.

Introduction

Stock price behaviour analysis in capital markets can be divided into two branches: fundamental and technical analysis. Technical analysis is based on the assumption that market prices follow patterns which can be used to forecast their future behaviour. While fundamental analysis consists in studying a company's historical earnings behaviour and analysing the evolution of its financial statements. These studies are supplemented with a detailed economic analysis: evaluation of the company's management efficiency, the evolution of its market share, and the prospects of the industry the company belongs to.

The purpose of this paper is to evaluate if sectoral economy indicators can help to predict stock market growth in the Baltic countries using econometric methods. The intuition for this is given by prospects of fundamental analysis and (Brown and Doran, 2005 [1]), 'the return from industry groups whose profits are likely to be procyclical relative to the share price of the industry group whose profits are likely to be a-cyclical should be a good forecast of the cycle itself'.

The evaluation of the predictive power between the key sectoral indicators of Baltic countries which reflect the state of the countries' economy and ten sectoral share price indices of OMX Baltic security market is based on vector autoregression approach

covering the period 2005Q1 to 2013Q4. A suitable VARX model where the X stands for the exogenous variables was specified, tested and validated for each sectoral index separately. Each equation of sectoral index reflects its own autoregression relations and the impact of corresponding sector of economy. Due to the shortness of the existing time series and limited scope of the paper, likely relationships between the different examined sectoral stock price indices have not been investigated.

1 The statistical model and its specification

The research objectives of this work are ten sectoral indices of the OMX Baltic stock prices in the securities market: Y1 – *Oil and gas* [1.25], Y2 – *Basic materials* [5.00], Y3 – *Industrials* [21.25], Y4 – *Consumer goods* [35.00], Y5 – *Healthcare* [6.25], Y6 – *Consumer services* [10], Y7 – *Telecommunications* [2.5], Y8 – *Utilities* [8.75], Y9 – *Financials* [8.75], Y10 – *Technology* [1.25]. The weight of each sector (percent level) which gives a measure of how developed are countries' sectors in the Baltic market as of 2014, are presented in brackets. The Baltic stock market enterprises in sectors are listed in Appendix 1 of the [2] paper. Prices of enterprices stocks are included automatically and number of enterprices in each stock index can vary. As shown, the *Consumer goods* sector is by far the most important sector, making up a relative weight of around 35 percent. The *Industrials* sector has around a twenty percent weight in the market; by contrast the *Oil and gas, Basic materials, Healthcare, Technology* and *Telecommunications* have a relatively low weight in the market.

The selection of sectoral economy indicators of the Baltic countries is backed with the findings of Lithuanian and foreign scientists from an extensive overview of specific literature [2]. Based on the experience in this area, and in order to summarize Baltic economy activity we rely on 44 variables from class of indicators such as Assets, Equity and liabilities, Production costs, Financial indicators. The quarterly data were obtained from database of the Statistics Lithuania and database of OMX Baltic security market. Since the available data series are a little short (data starts from 2005) and not all sectoral indicators are accounted in Latvia, Estonia, we have restricted ourselves to general sectoral economy indicators of Lithuania covering the period 2005Q1 to 2013Q4. Indicators of ratio are amounted to percent level, indicators of amount – to thousand in Litas.

Let Y_t denote the vector of m endogenous variables such as quarterly changes (percent) of ten sectoral share price indices. Let X_t denote the vector of n exogenous variables such as quarterly changes (percent) of abovementioned sectoral indicators. To test whether these sectoral economy indicators can help predict future stock market growth, a Vector Autoregressive (VARX) model is proposed:

$$Y_t = A_0 + \sum_{j=1}^{p} A_j Y_{t-j} + DX_t + e_t, \tag{1}$$

where Y_t is a 10×1 vector of sectoral stock indices; A_0 is a 10×1 vector of intercept terms; $A_1 \dots A_p$ are 10×10 coefficient matrices associated to each of the lagged endogenous variable 10×1 vectors Y_{t-j}, $j = 1, \dots, p$; D is a 10×44 matrix of exogenous variable coefficients; X_t is a 44×1 matrix of sectoral economy indicators and e_t is a 10×1 vector of random white noise error terms. Due to the shortness of the

existing time series and limited scope of the paper, likely relationships between the different examined sectoral stock price indices have not been investigated. Therefore, A_j matrices are diagonal. Due to the sheer number of factors and shortness of the existing time series, statistical model (1) development involved *four main steps* in this study:

First, ADF unit root tests were performed for all studied variables in order to check for stationarity. All the variables X_t and Y_t were found to be stationary, tests were carried out at the 5 percent level.

Second, with the aim of deepening the knowledge about the existing relationships between the variables analysed in this study, as well as investigating multicollinearity aspects, correlation matrices of sectoral variables were built with the each stock index. An exploratory analysis was made, which aims to select the most informative factors up to 10 (only statistically significant factors at the 5 percent level were selected).

Third, the Granger causality method to estimate a one-sided Granger causality for each share index was performed. We evaluate only these coefficients at those factors which were recognised statistically significant in the second stage of modelling (p-value does not exceed 0.05). With its help we strove to select the most informative factors and to reduce the number of coefficients, estimated in model up to 6.

Finally, the adequacy of the lag-length specification for each equation is examined by performing the Ljung-Box Q, White, Jarque–Berra tests that are fit to test for autocorrelation, heteroscedasticity and non-normality of the error terms.

2 Modelling results

The implementation of the methodology, described in above section, resulted in the equations of VARX model, presented in this section. The estimates of economic indicators and their significance levels (p-value values are presented in brackets) are presented in Table 1. When the standard critical values are applied, all parameters are significant at the 5 percent significance level and there no significant model adequacy problems (Ljung-Box Q, White, Jarque–Berra tests).

The most informative sectoral factors of Lithuania economy are: X1 – *Money Suply*, X2 – *Profitability Ratio*, X3 – *Profit of Economic Activity*, X4 – *Total Profit*, X5 – *Activity Charge*, X6 – *Material Asset*, X7 – *Subsidy*, X8 – *Financial Liability Ratio*, X9 – *Finansial Assets*, X10 – *Salary*, X11 – *Operation Costs*, X12 – *Profit*, X13 – *Social Security*, X14 – *Resourses*, X15 – *Liquidity Ratio*.

Equations of sectoral indices dependencies allows us to identify the key sectoral indicators, that statistically significantly affect fluctuations of the securities market and to quantify their impact on the stock price indices corresponding to different sectors of the economy. We see 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, besides, one index it affects positively while in another it stipulates negative changes. The results provide their impact depends on size of companies in each sector which is strongly influenced by the activities of individual companies. As a result, the accuracy (see Table 2) of *Basic materials* and *Financials* models is lower than the accuracy of the rest of the models.

Table 1. Investigation results of VARX model of sectoral stock price indices.

Y1(t)	X1(t)	X2(t)	X3($t-3$)	Y(1)($t-1$)	X1($t-1$)		
	1.51	0.21	−0.28	−0.65	1.09		
	(0.022)	(0.017)	(0.028)	(0.014)	(0.037)		
Y2(t)	X3(t)						
	0.21						
	(0.037)						
Y3(t)	X3(t)	X3($t-1$)	X1($t-1$)	Y(3)($t-1$)			
	0.24	0.30	−0.96	−0.42			
	(0.05)	(0.015)	(0.052)	(0.046)			
Y4(t)	X4($t-1$)	X2(t)	X10($t-1$)	X13($t-1$)	X4(t)		
	1.54	0.21	−1.391	1.245	1.14		
	(0.05)	(0.035)	(0.042)	(0.03)	(0.045)		
Y5(t)	X10($t-1$)	X13($t-1$)	X2($t-1$)	X8($t-3$)			
	−1.34	1.527	−0.30	−3.41			
	(0.019)	(0.009)	(0.041)	(0.047)			
Y6(t)	X9($t-3$)	X11($t-3$)	Y(6)($t-1$)				
	−0.82	−0.99	−0.32				
	(0.001)	(0.009)	(0.010)				
Y7(t)	X1(t)	X12(t)	X3(t)	X2(t)	X3($t-1$)	X2($t-1$)	Y(7)($t-1$)
	0.64	0.72	0.14	0.12	0.13	−0.16	−0.36
	(0.024)	(0.009)	(0.011)	(0.045)	(0.04)	(0.044)	(0.013)
Y8(t)	X4(t)	X2(t)	X5($t-1$)	X4($t-3$)			
	1.37	−0.66	0.46	−1.87			
	(0.047)	(0.051)	(0.048)	(0.038)			
Y9(t)	X3(t)	X6($t-1$)	X3($t-1$)				
	0.50	−3.17	0.32				
	(0.008)	(0.029)	(0.021)				
Y10(t)	X14(t)	X4(t)	X14($t-1$)	X7($t-1$)	X4($t-1$)	X15($t-3$)	Y10($t-3$)
	−1.62	1.09	−2.18	0.71	1.11	1.52	0.34
	(0.047)	(0.021)	(0.036)	(0.051)	(0.011)	(0.014)	(0.042)

Table 2. Accuracy of the stock price sectoral indice models: statistics R^2.

Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
0.80	0.54	0.82	0.79	0.75	0.82	0.83	0.73	0.66	0.79

As shown, the developed models have a low accuracy. It was expected, portfolio investments in shares have a high degree of risk, therefore the stock price prediction is problematic.

Generalizing the investigation results the comparison of the VARX model accuracy with the autoregressive investigation results, obtained in the [3] paper, testifies about that the values of model statistics R^2 in the latter work did not achieve 0.5, while the values of statistics amounted to 0.54–0.83 (see Table 2). Therefore, the investigated VARX model provides a lower level (in the most cases) of accuracy in estimating the growth of sectoral price index compared with the macroeconometric modelling results presented in the [2] paper. In the case of the longer time series, it would be appropriate to use sectoral and macroeconomic indicators both.

The forecasting performance is evaluated by estimating the model, using the 2005Q1:2013Q4 data and forecasting the dynamics of endogenous variables in quarters

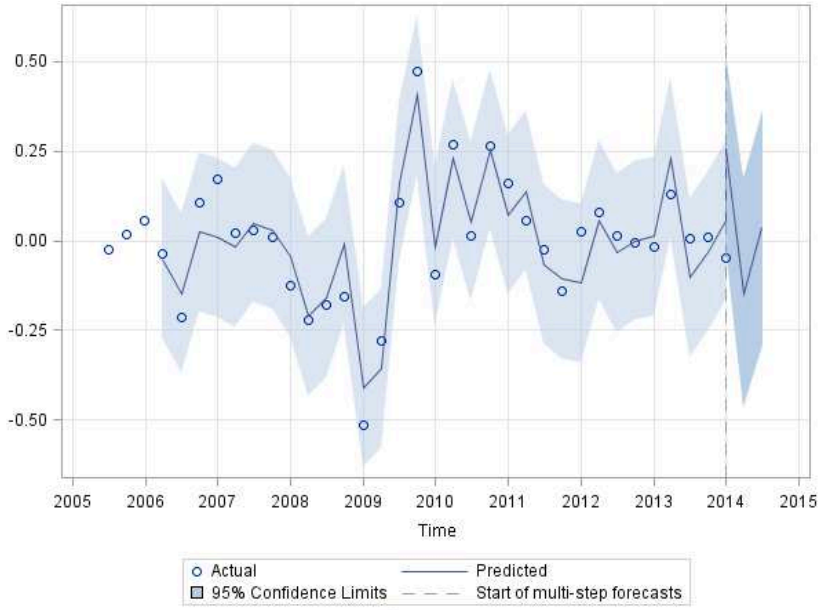

Fig. 1. Actual, modelling and predicted values of Utilities index.

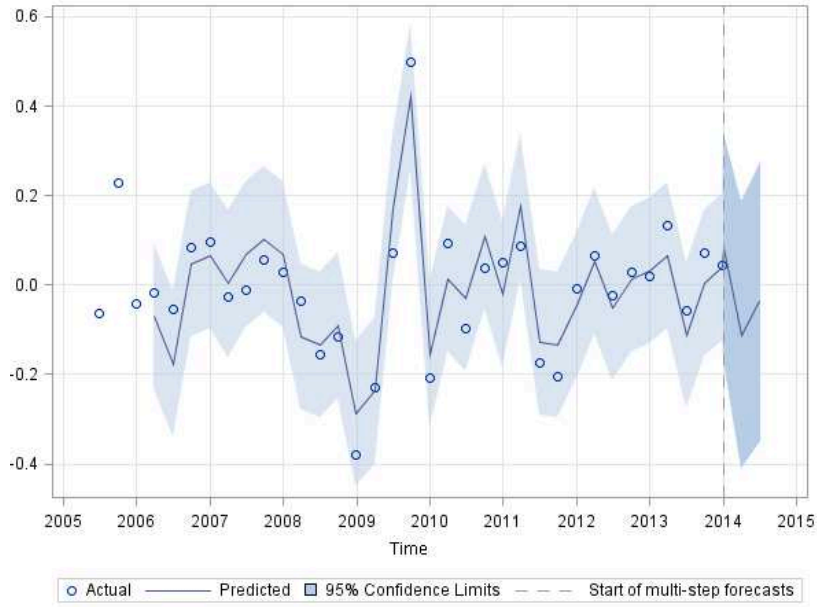

Fig. 2. Actual, modelling and predicted values of Consumer goods index.

2014Q1:2014Q3. The diagrams of actual, modelling and predicted values of *Utilities* and *Consumer goods* index are presented in Figs. 1 and 2.

3 Conclusions

The three main findings of the paper can be summarized as follows. First, the impact of the same factors on individual sector indices is quite different. It is therefore reasonable and appropriate to develop not only general, but also sectoral indicators in Baltic countries' economy. Second, sectoral economy indicators do in several cases significantly improve the predictive power compared with the benchmark VAR model presented in the [3] paper. Third, the investigated VARX model provides a lower level (in the most cases) of accuracy in estimating the growth of sectoral price index compared with the macroeconometric modelling presented in the [2] paper. Depending on these findings of the reseach, investigated VARX models should be expanded and updated. One of the ways of improving them is to consider not only statistical data of the respective economic activities as factors that affect sectoral indices, but also to include macroeconomic indicators both. The authors are planning to devote another study to this topic.

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REZIUMĖ

Baltijos šalių ūkio sektorinių rodiklių poveikis akcijų rinkai

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Straipsnyje ekonometriniais metodais nagrinėjama OMX Baltijos vertybinių popierių (VP) rinkos akcijų kainų sektorinių indeksų priklausomybė nuo praeities duomenų ir Lietuvos ūkio atitinkamų sektorių rodiklių. Regresinių modelių sudarymui naudojamos 2005–2013 metų laikotarpio ketvirtinės laiko eilutės. VAR modelių, kurie buvo gauti [3] tyrime, praplėtimas, įtraukiant Baltijos šalių sektorinius ekonominius rodiklius, ženkliai pagerino akcijų kainų indeksų elgsenos modelio tikslumą. Sudarytų modelių pagrindu gautos trumpalaikės akcijų kainų indeksų pokyčių prognozės. Dėl skirtingo įvairiems sektoriams priskiriamų įmonių veiklos pobūdžio, atitinkamus sektorinius kainų indeksus reikšmingai įtakojančių veiksnių grupės gali ženkliai skirtis. Atlikta ekonometrinė OMX Baltic rinkos analizė patvirtina šią hipotezę.

Raktiniai žodžiai: sektoriniai akcijų kainų indeksai, OMX Baltijos vertybinių popierių rinka, ekonometrinė analizė, vektorinis autoregresijos modelis VAR su egzogeniniais rodikliais.