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MACROECONOMIC VARIABLES AND THE STOCK MARKET: THE CASE OF LITHUANIA

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Abstract. Applying the EGARCH model, this paper finds that Lithuania's stock market index is positively impacted by real GDP, the M2/GDP ratio, and the stock market indexes in the U.S. and Germany and negatively affected by the ratio of the government deficit to GDP, the LTL/USD exchange rate or depreciation of the litas, the domestic real interest rate, the expected inflation rate, and the euro area government bond yield. Hence, a declining government deficit/GDP ratio, a lower interest rate or more money supply relative to GDP, the appreciation of the litas, a lower foreign interest rate, or a robust world stock market would help the stock market in Lithuania.

1. Introduction

Due to the recent global financial crisis, the Lithuanian stock market index (OMXV) had plunged 74.5% from a peak of 588.37 on October 5, 2007 to a trough of 149.96 on March 10, 2009, which was much worse than the 56.57% decline of the S&P 500 index during the recent worst-performing period. Although the OMXV has recovered and continued to exhibit an upward trend, the ending value of 420.00 on February 10, 2011 suggests that the Lithuanian stock market has not pulled out of the shadow of the global financial crisis. A substantial decline in stock prices is expected to result in negative effects on consumption spending due to the household wealth and liquidity effects. Decreased stock prices also cause adverse impacts on business financial conditions because of the balance sheet effect, business investment spending owing to Tobin's q theory, international capital inflows, and other related areas (Barro, 1990; Paiella, 2009).

This paper attempts to examine the macroeconomic determinants of Lithuania's stock market index by formulating a more comprehensive model incorporating fiscal policy, monetary policy, the exchange rate, the world interest rate, the world stock market indexes, and other related variables. For example, expansionary fiscal policy, expansionary monetary policy and currency depreciation are often used to stimulate the economy, raise aggregate demand, and increase real output. Whether their impacts on the stock market index would be positive or negative remain to be seen. Lithuania's stock market may be linked to or influenced by the U.S. and Germany stock markets. This paper estimates which stock market may have more impact on Lithuania's stock market. The paper is organized in the following manner. Literature survey will be given in the second section. The model will be presented in the third section. Empirical results will be analyzed in the fourth section. Summary and conclusions will be made in the last section.

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2. Literature Survey

Many previous studies of the relationship between stock prices or returns and macroeconomic variables focus on industrial countries such as the U.S. and other industrialized countries. Bulmash and Trivoli (1991) show that the U.S. stock market index has a positive relationship with M2 money in the short run and a negative relationship with M2 money in the long run, the short-term interest rate and the long-term interest rate. Abdullah and Hayworth (1993) show that U.S. stock returns have a positive relationship with inflation and money growth and a negative relationship with budget deficits, trade deficits, short-term interest rates, and long-term interest rates. Kim (2003) reports that the U.S. S&P 500 index has a positive relationship with industrial production and a negative relationship with the inflation rate, the interest rate, and real appreciation of the U.S. dollar and that innovations in the interest rate mainly cause the variation in the U.S. stock price index. In studying the behavior of the U.S. stock market index, Ratanapakorn and Sharma (2007) consider industrial production, the M1 money supply, the Treasury bill rate, the U.S. government bond yield, the inflation rate, and the yen/US dollar exchange rate. They find that the S&P 500 index is negatively associated with the Government bond yield and positively affected by the money supply, industrial production, the inflation rate, the yen/US dollar exchange rate, and the Treasury bill rate. According to Humpe and Macmillan (2009), the U.S. stock price has a positive relationship with industrial production, a negative relationship with the consumer price index and the long-term interest rate, and an insignificant relationship with the money supply. For Japan, the stock price is positively associated with industrial production and negatively influenced by the money supply.

Several recent studies focus on the Lithuanian and related stock markets. Asterioua and Kavetsosb (2006) examine stock market behaviors for eight transition economies in the Europe. For Lithuania, they find that there is lack of evidence of the January effect or the tax-loss selling hypothesis and that November shows the highest return whereas October exhibits the lowest return.

In analyzing Lithuania's stock market volatility, Teresienė (2009) indicates that the EGARCH model is the best estimation methodology for the analysis of volatility in the OMXV, consumer staples, industrials, that the PARCH model is more suitable for telecommunications and health care, and that the TARCH model fits the energy sector better.

Pilinkus (2009) classifies macroeconomic variables into several groups and reveals that gross external debt, gross domestic product deflator, the producer price index, index of capital goods, import volumes, residential building permits, the retail trade index, change in industrial production prices, nondurable consumer goods, foreign direct investment, the manufacturing index, general government revenue, and net exports can be employed to forecast stock market prices in Lithuania. Applying time series techniques, Pilinkus (2010) studies the relationships between stock prices and ten macroeconomic variables for Lithuania, Estonia, and Latvia and shows several major findings for Lithuania. According to the VAR analysis, the coefficients of the lagged stock market index, the trade balance, and foreign direct investment are significant. In the Johansen cointegration analysis, the coefficients of gross domestic product, foreign direct investment, the state debt, the harmonized consumer price index, the money supply, exports, imports, the trade balance, and short-term interest rates are significant. The long-run relationship is different from the short-run relationship and increases the explanatory power to 99%. Classification of macroeconomic variables into the leading, coincident and lagging indicators improves forecast performance.

Aktan, Korsakiene and Smaliukiene (2010) employ several types of the GARCH models to study the behavior of four major stock markets in the Baltic region including Lithuania. They show that the GARCH-type models can better capture the movements in these stock market returns, that a higher risk may not result in a higher stock return, and that these stock return data show long tails, asymmetry, and other complex properties.

This paper makes several contributions. The theoretical model is presented to detail the channels through which a change in the exchange rate would affect the stock market index. The EGARCH model is applied in empirical work so that potential asymmetry of the conditional variance is taken into consideration. The ratio of the government deficit to GDP, the ratio of M2 to GDP, the expected inflation rate, the world stock market index and the world interest rate are the new variables used in regression analysis. The signs and magnitude of estimated coefficients for these variables can be considered in the review of economic policy. The data are more recent, cover the period of the global financial crisis, and would be more applicable to Lithuania's stock market.

3. The Model

Based on economic theory of the demand for financial assets, the demand for stocks and stock prices respond to business opportunities, potential earnings, tax burden, the availability of credit or liquidity for business operations, the value of the litas versus other currencies, the cost of borrowing, inflation risk, stock values relative to foreign financial assets, etc. Extending the work of Bulmash and Trivoli (1991), Abdullah and Hayworth (1993), Kim (2003), Ratanapakorn and Sharma (2007), Humpe and Macmillan (2009), Pilinkus (2009, 2010) and others, we can express the stock market index in Lithuania as:

$$SP = F(Y, GD, MS, EX, DR, EI, WR, SP^*) \tag{3.1}$$

SP = the Lithuanian stock market index,
Y = Lithuanian real output,
GD = government deficit,
MS = Lituania´s money supply,
EX = the Lithuanianlitas / U.S. dollar (LTL/USD) exchangerate,
DR = the domestic real interest rate on Lithuanian money market,
EI = the expected inflation rate,
WR = the world interest rate, and
SP^* = the world stock market index.

The partial derivative of the stock market index with respect to each of the right-hand side variables can be expressed as:

$$\begin{aligned} \frac{\partial SP}{\partial Y} &> 0, \frac{\partial SP}{\partial DG} > or < 0, \frac{\partial SP}{\partial MS} > or < 0, \frac{\partial SP}{\partial EX} > or < 0, \frac{\partial SP}{\partial DR} < 0, \\ \frac{\partial SP}{\partial EI} &< 0, \frac{\partial SP}{\partial WR} > or < 0, \frac{\partial SP}{\partial SP^*} > 0 \end{aligned} \tag{3.2}$$

We expect that the Lithuanian stock market index is positively associated with real output and the world stock market index, is negatively impacted by the domestic real interest rate or the expected inflation rate, and may be negatively or positively affected by the government deficit, the money supply, the LTL/USD exchange rate or the world interest rate,

Increased government deficit-financed spending would increase aggregate demand in the short run, business opportunities, the interest rate and the price level and crowd out some of the private spending (Darrat, 1990a, 1990b; Ardagna, 2009). In the long run, deficit- or debt-financed government spending may have a neutral effect on the stock market index and real GDP due to the Ricardian equivalence theorem (Barro, 1974). Hence, its net impact is uncertain.

Increased money supply is expected to increase the expected inflation rate and real output, reduce the interest rate, and increase the demand for stocks (S) due to the portfolio adjustment (Dhakal, Kandil and Sharma, 1993; Abdullah and Hayworth, 1993; Mukherjee and Naka, 1995; Cheung and Lai, 1999; Chaudhuri and Smiles, 2004; Ratanapakorn and Shamar, 2007; Humpe, 2009). Hence, its net impact is ambiguous.

Theoretically, the depreciation of the Lithuanian litas is expected to reduce international capital inflows (IF), help exports (EP), raise import costs (IC), and increase the domestic price level (PL), and affect the stock market index as follows (Choi, 1995; Abdalla and Murinde, 1997; Nieh and Lee, 2001; Kim, 2003; Ratanapakorn and Sharma, 2007):

$$\frac{\partial SP}{\partial EX} = (\frac{\partial SP}{\partial IF} \times \frac{\partial IF}{\partial EX}) + (\frac{\partial SP}{\partial EP} \times \frac{\partial EP}{\partial EX}) + (\frac{\partial SP}{\partial IC} \times \frac{\partial IC}{\partial EX}) + (\frac{\partial SP}{\partial PL} \times \frac{\partial PL}{\partial EX}) \tag{3.3}$$

where

$$\frac{\partial IF}{\partial EX} < 0, \frac{\partial EP}{\partial EX} > 0, \frac{\partial IC}{\partial EX} > 0, \frac{\partial PL}{\partial EX} > 0 \tag{3.4}$$

In equation (3), the first, the third and the fourth terms are negative, and the second term is positive. Thus, the net impact of the depreciation of the Lithuanian litas on the stock market index is unclear.

As the world interest rate rises relative to the Lithuanian interest rate, investors move capital overseas to enjoy a higher rate of return and reduce the demand for Lithuanian stocks and stock prices. On the other hand, a higher world interest rate causes the foreign currency to appreciate, makes Lithuanian-made products cheaper, helps raise net exports, and increases businesses and stock prices. The contagion effect suggests that Lithuania's stock market is linked to and affected by the world stock market. Thus, Lithuania's stock market index responds positively (negatively) to an increase (a decrease) in the U.S. and other major stock market indexes.

4. Empirical Results

The data are collected from the International Financial Statistics, published by the International Monetary Fund. The stock market index is represented by the share price index with 2005 as the base year. Real output is represented by real GDP index with 2005 as the base year. GD is represented by the ratio of the government deficit to GDP as a percent. MS is represented by the ratio of M2 money supply to nominal GDP. EX is represented by the Lithuanian litas per U.S. dollar. Hence, an increase in the LTL/USD exchange rate means the depreciation of the Lithuanian litas and vice versa. The real interest rate is represented by the difference between the nominal lending rate and the expected inflation rate, which is measured by the average inflation rate of the past four quarters. The world interest rate is represented by the EU government bond yield. The share price indexes in the U.S. and Germany with 2005 as the base year are considered to compare their relative influence on the Lithuanian stock market index. Note that the German stock market index is selected to represent the stock market for the EU members. Except for the domestic real interest rate and the expected inflation rate with negative values, other variables are measured in the logarithmic scale in order to measure the responsiveness of the Lithuanian stock market index to each of the explanatory variables. The sample ranges from 2001.Q1 to 2009.Q4. Earlier data for the lending rate are not available.

The ADF test is performed to determine whether time series variables may have unit roots. We find that all the variables in the level form have unit roots and that all the variables in first difference are stationary at the 1% or 5% level. To determine whether the regression is spurious, the ADF test on the regression residuals is performed. Based on the AIC, a lag length of zero is chosen. The test statistic of -5.269 is greater than the critical value of -2.633 in absolute values at the 1% level. Hence, these time series variables are cointegrated and have a long-term stable relationship.

Table I presents the estimated parameters and other related statistics. Figures in the parenthesis are z-statistics. The EGARCH (Nelson, 1991) model is employed in empirical estimation for the following reasons: (1) it allows the conditional variance to react to the good and bad news asymmetrically and is suitable for modeling the behavior of general equity market indexes; (2) the conditional variance is a multiplicative function of lagged error terms; and (3) parameters in the conditional variance equation are not limited to positive values. In applying the

EGARCH model, the significance of the parameters in the variance equation is used to judge which version is most appropriate. For a detailed analysis and application of the EGARCH model, see Teresienė (2009).

Table I. Estimated Regression of the Stock Market Index for Lithuania: 2001Q1-2009Q4

	Version I	Version II	Version III	Version IV
Real GDP	0.791	0.847	0.771	1.116
	(13.456)	(14.128)	(11.799)	(9.859)
Government deficit/GDP ratio	-0.008	-	-0.006	-0.018
	(-3.287)	-	(-1.953)	(-5.040)
Government borrowing/GDP ratio	-	-0.01	-	-
	-	(-5.129)	-	-
M2/GDP ratio	0.432	0.419	-	0.832
	(6.833)	(6.003)	-	(11.168)
M1/GDP ratio	-	-	0.358	-
	-	-	(5.774)	-
LTL/USD exchange rate	-0.609	-0.588	-0.570	-1.021
	(-5.536)	(-6.130)	(-4.838)	(-6.336)
Real interest rate	-0.026	-0.022	-0.025	-0.111
	(-4.227)	(-3.491)	(-3.557)	(-15.688)
Expected inflation rate	-0.085	-0.076	-0.064	-0.440
	(-4.112)	(-3.800)	(-2.353)	(-15.751)
Euro area government bond yield	-1.812	-1.799	-1.719	-
	(-31.518)	(-34.754)	(-19.495)	-
U.S. government bond yield	-	-	-	-0.188
	-	-	-	(-1.721)
German stock market index	0.308	0.355	0.390	0.326
	(4.078)	(5.436)	(4.785)	(2.678)
U.S. stock market index	1.648	1.525	1.418	1.040
	(11.213)	(11.975)	(8.074)	(4.732)
Intercept	-6.676	-6.597	-5.673	-8.221
	(-10.170)	(-10.734)	(-10.110)	(-8.746)
Adjusted R-squared	0.973	0.975	0.977	0.907
F-statistic	104.434	116.038	126.803	29.310
Akaike information criterion	-2.091	-2.162	-2.123	-1.298
Schwarz information criterion	-1.519	-1.590	-1.551	-0.726
Estimation method	GARCH	GARCH	GARCH	GARCH

In Version I of the model, 97.3% of the variation in the Lithuanian stock market index can be explained by the nine right-hand side variables. All the estimated coefficients are significant at the 1% level. The Lithuanian stock market index is positively influenced by real GDP, the M2/GDP ratio and the stock market indexes in the U.S. and Germany, and it is negatively affected by the government deficit/GDP ratio, the LTL/USD exchange rate, the domestic real interest rate, the expected inflation rate, or the euro area government bond yield.

It is interesting to note that the Lithuanian stock market index responds to each of these independent variables differently. The Lithuanian stock market index is more sensitive to a percent change in the euro area government bond yield, the U.S. stock market index, real GDP or the LTL/USD exchange rate than other variables. For example, a 1% increase in the euro area government bond yield will result in a 1.812% decrease in Lithuania's stock market index, and a 1% increase in the U.S. stock market index will lead to a 1.648% increase in the Lithuanian stock market index. The elasticity of the Lithuanian stock market index with respect to the

U.S. stock market index is greater than the elasticity of the Lithuanian stock market index with respect to the German stock market index.

Different versions of the model are considered. When the ratio of the government deficit to GDP is replaced by the ratio of government borrowing to GDP (Version II), its negative coefficient is significant at the 1% level, and other results are similar. If the M2/GDP ratio is replaced by the M1/GDP ratio (Version III), it positive coefficient of 0.358 is significant at the 1% level and is slightly less than the coefficient of 0.432 for the M2/GDP ratio. When the 10-year U.S. government bond yield is chosen to represent the foreign interest rate (Version IV), its estimated coefficient of -0.163 is significant at the 1% level and much smaller in absolute values than the estimated coefficient of -1.812 for the euro area government bond yield in Version I. It may suggest that due to its EU membership, Lithuania's stock market is more linked to and affected by the euro area long-term interest rate than the U.S. long-term interest rate. When the Lithuanian litas/euro exchange rate is included in the regression, its coefficient is positive and insignificant at the 10% level. To save space, the results are not printed here and will be available upon request.

5. Summary and Conclusions

This paper has examined the macroeconomic determinants of the Lithuanian stock market index based on a quarterly sample during 2001.Q1 – 2009.Q4. The EGARCH model is employed in empirical work. More real output, a lower ratio of the government deficit to GDP, a higher M2/GDP ratio, a lower LTL/USD exchange rate, a lower domestic real interest rate, a lower expected inflation rate, a lower euro area government bond yield, a higher U.S. stock market index, or a higher German stock market index leads to a higher stock market index in Lithuania.

There are several policy implications. According to the IMF (2010) forecast of the Lithuanian economy in 2010, a relatively high government deficit/GDP ratio of 7.8%, a rising government debt/GDP ratio of 39.1%, and an upward trend of the interest rate would work against the Lithuanian stock market whereas a 2.1% growth rate of real GDP, an upward trend of a stronger litas, and a relatively low expected inflation rate would work in favor of the Lithuanian stock market. There are several external factors including the U.S. stock market, the German stock market, and the euro area government bond yield that are expected to influence stock prices in Lithuania. Hence, the Lithuanian authorities need to closely monitor both the domestic and external factors in order to estimate their potential effects on the Lithuanian stock market index.

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