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Cointegration of Baltic Stock Markets in the Financial Tsunami: Empirical Evidence

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ABSTRACT

This paper investigates the co-integration and causal relationship between the various stock exchanges of the Baltic Countries. The study aims to give the analysis of the relationship between the markets of Estonia, Latvia and Lithuania. We present the analysis of the cointegration and causal relationship between Riga, Vilnius, Tallinn stock exchanges, the SPX and Baltic bench. The analysis employs Augmented Dickey Fuller (ADF) test, Johansson co-integration approach, Vector error Correction model, Granger Causality test. By analyzing the co-integration and other tests on these Baltic stock markets of the EU over the study period, the relationships between the two variables are examined.

JEL Classification: *C15, C32*

Keywords: *Baltic countries; Cointegration; Comovements; Stock markets*

I. INTRODUCTION

In the last two decades, economists have developed a number of tools to examine whether economic variables trend together in ways predicted by theory, most notably cointegration tests. Cointegration methods have been very popular tools in applied economic work since their introduction about twenty years ago. However, the strict unit-root assumption that these methods typically rely upon is often not easy to justify on economic or theoretical grounds. The multivariate testing procedure of Johansen (1988, 1991) has become a popular method of testing for cointegration of the I(1)/I(0) variety, where I(1) and I(0) stand for integration of orders one and zero, respectively. In the Johansen methodology, series are pre-tested for unit roots. The series that appear to have unit roots are put into a vector auto regression from which one can test for the existence of one or more I(0) linear combinations.

Cointegration methodology has been extensively used as a convenient way of testing for the weak-form of asset market efficiency, which states that no asset price should be forecastable from the prices of other assets The Johansen (1988) method of testing for the existence of cointegrating relationships has become standard in the econometrics literature.

Since unit-root tests have very limited power to distinguish between a unit-root and a close alternative, the pure unit-root assumption is typically based on convenience rather than on strong theoretical or empirical facts. This has led many economists and econometricians to believe near-integrated processes. Near-integrated and integrated time series have implications for estimation and inference that are similar in many respects. Cointegration, however, simply requires that cointegrating linear combinations have lower orders of integration than their parent series Granger (1986). Granger and Joyeux (1980) and Hosking (1981), where continuous orders of integration from the real line are considered, the case where there exists an $I(d - b)$ linear combination of two or more $I(d)$ series are known as fractional cointegration.

The cointegration approach is one of the recent methodologies employed to identify the determinants of profitability in banking. It enables the estimation of a relationship among non-stationary variables by revealing the long-run equilibrium relationship among the variables. This paper will help banks' stakeholders especially the managers and regulatory authorities to improve the sector soundness by boosting the impact of positive factors and lessening the impact of the negative factors.

A good econometric practice always includes tests on the cointegrating vectors to establish whether relevant restrictions are rejected or not. If such restrictions are not tested, a non-zero cointegrating rank might mistakenly be taken as evidence in favour of cointegration between variables. This is particularly relevant when there are strong prior opinions regarding which variables "have to" be in the cointegrating relationship. Unit root tests are performed on unvariate time series in order to test the order or integration. If individual time series are found to be integrated of same order after the unit root tests, then these variables may be cointegrated. Cointegration deals with relationships among the group of variables where each has a unit root. Application of cointegration test in the estimation of money demand were analyzed by Johansen and Juselius (1990) and Dickey, Thansen and Thornton (1991).

The paper has been divided into five sections. Section II gives the information about the background. Section III gives the brief overview of the Baltic markets.

Section IV will give a complete description about the methodologies of the various tests performed in this paper, and Section V contains the empirical results. Finally, Section VI concludes with a short summary.

II. MOTIVATION AND BACKGROUND

The world of finance has undergone major changes over the last three decades. In fact, in the wake of breakdown of the Bretton Woods in the early 1970s, businesses have become more global. Later, the terms "globalization", "financial integration", "liberalization", "financial innovation", deregulation" and "short-term capital flow so called hot money" have come on the countries' agenda.

One of the very crucial effects of globalization is that money began to flow freely and rapidly among different markets of the world. As capital becomes borderless, diversifying portfolio in international markets became easier. On the other hand, owing to globalization the differences among world markets decreased as well which began to hinder the international diversification opportunities. The need for accurate identification of the degree of international portfolio diversification opportunities makes studies on comovements of international markets important.

Grubel (1968) was the first to apply asset diversification phenomena to international asset holdings and underline the merits of international diversification of portfolios. He also illustrated the potential gains from diversification on 11 major stock markets including the USA, Canada, the U.K., Germany, France, Italy, Belgium, the Netherlands, Japan, Australia and South Africa. Comovements of international markets have been studied in various papers ever since. The early studies following Grubel (1968) tried to describe the stock markets covariation patterns, stock market structures and structural changes of various countries, (e.g. 19 countries by Ripley (1973), 12 countries by Panton et. al. (1976), 16 countries by Lessard (1976)).

One of the research streams in more recent co-movements literature is the study of the major markets like those of the U.S., the U.K., Germany and Japan and uncovering the dynamics behind the co-movement patterns. Taylor and Tonks (1989) show that the stock markets of the U.K., Germany, the Netherlands, Japan and the USA move together following the year 1979 on which the exchange control was abolished in the U.K. Shiller (1989) raised the question of whether the stock price comovements of the U.S. and the U.K. market can be justified by comovements in dividends and interest rates however he argues that the comovements between these markets are too large to be explained by the comovements of dividends and interest rates. Arshanapalli and Doukas (1993) report that while there is no interpedendence among national stock markets before October 1987, the interdependence has increased substantially after this date among the stock markets of France, the U.K., Germany and the USA. On the other hand the results by Kanas (1998) overrule the results indicating pairwise cointegration of the U.S. stock market with any of the European markets. Following these controversial results, studies that are more recent agree on the increasing but time varying cointegration between countries. Longin and Solnik (1995) found that the correlation among international markets increase over time and not stable. While they argue that correlation rises in high volatility times, the results of their later studies show that correlation is related to market trend rather than the volatility and correlation increases in bear markets (Longin and Solnik, 2001). Morana and Beltratti (2008) document a progressive integration of the U.S., the U.K., German and Japanese stock markets and increasing co-movements in prices, returns, volatilities and correlations. While the co-movements of the U.S., the U.K., and German stock markets are stronger, Japanese market was found more idiosyncratic.

Eun and Shim (1989) report a substantial amount of multilateral interaction among international stock markets and the while the innovations in the U.S. market are transmitted to other markets, other single foreign markets can not explain movements in the U.S. market. Bonfiglioli and Favero (2005) attempt to disentangle the effects of interdependence from contagion in comovements in German and the U.S. stock markets. Their results suggest no long-run interdependence between two markets and while sizeable and significant fluctuations in the U.S. market affects German stock market, this is not the case for normal fluctuations. To our knowledge the most comprehensive study in terms of the number of countries in the sample is Forbes and Rigobon (2002). Analyzing stock markets of 28 countries, Forbes and Rigobon (2002) document that there is no contagion effect during 1997 Asian crisis, 1994 Mexican devaluation and 1987 U.S. market crash but the co-movements between stock markets are due to interdependence.

The integration of markets of a particular region among themselves and the integration of the markets with other major international markets is another stream of research. Stock markets of Hungary, Poland and the Czech Republic are studied by Scheicher (2001) who found that these markets were affected by both regional and global influences in terms of return and they are affected by regional influences in terms of volatility. He argued that the global integration of Eastern European countries is limited while there is a higher regional integration especially between Hungary and Poland. Baltic stock markets including stock markets of Estonia, Latvia and Lithuania were investigated by Maneschiöld (2006). The results indicate that the integration between Baltic stock markets and international capital markets represented by the stock markets of the U.S., the U.K., Germany, France and Japan are low. Meric et al. (2007) argue that Middle East stock markets (including Turkey) are not sufficiently studied in terms of co-movements between them and investigate the co-movements of Egyptian, Israeli, Jordanian and Turkish stock markets. A very low correlation is found between these markets which provide portfolio diversification opportunities for investors. Meric et al. (2008) investigate co-movements of stock markets of U.S., U.K. and six other countries, namely Australia, China, India, Japan, South Korea and Russia, during the five-year before and after September 11, 2001. Their results show a change in the patters of co-movements of the stated markets. The correlation between the markets increases significantly which leads the benefits of global portfolio diversification with these stock markets to decrease. Despite their interesting findings, they fail to explain why September 11, 2001 would matter for the pattern change in the co-movements of the markets. Using a shorter time frame Yavas (2007) also documents that the correlations between Germany and the U.S. increased significantly following September 11, 2001. On the co-movements of the major markets including the U.S., German and Japan, the study by Yavas (2007) supports the variation of co-movements of U.S. and German markets. However, he finds no significant effect of Japanese market on other markets. Raj and Dhal (2009) investigate the integration of India with major global markets and regional markets. They find that the integration of India's stock market with international markets strengthen after 2003. Most recently Vo (2009) investigates the integration of Asian bond markets and those of Australian and the U.S. and finds a low degree of integration.

Besides stock markets, co-movements and co-integration of bond markets are also studied in the literature. Kelly et al. (2008) identify common trends for G-7 countries' bond returns and show that the stability of common trend varies over time. The U.S., the U.K., Germany and Japan are studied in terms of cointegration in bond markets by Ciner (2007) and the bond indexes of the countries are not found cointegrated in the full sample. However, the markets are found cointegrated when the sample is divided into two parts suggesting diversification opportunities are decreasing when compared to earlier periods. Analyzing the co-movements between the U.S. and German bond markets, Engsted and Tanggaard (2007) find that the main reason for the co-movement is expected future inflation rather than future real interest rates and future excess bond returns.

III. BALTIC MARKET OVERVIEW

Baltic market in North Europe consists of three countries, Estonia, Latvia and Lithuania and all are the members of the EU. Tallinn Stock Exchange of Estonia, Riga Stock Exchange of Latvia and Vilnius Stock Exchange of Lithuania are known as the Baltic Stock Markets and were established in 1920, 1926 and 1937 respectively. While Vilnius Stock Exchange was closed in 1936, Tallinn and Riga Stock Exchanges were closed upon Soviet invasion in 1941. Following the dissolution of Union of Soviet Socialist Republics in 1991, Baltic countries' national stock markets began trading in mid 1990's. Vilnius Stock Exchange was the first to begin trading in 1993, Riga Stock Exchange was the second in 1995 and Tallinn Stock Exchange in 1996 (TSPAKB, 2005).

Despite the initial resistance of Baltic countries to the idea of a joint Baltic exchange in the establishment phase, today there is a "Pan-Baltic Exchange" not in legal but in economic terms. While the companies in Baltic countries legally listed on home countries' markets, they also have a common presentation in Baltic Stock Exchange together. Helsinki Stock Exchange (HEX) purchased Talinn and Riga Stock Exchanges during 2002 and 2004. Subsequently each Baltic Stock Exchange was purchased by OMX Group which was established by the purchase of HEX by the Stockholm Bourse OM. Finally, upon the acquisition of OMX Group by NASDAQ and Bourse Dubai, NASDAQ OMX Group was established on February 2008 and the group owns the Baltic Stock Exchanges. (Burke, 2008)

Today Baltic Stock Exchanges employ the Saxess trading model. Transactions in the exchanges can be negotiated in both automatic matching and manual trades. Securities traded in the NASDAQ OMX Tallinn, Riga and Vilnius exchanges are structured as Baltic Main List, Baltic Secondary List, Baltic Funds List and Baltic Bond List. As of March 2009, 39 companies are listed in the main list and 56 companies are listed in the secondary list. Following a pre-trading session and a period before the opening call from 08:30 to 09:59, trading in Baltic Stock Exchanges starts at 10:00 and ends at 16:00. There is also a post-trading session between 16:05 and 16:30. While Euro is the official trading currency of the Tallinn, the securities are traded in national currency Lat and Litas in Riga and Vilnius respectively. As of March 2009 the Baltic Stock Exchanges have a market capitalization of 4.75 Billion Euros. Trades took place in Vilnius account for the 70% of all trade volume, about 27% of the trade took place in Tallinn and the rest took place in Riga.

IV. METHOGOLOGY

The estimation of the long run relationship between the variables, time series properties of the individual variables are examined by conducting Augmented Dickey Fuller (ADF) stationary tests, then the short run dynamic and long run co-integration relationship are investigated by using the multivariate Johansen's co-integration test and Granger Causality test.

A. Unit Root Tests

The Augmented Dickey-Fuller (ADF) unit root test method put forward by American scholars Dickey and Fuller is widely used in the academia to examine the stationarity of the time series and determine the integration order of non-stationary time series. Unit root tests are first conducted to establish the stationary properties of the time series data sets. Stationary entails long run mean reversion and determining a series stationary property avoids spurious regression relations. It occurs when series having unit roots are regressed into one another.

The presence of non-stationary variables might lead to spurious regressions and non-objective policy implications. Augmented Dickey Fuller (ADF) tests are used for this purpose in conjunction with the critical values, which allows for calculation of critical values for any number of regressors and sample size. The ADF model used is describes as follows:

$$\Delta \ln Y = \alpha + T + \omega \ln Y_{t-1} + \sum_{i-1}^{p} \delta \Delta Y \ln_{t-1} + \varepsilon \tag{1}$$

Where Y is variable used for unit root test, α is the constant, T represents the trend, ω = p-1 and ε is the white noise series. The null hypothesis is H_O: ω =0. If the ADF value of the lnY is bigger than the McKinnon value at 5% significant level, the null hypothesis is accepted, which means lnY has unit root and is non-stationary. If it is less than the McKinnon value then the H_0 is rejected and lnY is stationary. As for the non-stationary series, we should test the stationarity of its 1st difference. If the 1st difference is stationary, the series has unit root and it is first order integration I (1).

B. Johansen's Co-integration Test

According to the co-integration theory, there may be co-integration relationship between the variables involved if they are 1st order integration series, i.e. their 1st difference is stationary. There are two methods to examine this cointegration relationship, one is EG two-step procedure, put forward by Engle and Granger in 1987, the other is Johansen cointegration test (Johansen(1988) and Juselius1990) based on Vector Auto Regression (VAR).

For co-integration test, we will conduct the Johansen's multivariate co-integration tests. The Johansen's multivariate co-integration test involved testing the relationships between the variables following the vector auto-regression (VAR) model:

$$\Delta \ln Y = \sum_{i=1}^{p} \Gamma_i \Delta \ln Y_{t-1} + \Pi \ln Y_{t-1} + BX_t + \varepsilon, \tag{2}$$

where $\Gamma_i = -\sum_{j=i+1}^{p} A_j$ and $\Pi = \sum_{i=1}^{p} A_i - I_m$. Y_t represents n*1 vector of I (1) variables. Γ and Π are n*n matrix of coefficients to be tested. B denoted n*h matrix and X_t denoted h*1 vector of I(0) variables. Π denoted the rank of the matrix and interrogates the long-run relationships in the variable and is equal to the number of independent co-integrating vectors. If rank of Π is 0, the variables in are not cointegrated.

Johansen developed two test statistics: the trace test and the maximum eigen value test. λ_{trace} statistic tests the null hypothesis that r= 0 (no co-integration) against a general alternative hypothesis of r>0 (co-integration). The K_{max} statistic tests the null hypothesis that the number of co-integrating vectors is r against the specific alternative of r+1 co-integrating vectors. The test statistics obtained from λ_{trace} and K_{max} tests are compared against the asymptotic critical values of the two test statistics by Johansen and Juselius.

C. Kwiatkowski-Phillips-Schmidt-Shin Test for Indices

This test differs from those in common use (such as Dickey-Fuller and Perron) by having a null hypothesis of stationarity. The test may be conducted under the null of either trend stationarity (the default) or level stationarity. Inference from this test is complementary to that derived from those based on the Dickey-Fuller distribution. The KPSS test is often used in conjunction with those tests to investigate the possibility that a series is fractionally integrated (that is, neither I(1) nor I(0)). It may be applied to a single time series in a panel with the qualifier or to all time series with the by prefix.

D. Vector Error Correction Model

A vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with nonstationary series that are known to be cointegrated. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics.

As the VEC specification only applies to cointegrated series, one should run the Johansen cointegration test prior to VEC specification. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

The vector error correction model can be written as

$$\Delta y_{1,t} = r_1.(y_{2,t-1}.\beta.y_{1,t-1}) + \varepsilon_{1,t} \tag{3}$$

$$\Delta y_{2,t} = r_2.(y_{2,t-1}.\beta.y_{1,t-1}) + \varepsilon_{2,t} \tag{4}$$

Here the right side variable represents the error correction term ($y_{2,\ t-1}\ .\beta.y_{1,\ t-1}$). The coefficients r_1 and r_2 measure the speed of adjustment.

V. EMPIRICAL ANALYSIS

A. Unit Root Test

Based on the ADF and Philips Perron unit root tests, we can conclude that the series are difference-stationary processes. We test for the presence of unit roots and identify the order of integration for each variable using the Augmented Dickey–Fuller (ADF). The null hypothesis is considered as non-stationary. The test on the variables gave the following result.

Table 1
ADF unit root tests for indices

Variables	Levels	First Difference	5% Critical Value[1]	1% Critical Value
SPX	-0.016781	-34.14750**	-3.412486	-3.963515
BALTIC Bench	1.714325	-35.71427**	-3.412486	-3.963515
RIGA	2.678744	-38.86130**	-3.412486	-3.963515
VILNIUS	2.917812	-34.98612**	-3.412486	-3.963515
TALLINN	1.872424	-19.47614**	-3.412486	-3.963515

[1]MacKinnon critical values for rejection of hypothesis of a unit root.
**Denotes significance at the 1 percent level. Lag length based on SIC criterion with a Maximum lag = 14. Estimations undertaken with EViews 6.0.

Table 2
Philips-Perron test for indices

Variables	Levels	First Difference	5% Critical Value[1]	1% Critical Value
SPX	-0.251269	-46.42515	-3.412486	-3.963515
BALTIC Bench	1.243820	-37.03478	-3.412486	-3.963515
RIGA	2.004230	-39.61786	-3.412485	-3.963512
VILNIUS	2.917812	-34.98612	-3.412486	-3.963515
TALLINN	1.664793	-36.44323	-3.412486	-3.963515

[1]MacKinnon critical values for rejection of hypothesis of a unit root.
**Denotes significance at the 1 percent level. Estimations undertaken with EViews 6.0.

The result shows that it is evident that we found the presence of a unit root at conventional levels of statistical significance for the given variables. To see whether they are integrated of order one I(1) at the 1% level, we performed augmented Dickey–Fuller tests on their first difference. The results of the unit root test show that the first differences of both series are stationary which are found to reject the null hypothesis of unit root. Therefore we can conclude that all series involved in the estimation procedure are regarded as I(1), and it is suitable to make co integration test.

B. Johansen's Cointegration Test

Having shown that the variables are integrated of order one, I(1), it is necessary to determine whether there is at least one linear combination of these variables that is I(0). This was done by using the cointegration method [Johansen]. The Johansen method was chosen over the one originally proposed by Engle and Granger (1987) because it is capable of determining the number of cointegrating vectors for any given number of non-stationary series (of the same order), its application is appropriate in the presence of more than two variables, and more important, the likelihood ratio tests used in the procedure (unlike the ADF tests) have well- defined limiting distributions [Miguel D. Ramirez].

Table 3
Results of Johansen's cointegration test (1)

Variables	Eigen-value	t-statistic	Critical value (0.05)	Prob.
SPX	0.036670	108.1247	79.34145	0.0001
BALTIC bench	0.011656	45.5101	55.24578	0.2694
RIGA	0.010701	25.8594	35.01090	0.3349
VILNIUS	0.004644	7.82756	18.39771	0.7005
TALLINN	1.54E05	0.02584	3.84147	0.8722

Based on the above cointegration test, we can say that there is no cointegration in SPX and VILNIUS. Therefore, we perform another cointegration test without these two variables.

Table 4
Results of Johansen's cointegration test (2)

Variables	Eigen-value	t-statistic	Critical value (0.05)	Prob
BALTIC bench	0.032370	68.91292	35.01090	0.0000
RIGA	0.008096	13.72962	18.39771	0.1991
TALLINN	5.80E-05	0.09732	3.84147	0.7551

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level.

Table 5
Kwiatkowski-Phillips-Schmidt-Shin test for indices

Variables	Levels	First Difference	5% Critical Value[1]	1% Critical Value
SPX	0.390975	0.239138	0.146000	0.216000
BALTIC Bench	0.771071	0.264263	0.146000	0.216000
RIGA	0.692057	0.354333	0.146000	0.216000
VILNIUS	0.631422	0.280495	0.146000	0.216000
TALLINN	0.617432	0.309023	0.146000	0.216000

[1] Kwiatkowski-Phillips-Schmidt-Shin critical values for rejection of hypothesis of a stationary.
**Denotes significance at the 1 percent level. Estimations undertaken with EViews6.

Therefore, by applying Johansen test on Baltic bench, Riga and Tallinn series, we found the presence of two cointegration vectors. Therefore, by applying Johansen decision rule, we conclude that there are two co-integration vectors for the model. Hence our findings imply that there are stable long run relationships between the three variables i.e. Baltic bench, Riga and Tallinn.

C. Vector Error Correction Model

A system of cointegrated vectors can be represented by a dynamic error correction model (ECM). Thus we proceed to the test for error correction by using the Johansson and Jeueslius vector error correction method, and the results are shown below. The coefficient of this term reflects the process by which the dependent variable adjusts positively in the short run position.

Table 6
Vector error correction model

Cointegrating Eq:	CointEq1		
RIGA(-1)	1.000000		
TALLINN(-1)	0.458521		
	(0.22709)		
	[2.01912]		
BALTIC_BENCHMARK(-1)	-1.515664		
	(0.22525)		
	[-6.72889]		
@TREND(1)	-0.025559		
C	34.43550		
Error Correction:	D(RIGA)	D(TALLINN)	D(BALTIC_BENCHMARK)
CointEq1	-0.007072	-0.008975	-0.003655
	(0.00128)	(0.00142)	(0.00138)
	[-5.50759]	[-6.30142]	[-2.65800]
D(RIGA(-1))	0.017396	0.047482	-0.093453
	(0.02466)	(0.02735)	(0.02641)
	[0.70549]	[1.73617]	[-3.53899]
D(RIGA(-2))	0.015429	0.030832	-0.049890
	(0.02474)	(0.02744)	(0.02649)
	[0.62369]	[1.12375]	[-1.88321]
D(TALLINN(-1))	0.078883	0.138492	0.117271
	(0.02236)	(0.02480)	(0.02395)
	[3.52725]	[5.58343]	[4.89662]

Table 6 (continued)

Error Correction:	D(RIGA)	D(TALLINN)	D(BALTIC_BENCHMARK)
D(TALLINN(-2))	0.037504	0.021676	-0.048967
	(0.02252)	(0.02498)	(0.02412)
	[1.66501]	[0.86765]	[-2.03001]
D(BALTIC_BENCHMARK(-1))	-0.029073	-0.022269	0.117552
	(0.02311)	(0.02563)	(0.02475)
	[-1.25818]	[-0.86893]	[4.75042]
D(BALTIC_BENCHMARK(-2))	-0.044459	-0.041377	0.007239
	(0.02298)	(0.02549)	(0.02461)
	[-1.93436]	[-1.62314]	[0.29412]
C	0.625048	0.915254	0.899394
	(0.26009)	(0.28847)	(0.27853)
	[2.40324]	[3.17283]	[3.22911]
@TREND(1)	-0.000718	-0.001011	-0.001015
	(0.00027)	(0.00030)	(0.00029)
	[-2.67304]	[-3.39462]	[-3.53097]
R-squared	0.041245	0.066856	0.053362
Adj. R-squared	0.036652	0.062386	0.048828
Sum sq. resids	45840.26	56389.95	52571.10
S.E. equation	5.239204	5.810890	5.610677
F-statistic	8.980305	14.95605	11.76736
Log likelihood	-5158.594	-5332.478	-5273.609
Akaike AIC	6.155562	6.362690	6.292566
Schwarz SC	6.184647	6.391775	6.321651
Mean dependent	0.026998	0.075569	0.054455
S.D. dependent	5.337941	6.001095	5.752885

VI. CONCLUDING REMARKS

In testing the co-integration and causal relationship between SPX, Baltic bench, Riga, Villnius, and Tallinn, the time series model of ADF unit-root test, Johansen co-integration test, Kwiatkowski-Phillips-Schmidt-Shin Test and vector error correction model are employed. The empirical results have found strong evidence that the variables are co-integrated and feedback.

By applying Johansen decision rule, we found that there are two co-integration vectors for the given variables which prove the existence of a long-run bidirectional causal relationship between Baltic bench, Riga and Tallinn. This relationship has made the exchanges more stable and contributed to the economy of these Baltic states as relative stability of exchange rate in the long run would have great significance for promoting liquidity inflows as the stability of the exchange rate can strengthen the foreign investors' trust and encourage their investment positively. The disequilibrium in the short term is also corrected by the proposed error correction model.

REFERENCES

Arshanapalli, B., and J. Doukas, 1993, "International Stock Market Linkages: Evidence from the Pre- and Post-October 1987 Period", *Journal of Banking and Finance*, 17, pp. 193-208.

Athukorala, P.-C., and L.P. Tsai, 2003, "Determinants of Household Saving in Taiwan: Growth, Demography and Public Policy", *Journal of Development Studies*, 39, 5, pp. 69-88.

Agrawal, P., 2001, "The Relation between Savings and Growth: Cointegration and Causality Evidence from Asia", *Applied Economics*, 33, pp. 499-513.

Bonfiglioli, A. and C.A. Favero, 2005, "Explaining Co-movements between Stock Markets: The Case of US and Germany", *Journal of International Money and Finance,* 24, pp. 1299-1316.

Burke, J.J.A., 2008, "The Baltic Securities Market: Product of Economic Innovation", *Working Paper Series*, Kazakhstan Institute of Management, Economics and Strategic Research. Available at SSRN: http://ssrn.com/abstract=1276376

Bashir, A.-H., 2003, "Determinants of Profitability in Islamic Banks: Some Evidence from the Middle East", *Islamic Economic Studies*, 11, 1, pp. 31-60.

Blonigen, B.A., 1997, "Firm-Specific Assets and the Link between Exchange Rate and Foreign Direct Investment," *American Economic Review*, 87, 3, pp. 447-465.

Ciner, C., 2007, "Dynamic Linkages between International Bond Markets", *Multinational Financial Management*, 17, pp. 290-303.

Doshi, K., 1994, "Determinants of Saving Rate: An International Comparison", *Contemporary Economic Policy*, January, 12, 1, pp. 37-45.

Demirgüç-Kunt, A., and H. Huizinga, 1999, "Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence", (Electronic Version), *The World Bank economic Review*, Oxford University Journal, 13, May 2, pp. 379-408.

Dickey, D.A., and W.A. Fuller, 1979, "Distribution of the Estimates for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association* , 74, pp. 427-431.

Dickey, D.A., and W. A. Fuller, 1981, "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica*, 49, pp. 1057-1072

Engsted, T., and C. Tanggaard, 2007, "The Comovement of US and German Bond Markets", *International Review of Financial Analysis,* 16, pp. 172-182.

Eun, C.S., and S. Shim, 1989, "International Transmission of Stock Market Movements", *Journal of Financial and Quantitative Analysis*, 24, 2, pp. 241-256.

Forbes, K.J., and R. Rigobon, 2002, "No Contagion, Only Interdependence: Measuring Stock Market Comovements", *Journal of Finance,* 57, 5, pp. 2223-2261.

Haron, S., and W.N.W. Azmi, 2004, "Profitability Determinants of Islamic Banks: A Co integration Approach", (Electronic Version), *Islamic Banking Conference,* Union Arab Bank, Beirut, Lebanon, 5-7 December.

Heggested, A.A., 1977, "Market Structure, Risk, and Profitability in Commercial Banking." *Journal of Finance,* 32 (September), 1207-16.

Kanas, A., 1998, "Linkages between the US and European Equity Markets: Further Evidence from Cointegration Tests", *Applied Financial Economics*, 8, pp. 607-614.

Kelly, G.W., K.E. Rogers, and N.K. Van Rensselaer, 2008, "International Bond Markets: A Cointegration Study", *Academy of Accounting and Financial Studies Journal*, 12, 1, pp. 123-135.

Lessard, D.R., 1976, "World, Country, and Industry Relationships in Equity Returns: Implications for Risk Reduction Through International Diversification", *Financial Analysts Journal*, 32, 1, pp. 32-38.

Longin, F., and B. Solnik, 1995, "Is the Correlation in International Equity Returns Constant: 1960-1990?", *Journal of International Money and Finance*, 14, 1, pp. 3-26.

Longin, F., and B. Solnik, 2001, "Extreme Correlation of International Equity Markets", *Journal of Finance*, 56, 2, pp. 649-676.

Maneschiold, P., 2006, "Integration between the Baltic and International Stock Markets", *Emerging Markets Finance and Trade,* 42, 6, pp. 25-45.

Masood, O., B. Aktan, and S. Chaudhary, 2009, "An Empirical Study on the Banks Profitability in the KSA: A Cointegration Approach" *African Journal of Business Management*, Vol 3(8), pp. 374-382.

Meric, I., S. Kim, J.H. Kim, and G. Meric, 2008, "Co-Movements of U.S., U.K., and Asian Stock Markets Before and After September 11, 2001", *Journal of Money, Investment and Banking,* 3, pp. 47-57.

Meric, G., M. Ratner, and I. Meric, 2007, "Co-Movements of the U.S., U.K. and Middle East Stock Markets", *Middle Eastern Finance and Economics*, 1, pp. 60-73.

Molyneux, P., and J. Thornton, 1992, "Determinants of European Bank Profitability: A Note", *Journal of Banking and Finance*, 16, pp. 1173-1178.

Metwally, M.M., 1997, "Differences between the Financial Characteristics of Interest-Free Banks and Conventional Banks", *European Business Review*, 97, 2, pp. 92-98.

Mullineaux, D.J., 1978, "Economies of Scale and Organizational Efficiency in Banking: A Profit-Function Approach", *Journal of Finance*, 33, pp. 259-280.

Modigliani, F., and R. Blumberg, 1954, "Utility Analysis and the Consumption Function: An interpolation of the Cross-Section Data, in Post-Keynesian Economics", (Ed.) K. Kurihara, *Rutgers U. Press*, New Brunswick, NJ, pp. 388-436

Panton, D.B., V.P. Lessig, and O.M. Joy, 1976, "Comovement of International Equity Markets: A Taxonomic Approach", *Journal of Financial and Quantitative Analysis*, 11, 3, pp. 415-432.

Ripley, D.M., 1973, "Systematic Elements in the Linkage of National Stock Market Indices", *Review of Economics and Statistics*, 55, 3, pp. 356-361.

Smirlock, M., 1985, "Evidence on the (Non) Relationship between Concentration and Profitability in Banking." *Journal of Money, Credit and Banking*, 17, 1(February), pp. 69-83.

Steinherr, A., and C. Huveneers, 1994, "On the Performance of Differently Regulated Financial Institutions: Some Empirical Evidence." *Journal of Banking and Finance*, 18, pp. 271-306.

Scheicher, M., 2001, “The Co-movements of Stock Markets in Hungary, Poland and the Czech Republic”, *International Journal of Finance and Economics*, 6, 1, pp. 27-39.

Shiller, R.J., 1989, “Comovements in Stock Prices and Comovements in Dividends”, *Journal of Finance*, 44, 3, pp. 719-729.

Taylor, M.P., and I. Tonks, 1989, “The Internationalisation of Stock Markets and the Abolition of U.K. Exchange Control”, *Review of Economics and Statistics*, 71, 2, pp. 332-336.

TSPAKB, 2005, *Capital Market Agenda (Sermaye Piyasasında Gündem)*, 29, January.

Vo, X.V., 2009, “International Financial Integration in Asian Bond Markets”, *Research in International Business and Finance*, 23, pp. 90-106.

Yavas, B.F., 2007, “Benefits of International Portfolio Diversification”, *Graziadio Business Report*, Pepperdine University, 10, 2. Available at http://gbr.pepperdine.edu/072/diversification.html