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INTEGRATION OF THE BALTIC STOCK MARKETS WITH GLOBAL MARKETS DURING THE PREVIOUS DECADE

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Abstract. The three Baltic countries of Estonia, Latvia and Lithuania achieved independence in 1991. In the period between 1993 and 1996, the three Baltic countries established their own stock exchanges. The dualistic nature of these economies – namely, relatively young democracies with newly established stock exchanges on the one hand and high levels of integration into Europe due to EU and Euro area membership on the other – gives rise to the question of whether these stock exchanges are integrated with the developed markets or the emerging markets. The objective of this study is to empirically ascertain the extent of stock market integration of the Baltic markets with global stock markets. The extent of integration with developed and emerging markets is established. The preliminary analysis compares the economic structures of the three domestic economies, the industry contributions of the stock exchanges, and the major international countries investing in the three stock markets. The subsequent stage of the analysis entails the utilisation of principal component analysis. The specified number of latent factors behind global systemic risk are extracted from the panel data set employing factor analysis. Subsequently, these factors serve as independent variables, thereby explaining the variation in returns observed in each country's stock market. The explanatory power of the regressions thus indicates the degree of integration of the stock market with global markets. Despite similar economic structures, with the same sectors contributing almost equally to total output, the sectors represented on their stock exchanges are different. Financials contribute the most to the Estonian stock exchange, followed by utilities. In Lithuania, utilities dominate, with telecommunications in second place. More than half of the Latvian market is made up of utilities and another quarter of financials. Investors from a variety of countries have made investments in the three Baltic exchanges, with the composition of these investments undergoing notable shifts over the past decade. A factor analysis indicates that these Baltic markets are more integrated with the global developed stock markets than with emerging markets. However, these levels of integration are low, and movements on these exchanges are potentially more reflective of country- or region-specific factors than of global factors. There are some indications that the Estonian stock exchange was less integrated in 2019 than in 2010, while the other two show signs of increasing integration.

Keywords: Baltic countries, stock market integration, factor analysis.

JEL Classification: G12, G15, C22

1. Introduction

In classifying a specific equity market, FTSE considers the characteristics, controls and regulations of the market in question. However, it also takes into account the level of economic development, as measured by GNI per capita, and the creditworthiness of the market (FTSE Russell, 2023). The Baltic countries of Estonia, Latvia and Lithuania attained independence in 1991 (Maneschiöld, 2006). Since that time, the countries have reached several significant milestones, including joining the EU in 2004, the Eurozone in 2011 (with Estonia joining first, followed by Latvia in 2014 and Lithuania in 2015), and the OECD at a later date (Harkmann, 2020). These memberships served to confirm the reputation of these countries as developed states.

Following the attainment of independence, each of the three countries proceeded to establish its own stock market. The stock exchange of Lithuania was established in 1993, that of Latvia in 1995, and that of Estonia one year later, in 1996 (Maneschiöld, 2006). Notwithstanding the fact that the three economies are regarded as developed, FTSE continues to categorise these three nascent stock markets as "frontier" (FTSE Russell, 2023). The highest classification is that of "developed stock markets,"

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which includes the UK, USA, Germany, France, and so forth. Subsequently, the "emerging markets" are categorised in descending order. These are subdivided into "advanced emerging" (Brazil, South Africa, Hungary, Poland, etc.) and "secondary emerging" (Chile, China, India, the Philippines, etc.). The lowest category is that of "frontier markets". The three Baltic markets are included in this category, as are countries such as Argentina, Croatia, Serbia and Vietnam.

In light of the dualistic nature of these three economies – namely, that they are all developed economies that are part of the EU, with relatively newly established stock markets that are classified as *frontier* – it is pertinent to inquire whether the three stock markets in question co-move with those of their fellow EU members, who are mostly developed markets, or with those of countries that are classified as emerging. The objective of this study is to empirically ascertain the extent of integration between the stock markets of the Baltic states and those of the global economy, including both developed and emerging markets.

2. Background on the Three Economies

2.1 Macroeconomy

Prior to an examination of the three stock markets, it is first necessary to present background information and context regarding the three macroeconomies. The World Bank first recorded GDP data for them in 1995, four years after the countries in question had gained their independence (World Bank 2024). Table 1 presents a selection of macroeconomic indicators for the period between 1995 and 2020. In terms of economic size, Estonia is the smallest of the three countries, with Latvia producing 1.2 times the Estonian GDP in 1995. In contrast, Lithuania has the largest economy, producing 1.7 times the Estonian GDP. The uninterrupted GDP values demonstrate a consistent pattern of economic expansion across

Table 1
Macroeconomic characteristics of the three Baltic countries

	Estonia	Lithuania	Latvia
GDP (constant LCU)			
1995	9241911000	16145212000	11131271000
2000	12540787000	20260235000	14350958000
2005	17865712000	29246554000	21240502000
2010	17503789000	31005820000	20724305000
2015	20631362000	37345698000	24572126000
2020	24107393000	43446905000	26228007000
GDP per capita (constant LCU)			
1995	6433,0	4448,8	4479,3
2000	8977,0	5789,4	6061,5
2005	13187,2	8802,5	9487,5
2010	13146,2	10010,7	9880,2
2015	15684,4	12856,1	12425,7
2020	18132,4	15545,1	13801,0
Human Capital Index			
2010	0,725663781	0,688390017	0,67645812
2020	0,777203202	0,706047952	0,706581414
Human Development Index			
2022	0,899	0,879	0,879
Sector contribution to GDP in %			
2010			
Industry	24,4	26,2	20,4
Manufacturing	13,7	16,9	11,9
Services	59,9	60,7	64,5
Agriculture, forestry, fishing	3,2	3,0	4,1
2020			
Industry	22,8	24,9	19,6
Manufacturing	12,8	15,6	11,1
Services	63,0	61,2	63,6
Agriculture, forestry, fishing	2,1	3,5	4,0

Source: World Bank (2024) and United Nations Development Programme (UNDP) (2024)

all three countries over time, despite a slight decline between 2005 and 2010 in Estonia and Latvia. In comparison to Latvia, Estonia has demonstrated superior economic growth. In 2020, the GDP of Latvia was only 1.09 times that of Estonia, compared to 1.2 times in 1995. In 2020, Lithuania retained its dominant position with a GDP that was 1.8 times that of Estonia.

While Estonia produces less GDP in absolute terms compared to the other two nations, there has been a general increase in GDP per capita for all three countries. Furthermore, the Estonian GDP per capita is consistently higher. This higher per capita GDP is also reflected in a relatively higher Human Development Index (HDI) for Estonia. While per capita income constitutes one component of the HDI, it is also measured against a range of other indicators, including life expectancy at birth and the level of schooling. Nevertheless, all three countries are considered to exhibit "very high" levels of HDI, as documented by the UNDP (2024). In the global context, Switzerland exhibited the highest HDI in 2022, with a value of 0.967. The Human Capital Index, one of the more recently introduced indicators by the World Bank, offers insight into the impact of health and education on the future productivity of the workforce (World Bank, 2024). Once more, Estonia demonstrates superior performance and is evaluated as allocating a greater proportion of resources to the advancement of the future workforce's productivity. To contextualise this, in 2020, Singapore recorded the highest Human Capital Index (HCI) of 0.879 globally (World Bank, 2024).

The final section of Table 1 illustrates the proportion of GDP contributed by different economic sectors in each country. It is evident that the three Baltic economies exhibit a high degree of similarity. In all three cases, the contribution of *services* to GDP is approximately 60%. The next largest contributor is the *industrial sector*, which accounts for approximately 20% of GDP. The *manufacturing sector* contributes a slightly larger share, around 13%. The *agricultural, forestry, and fishing sectors* collectively account for the smallest share of GDP, at approximately 3%.

In a study published in 2011, Vanags examined the economic integration of the Baltic region following its accession to the European Union. A review of trade data from 2008 revealed an increase in the level of trade integration among the three Baltic countries. However, an analysis of the structure of trade with the rest of Europe shows that exports from Latvia and Lithuania are increasingly destined for Eastern Europe, while Estonia continues to export mainly to Eastern Europe. In their study of the Baltic stock markets, Aleknevičienė, Klasauskaitė and Aleknevičiūtė (2022) identified calendar anomalies in all three exchanges. However, the Monday effect was only observed to have a negative and significant impact on the markets of Latvia and Lithuania, and not on those of Estonia.

2.2 Stock Market

The stock exchanges of Lithuania, Latvia and Estonia were established shortly after the countries gained their independence (Maneschiöld, 2006). It is widely accepted that the stock market of a country should reflect the composition and trends of the underlying macroeconomy. Table 2 provides a summary of the key characteristics of the three stock markets. The Tallinn Stock Exchange in Estonia is represented by the OMX Tallinn All Share Gross Index (OMXTGI), the Vilnius Stock Exchange in Lithuania by the OMX Vilnius All Share Gross Index (OMXVGI) and the Riga Stock Exchange in Latvia by the OMX Riga All Share Gross Index (OMXRGI). Despite the fact that Estonia's economy is the smallest of the three, the Estonian stock exchange had the highest market capitalisation at the beginning of 2024, at 5.2 billion EUR (Nasdaq 2024). Lithuania's market capitalisation was slightly lower at 5.1 billion EUR and the Latvian stock exchange was only 0.6 billion EUR. Table 1 shows that the GDP of Estonia and Latvia was almost the same in 2020. It is therefore somewhat surprising that the market capitalisation of the Estonian stock exchange is 8.6 times higher than that of Latvia. In 2024, OMXVGI had 25 listings, OMXTGI 20 and OMXRGI only 13.

According to the percentages shown in Table 1, the sectoral contributions to GDP in the three countries are relatively similar. The sectoral breakdown of the three stock markets shows a different picture. Utilities, the largest contributor, accounts for more than half of the market capitalisation in Latvia and almost a third in Lithuania. Although *utilities* also contribute 25% to the Estonia stock exchange, *financials* are the main contributor here. Consumer discretionary accounts for 24% in Estonia compared to only 6% in Lithuania and none in Latvia. Another noticeable difference is that telecommunications is relatively important in Lithuania and not so in the other two.

2.3 Capital Flow Sources

As a final attempt to provide some background to the question at hand, the origin investment in the three countries is identified. The IMF regularly conducts its Coordinated Portfolio Investment Survey (CPIS). The data are compiled from a survey of portfolio holdings by non-residents. This allows the IMF to identify which investors from which country are investing in a particular country. The percentages presented in Table 3 have been calculated with this survey as a basis, particularly with regard

Table 2
Characteristics of stock market indices 2024

	OMXTGI (Estonia)	OMVGI (Lithuania)	OMXRGI (Latvia)
Market cap	5.2 billion EUR	5.1 billion EUR	0.6 billion EUR
# of listings	20	25	13
Industry breakdown			
Basic metals	0.00	3.68	0.00
Consumer discretionary	24.15	5.69	0.00
Consumer staples	0.14	13.35	12.58
Energy	0.00	0.00	0.00
Financials	31.70	15.96	25.42
Healthcare	0.00	0.00	1.47
Industrials	16.17	2.36	0.18
Real estate	2.35	0.95	0.00
Technology	0.00	0.00	0.00
Telecommunications	0.00	24.40	4.46
Utilities	25.50	33.62	55.59

Source: Nasdaq 2024

to the stock of non-residents' holdings of Estonian/Latvian/Lithuanian equity and investment fund shares. The table illustrates the percentage of the total investments in equity and investment fund shares at the end of December in the specific year held by investors from the various countries. The calculated values presented in Table 3 offer a general indication of the extent to which countries invest in the shares of the three Baltic countries. Nevertheless, it does not represent the actual situation in an exact manner. In certain instances, the values in question were withheld by the reporting economy in order to safeguard confidentiality (IMF, 2024). The countries for which suppressed values were recorded in the sample include Australia, Ireland, Malta, the Philippines, Poland, Spain and Switzerland. Although this may affect the analysis, it is worth noting that the same countries would then be missing from the data for all three Baltic countries – which would then have less of an impact on the overall picture.

At the end of 2001, Luxembourg, the United States (US) and Sweden were the three countries with a dominant share of equity investment in the Baltic States. The US was much more involved in Latvia (almost 50% of total investment), compared with 25% in Estonia and only 8% in Lithuania. Germany has only been involved in Estonia, whereas Estonia has been investing in Latvian and Lithuanian shares since 2001. In 2009, Germany was a prominent investor in Latvia (29%) and Lithuania (47%), with a comparatively lower level of involvement in Estonia compared to 2001. Norway also emerged as a significant Latvian investor in 2009, while Guernsey became a notable investor in Lithuania. In 2019, Sweden's involvement shifted to Estonia only, with no further presence in the other two countries. There was a sudden shift in the distribution of equities in the Baltic states, with Latvia and Lithuania assuming a dominant position in Estonia, while Guernsey held a significant 62% stake in Lithuanian equities.

In light of the shared history, geographic proximity, and membership in the EU and the Eurozone, it would be reasonable to anticipate that the stock markets of the three Baltic countries would exhibit a degree of co-movement and respond to global shocks in a similar manner. The following section presents additional background information that provides further insights. The three economies exhibit a similar structural configuration, with the same sectors contributing in approximately equal proportions to total production. Estonia, with the smallest economy, appears to have the highest per capita income and the highest levels of development indicators among the three economies. Furthermore, the Estonian stock market exhibits the highest market capitalisation, despite the relatively modest size of the economy. The industry breakdown of the three stock exchanges also demonstrated the ways in which OMXTGI differs from both OMXRGI and OMXVGI. Finally, Table 3 illustrates the extent to which investors from different countries direct their capital towards the three Baltic exchanges. In light of the aforementioned evidence, it is reasonable to conclude that the Baltic stock markets are unlikely to exhibit comparable movements and varying degrees of responsiveness to global events. The following section presents a summary of existing studies on this topic.

Table 3
Share of holdings in equity and investment liabilities at the end of the year

Estonia		Latvia		Lithuania	
Country	Share	Country	Share	Country	Share
December 2001					
Luxembourg	36,958	United States	48,012	Luxembourg	32,100
United States	24,657	Denmark	25,472	Guernsey	19,875
Guernsey	12,053	Luxembourg	16,930	Republic of Estonia	16,863
Sweden	10,680	Republic of Estonia	6,238	Denmark	10,340
United Kingdom	6,419	Sweden	1,744	Sweden	9,061
Germany	5,572	Ukraine	1,278	United States	7,672
December 2009					
Lithuania	25,400	Norway	44,388	Germany	47,487
Luxembourg	23,002	Germany	29,390	Luxembourg	17,658
Finland	21,116	Guernsey	10,830	Sweden	9,168
United States	10,660	Finland	5,047	Finland	8,531
Sweden	9,372	Sweden	2,964	Denmark	5,933
Republic of Poland	3,273	Luxembourg	2,250	United States	4,145
Russian Federation	2,475	United States	2,061	Republic of Estonia	3,670
Germany	1,645	Republic of Estonia	1,460	Norway	1,264
December 2019					
Latvia	20,302	Republic of Estonia	32,569	Guernsey	62,294
Lithuania	19,683	Norway	24,778	Republic of Korea	10,055
Finland	12,471	Lithuania	14,492	Republic of Estonia	9,820
Sweden	12,382	Germany	9,168	Luxembourg	5,779
United States	9,165	Republic of Korea	6,478	Latvia	3,036
France	5,876	Jersey	4,016	Norway	2,244
Luxembourg	5,646	Finland	2,865	United States	2,139
Germany	3,625	United States	2,040	United Kingdom	1,876
Norway	2,720	Switzerland	1,414	Finland	0,885

Source: author's own calculations based on IMF data (CPIS Table 8)

3. Literature: Previous Studies

A number of studies have been conducted to examine the level of integration among the three Baltic stock markets, as well as the integration of the Baltic exchanges with other international ones.

In their 2006 study, Maneschiöld examined the integration of the stock markets of the Baltic countries with those of Europe, focusing on exchanges in the UK, the US, Germany, France and Japan. The empirical study encompasses data from June 1996 to September 2005 and employs a range of techniques, including correlation, causality tests and cointegration. The results substantiate the integration of Latvia into the European economic landscape, particularly in relation to the German stock market. The repercussions of shocks in the United States are observed to affect the markets of Estonia and Lithuania, but not Latvia.

In a similar but shorter period, Stasiukonytė and Vasiliauskaitė (2008) demonstrated that the Scandinavian and Baltic markets are integrated. However, the level of integration exhibited a decline over the sample period of 2000 to 2006. The researchers did not find evidence of cointegration between the Baltic exchanges based on techniques testing for unit roots and Granger causality, as well as vector autoregressions.

The study by Deltuvaitė (2016) concentrated exclusively on the integration of the stock markets of the three Baltic exchanges. The analysis was based on daily data from January 2000 to June 2014. A variety of techniques were employed, including correlation, ARCH estimation, Granger causality, cointegration, ARDL models and error correction models. The results indicated that the markets of Estonia and Lithuania are more closely related, while Latvia could be regarded as exhibiting a greater degree of isolation.

In a master's dissertation published in 2019, Stulga (2019) presents daily stock market data from 2010 to 2018. The sample of 25 countries represents the largest sample referenced in this discussion of the literature. The empirical section comprised DCC-GARCH

estimations, cointegration tests and estimates of frequency connectedness. The analyses were conducted on one Baltic market and one representative from the global market at a time. The findings indicated that Baltic markets are weakly integrated with global markets. Among the three markets, Estonia and Lithuania demonstrated greater integration than Latvia (Stulga, 2019).

The most recent study referenced in this text was published in 2020. The study was based on weekly returns for the period 2002 to 2015, and included cointegration testing. The study was based on weekly returns for the period 2002 to 2015, and included cointegration testing. The results substantiated the hypothesis that the Baltic markets are integrated with the Swedish market. As a consequence of their well-established economic relations with the Nordic countries, in particular Sweden, their connections with the Nordic countries are much stronger than with Poland, Hungary and the Czech Republic (Harkmann, 2020).

While Stulga's 2019 sample of 25 countries is the most comprehensive, it should be noted that none of the quoted studies included a global sample. The estimation techniques employed in the studies all used a single market at a time. For instance, one Baltic market was used together with one European market when testing for cointegration or Granger causality. This empirical study builds on previous research by compiling a global sample of stock exchanges and attempting to ascertain whether the various Baltic markets are integrated with global markets, rather than being isolated. Furthermore, the study will examine the dynamic nature of integration, investigating whether co-movements increase or decrease over time and whether they are generally higher during specific periods.

4. Data and Method

The historic stock market data for the three Baltic countries, spanning the period from January 2010 to December 2019, was sourced from Refinitiv (Thomson Reuters) Eikon. The daily data for OMXRGI, OMXTGI and OMXVGI was transformed into weekly data, with the weekly value being represented by the average of the five closing values for the week. The weekly average closing values were then employed in the calculation of weekly returns. Figure 1 illustrates the trends and movements in the three stock exchanges over time.

All three indices exhibited growth and were at a higher level by the end of 2019, in comparison to their respective starting values in January 2010. The Vilnius index (OMXV) appears to demonstrate a comparatively lower rate of growth in comparison to the other two. The green line starts at about 400 and ends at about 800. The orange line for Tallinn (OMXT) starts at around 600 and ends at around 1400. The blue line for Riga (OMXR) starts just above 400 and ends just below 1200 – indicating the highest growth of the index value over time. All three indices reached a maximum in early 2018, but show some unique trends over time. The Tallinn index demonstrates a sudden increase at the beginning of 2013, a phenomenon that is mirrored by the Riga index two-thirds of the way through 2015. Table 4 presents a summary of the descriptive statistics associated with the calculated weekly returns.

The Riga exchange recorded the highest mean weekly returns, followed by Tallinn and Vilnius. The ranking of the three average returns serves to corroborate the trend observed in Figure 1. The maximum recorded weekly return was the highest in Riga, while the minimum weekly return was the lowest. The standard deviations illustrate a more

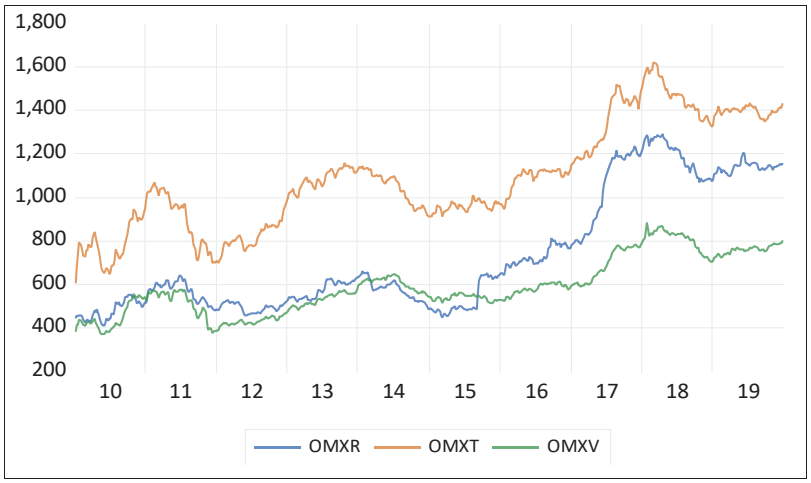

Figure 1. Trends in the three Baltic stock exchanges

Table 4
Descriptive statistics of weekly returns

Statistic	OMXRGI	OMXTGI	OMXVGI
Mean	0.001909	0.001686	0.001435
Median	0.001317	0.001649	0.002237
Maximum	0.142528	0.119953	0.081025
Minimum	-0.065577	-0.095528	-0.106957
Standard deviation	0.019855	0.019061	0.017765

Source: author's own calculations

volatile Riga index, followed by those of Tallinn and Vilnius. As illustrated in Figure 1 and Table 4, there are instances when the three indices do not exhibit the same trend. This is corroborated by the calculated correlations between the three indices, as presented in the initial columns of Table 5, and their calculated returns, as displayed in the subsequent columns of the same table.

The correlation between OMXRGI and OMXTGI is very similar to that between OMXRGI and OMXVGI. OMXTGI and OMXVGI have the highest correlation. The correlations between the three returns follow the same trend.

The capital asset pricing model (CAPM) proposed by Sharpe (1964) and Lintner (1965) forms the basis of the empirical approach adopted in this paper. According to CAPM, one factor is driving excess returns on equity markets. The initial CAPM was later adjusted into the arbitrage pricing theory (APT) by Ross (1976), which allows for a multi-factor model. Systematic movements in stock returns could now be attributed to more than one factor – or to a linear function of a number of factors. A few years later, Chamberlain and Rothschild (1983) provided asymptotic conditions for empirically estimating the factors underlying the APT using principal component analysis. In this way, changes observed in a panel of time series are attributed to either a common component or an idiosyncratic component. A number of latent factors could account for the common component, while the unique movement of a time series is attributed to an idiosyncratic component or factors that specifically affect the specific series.

Based on the above discussion – in particular the APT – the empirical analysis looks for common sources of variation in a global sample of stock market returns. Factor analysis, using principal component analysis, first identifies the relevant number of latent factors driving variation in this global sample. The next step is to extract the indicated number of latent factors behind global systemic risk. These factors are included as independent variables explaining the variation in returns of each country's stock market. The estimated R-squared (or explanatory power of the regression) provides an indication of the degree of stock market integration with global markets. In this study, the approach is to regress Estonian, Latvian and Lithuanian returns on the aforementioned factors in order to ascertain their individual levels of stock market integration. This empirical approach is analogous to those employed by Kabundi and Mouchili (2009) and Pukthuanthong and Roll (2009).

In order to identify these underlying common factors, a global sample of stock market indices was retrieved from Refinitiv (Thomson Reuters) Eikon. The all-share indices for 41 countries were compiled by Thomson Reuters and are therefore comparable. In order to eliminate the impact of exchange rate variability, the daily closing values of the indices are reported in the common exchange rate of the US dollar. Subsequently, the five daily values are converted into weekly averages for the entire period between January 2010 and December 2019, resulting in 521 weekly observations. The calculation of weekly returns is based on the logarithmic first differences of the index values. The series of weekly returns are stationary, which is a prerequisite for factor analysis.

The data for the 41 countries was grouped into two subsamples, which were deemed to be representative of developed and emerging stock markets, respectively. The developed group comprises the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong,

Table 5
Cross-correlations

	Index values				Returns		
	OMXRGI	OMXTGI	OMXVGI		OMXRGI	OMXTGI	OMXVGI
OMXRGI	1.00000			OMXRGI	1.00000		
OMXTGI	0.93737	1.00000		OMXTGI	0.55090	1.00000	
OMXVGI	0.93199	0.96558	1.00000	OMXVGI	0.56852	0.71512	1.00000

Source: author's own calculations

Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, South Korea, Spain, Switzerland, the UK and the US. The emerging markets group comprises the following countries: Brazil, Chile, the Czech Republic, Egypt, Greece, India, Indonesia, Malaysia, Mexico, Pakistan, the Philippines, Poland, Qatar, South Africa, Taiwan, Thailand, Turkey and the UAE.

5. Results and Discussion

The factor analysis commences with the identification of the number of latent factors present in each of the two subsamples. The Bai and Ng (2002) ICp_1 criteria, calculated from both samples, do not provide a definitive indication of the number of factors present in either sample. The eigenvalue criteria indicate that two common factors are sufficient to explain the variation observed in the developed markets sample. The third potential factor has an eigenvalue below 5%, and thus is not considered further. The variation in the emerging markets sample is more diverse, and thus five factors are proposed. In order to ensure consistency and facilitate comparison of the results of the two samples, two factors are extracted from each sample. Two common factors were also employed in previous studies, as evidenced by Lin (2005), who analysed a sample period of 1985 to 1999. Conversely, Morana and Beltratti (2008) used only one factor to explain stock market returns in their study.

The initial factor derived from the developed markets sample accounts for 70.26% of the observed variation in the panel. The initial factor derived from the panel of emerging markets only accounts for 45.27% of the observed variation within that group. This may be indicative of a greater degree of alignment and uniformity in the response of developed markets to similar shocks or developments. The emerging stock markets appear to exhibit greater diversity and less alignment. The variance share of the second factor for the sample of developed markets is 6.08%, which indicates that it is responsible for explaining a smaller proportion of the variation observed within the group in comparison to the first factor. The second common factor for the emerging markets group accounts for 7.07% of the observed variation within that group. The combined variance share of the two developed factors is 76.34%, in comparison to the considerably lower 52.34% observed in the emerging markets. This may be the reason why the test statistic indicated that a greater number of common factors should be extracted from the emerging markets sample.

The correlations between the extracted common factors yield intriguing observations, as illustrated in Table 6. The first two factors demonstrate a high degree of correlation. This may be indicative of the proposition that the same events and/or shocks exert an influence on global stock markets irrespective of whether they are classified as developed or emerging. The second developed factor is entirely distinct from the first. The correlation is negative and very small in absolute terms. A similar conclusion can be drawn with regard to the correlation between the two emerging factors. The two secondary factors also demonstrate a negative and very small correlation in absolute terms. It is recommended that future studies consider the potential for linking these latent common factors to specific macroeconomic variables. This may be associated with interest rates or economic growth in dominant economies.

The objective of this study is to ascertain the extent of stock market integration of the three Baltic countries. As previously stated, the degree of integration is determined by the explanatory power of a multi-factor model. Consequently, the standardised returns of the three stock exchanges are regressed on the two factors from each group. The results are presented in Table 7.

Table 6
Cross-correlations between common factors

	Developed 1	Developed 2	Emerging 1	Emerging 2
Developed 1	1.000000			
Developed 2	-5.87E-12	1.000000		
Emerging 1	0.860271	0.273923	1.000000	
Emerging 2	0.119746	-0.104528	-3.57E-11	1.000000

Source: author's own calculations

Table 7
Estimated stock market integration

	OMXTGI	OMXRGI	OMXVGI
Developed markets	0.286	0.183	0.330
Emerging markets	0.238	0.141	0.277

Source: author's own calculations

The results of the regression analysis indicate that the Tallinn Stock Exchange was 28.6% integrated with developed stock markets over the period 2010 to 2019 and at 23.8% slightly less integrated with emerging stock markets. The Latvian Riga exchange exhibited the lowest levels of integration, while the Lithuanian Vilnius exchange demonstrated the highest levels of integration. The reported variance shares in Table 7 corroborate the low levels of integration that have been documented in previous studies focusing on the Baltic markets. For example, see Stulga (2019). Furthermore, the findings corroborate previous reports indicating that the stock exchange of Latvia exhibits the lowest degree of integration among the three Baltic countries. Consequently, it is more susceptible to the influence of domestic or idiosyncratic factors. The analysis presented herein offers two novel insights. All three Baltic exchanges are more integrated with developed stock markets than with their emerging counterparts, which may be attributed to their membership of the EU and the Eurozone. However, any future change in their classification would result in them being placed in the emerging group, rather than in the category of developed markets.

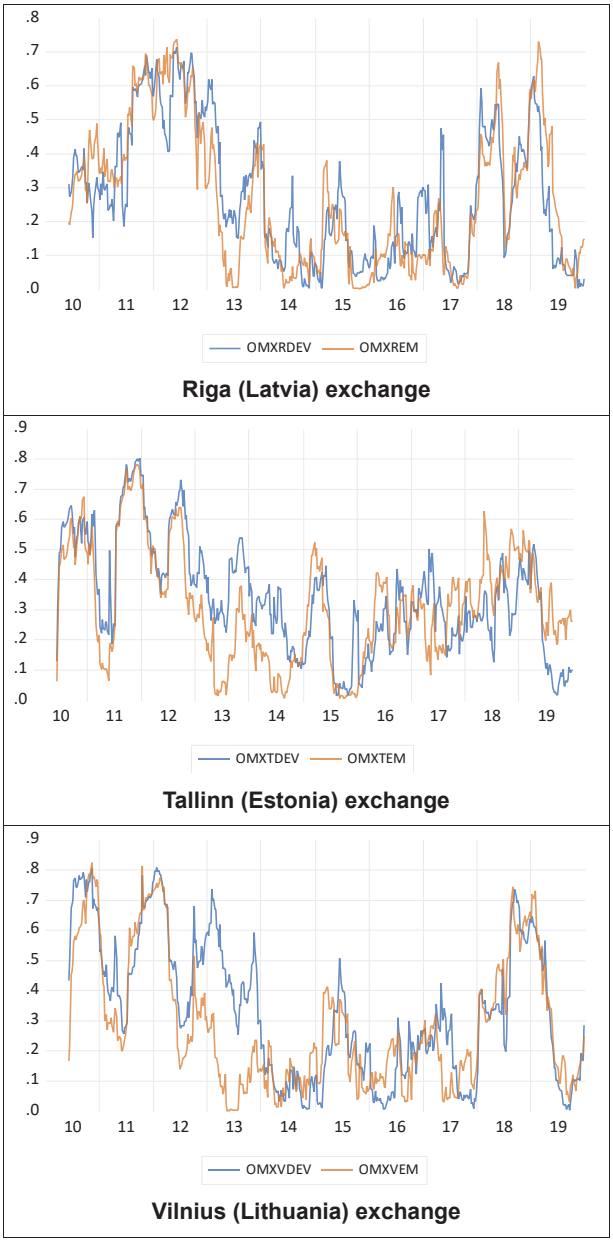

Figure 2. Dynamic stock market integration

The concluding section of the analysis addresses the potential for stock market integration to exhibit dynamic characteristics. In lieu of estimating the regressions over the entire sample period, as documented in Table 7, the estimation is conducted over successive 24-week periods. The R-squared value for each rolling window period is recorded. If these R-squared values remain relatively constant, it can be concluded that the level of market integration remains constant and does not change. Conversely, if the estimated R-squared values fluctuate over time, it can be inferred that the level of integration is not static but rather subject to change. This observation is indicative of dynamic integration. Figure 2 depicts the estimated R-squared values over time. The figure illustrates the integration of each country with developed and emerging markets, respectively, as indicated by the blue and red lines.

While all three exchanges demonstrated greater integration with developed markets than with emerging markets, Figure 2 illustrates instances where emerging market factors exerted a dominant influence. This is evident in the case of Latvia and Estonia in 2018 and 2019, respectively. Conversely, there were instances of heightened integration with the developed markets, as evidenced by Latvia in 2012, 2013, 2014, 2016 and 2017; Estonia for the majority of the initial sample period; and Lithuania in 2012 and 2013. Further analysis may facilitate the identification of specific reasons for these trends.

The evidence suggests that Estonian integration is the most consistent, with levels not exhibiting the pronounced decline observed in Lithuania in 2014 and Latvia towards the end of 2015. However, the overall trend is negative. It appears that the Estonian stock market is exhibiting a diminished degree of integration with both developed and emerging markets towards the conclusion of the sample period. Both Latvia and Lithuania demonstrate indications of reduced integration in 2019; however, during the preceding two years, the trend exhibited an upward trajectory. These trends are in contrast with the observations of Stasiukonytė and Vasiliauskaitė (2008), which may be due in part to the fact that their analysis covered an earlier sample period.

6. Conclusions

The three Baltic countries of Estonia, Latvia and Lithuania achieved independence in 1991 and established their own stock exchanges between 1993 and 1996. These relatively young exchanges operate within economies that have long-standing European relationships, including membership of the EU, OECD, and the euro area. Nevertheless, despite their European linkages, they are classified as "frontier markets", with future expectations of being reclassified as "emerging" and subsequently as "developed". The economic structures are analogous, with the same industries contributing analogous shares to total production. The similarities between these industry contributions to GDP are however not reflected in the industry breakdown of the exchanges. For instance, OMXTGI has a considerably lower market capitalisation and number of listings. Additionally, investments in equities of the three Baltic states are made by different countries. Factor analysis over the decade 2010 to 2019 confirms low levels of integration with both developed and emerging global equity markets – but slightly higher integration with developed markets. There are signs of changes in the level of integration over this period. OMXTGI seems to end the decade with less integration, while there are indications that OMXRGI and OMXVGI may be on the way to higher integration.

The sample period deliberately excludes the volatile period of the COVID-19 pandemic and the Russian invasion of Ukraine. The results and observed trends would be very different if these later periods were included. It is therefore likely that the results are due to economic rather than geopolitical factors.

Author Contribution

This article was independently compiled by Anmar Pretorius utilising the listed resources.

References:

Aleknevičienė, V., Klasauskaitė, V., & Aleknevičiūtė, E. (2022). Behavior of calendar anomalies and the adaptive market hypothesis: evidence from the Baltic stock markets. *Journal of Baltic Studies*, *53*(2):187–210.

Alessi, L., Barrogozzi, M., & Capasso, M. (2010). Improved penalization for determining the number of factors in approximate factor models. *Statistics and Probability Letters*, 80(23-24):1806–1813.

Bai, J., & Ng, S. (2002). Determining the number of factors in approximate factor models. *Econometrica*, 70(1):191–221.

Chamberlain, G., & Rothschild, M. (1983). Arbitrage, factor structure, and mean variance analysis of large asset markets. *Econometrica*, 51(5):1281–1304.

Deltuvaitė, V. (2016). Investigation of stock market integration in the Baltic countries. *Economics and Business*, *28*(1):38–44.

FTSE Russell (2023). FTSE Equity Country Classification September 2023 Annual Announcement. Available at https://research.ftserussell.com/products/downloads/FTSE-Country-Classification-Update_latest.pdf

Harkmann, K. (2022). Integration of the Baltic stock markets with developed European markets. *International Journal of Finance & Economics*, *27*(1):506–517.

Kabundi, A., & Mouchili, I. (2009). Stock Market Integration: A South African Perspective. *The African Finance Journal*, 11(2):51–66.

Kenourgios, D., & Samitas, A. (2011). Equity market integration in emerging Balkan markets. *Research in International Business and Finance*, *25*(3):296–307.

Lin, M. (2005). Capital Market Integration and Market Liberalization in Asian Emerging Markets. *International Journal of Management*, 22(2):249–265.

Lintner, J. (1965). The valuation of risky assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, 47(1):163–196.

Maneschiöld, P. O. (2006). Integration between the Baltic and international stock markets. *Emerging Markets Finance and Trade*, *42*(6):25–45.

Morana, C., & Beltratti, A. (2008). Comovements in international stock markets. *Journal of International Financial Markets, Institutions & Money*, 18(1):31–45.

Nasdaq (2024). Equity Indexes. Available at: https://indexes.nasdaqomx.com/

Pukthuanthong, K., & Roll, R. (2009). Global market integration: An alternative measure and its application. *Journal of Financial Economics*, 94(2):214–232.

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, 13(3):341–360.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance,* 19(3):425–442.

Stasiukonytė, J., & Vasiliauskaitė, A. (2008). Nature of Baltic and Scandinavian stock markets' integration process. *Economics & Management*.

Stulga, Š. (2019). Baltic Stock Market Integration. Master's thesis submitted to Faculty of Social Sciences, Charles University.

Syllignakis, M. N., & Kouretas, G. P. (2011). Dynamic correlation analysis of financial contagion: Evidence from the Central and Eastern European markets. *International Review of Economics & Finance, 20*(4):717–732.

United Nations Development Programme (2024) UNDP Human Development Index. Available at: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI

Vanags, A. (2011). Economic integration and cohesion in the Baltic Sea region: A critical perspective from the Baltic States. *Journal of Baltic Studies, 42*(1):91–102.

World Bank (2024) World Bank open data. Available at https://data.worldbank.org/

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