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THE EFFECT OF REAL EXCHANGE RATE VOLATILITY ON EXPORTS IN THE BALTIC REGION

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ABSTRACT

In this paper we analyze the effects of the real exchange rate volatility on exports in the Baltic region. The study focuses on three countries in the Baltic region, namely, Estonia, Latvia, and Lithuania, and uses quarterly exports of these countries to their major trading partners over the period from 1993Q1 to 2014Q4. It uses both the panel co-integration analysis and the method of bounds testing or the Autoregressive Distributed Lag (ARDL) approach to co-integration analysis to estimate the short-run and long-run effects of the real exchange rate volatility on exports. Our results reveal that exports depend positively on the levels of foreign economic activity but negatively on relative prices and real exchange rate. However, the exchange rate volatility tends to provide mixed effects. Furthermore, the effects of exchange volatility are found to yield mixed effects both in the short-run and the long-run. The results also indicate that the effects vary from country to country.

JEL: F14, F31

KEYWORDS: Baltic Countries, Exports, Exchange Rate Volatility, GARCH Volatility Measures, Panel Unit Roots, Panel Co-integration

INTRODUCTION

There are numerous theoretical and empirical studies that analyze the effects of the exchange rate volatility on international trade flows. Notwithstanding the sizeable number of studies conducted, no real consensus about the impact of exchange rate volatility on trade has emerged. Most of the empirical studies have found that exchange rate volatility tends to reduce the level of trade. Some of these studies include, Byrne, Darby, and MacDonald (2008), Choudhry (2005), Bahmanee-Oskooee (2002), Arize, *et al.* (2000), Arize (1995), Chowdhury (1993), Pozo (1992), and Bahmani-Oskooee and Ltaifa (1992). Some of the reasons for a negative relationship between exchange rate volatility and trade flows include (a) exchange rate volatility may affect exports directly through uncertainty and adjustment costs for risk-averse exporting investors, and (b) exchange rate volatility may have an indirect effect through its impact on the structure of output, investment and government policy. Some empirical studies have found a positive relationship or an insignificant negative relationship between exchange rate volatility and trade flows. Examples of such studies include Doyle (2001), Chou (2000), McKenzie and Brooks (1997), Qian and Varangis (1994), Kroner and Lastrapes (1993), Assery and Peel (1991), Aristotelous (2001), Bahmani-Oskooee and Payestch (1993), Bahmani-Oskooee (1991), and Hooper and Kohlhagen (1978). Exchange rate volatility making exporting more attractive to risk-tolerant exporting firms has often been cited as the plausible reason for a positive relationship between the two variables.

There are several reasons for contradictory results by different studies. Some of the reasons include: the differences in the measurement of exchange rate volatility; the differences in type of sample data used, for example, the use of aggregate export data versus sectoral export data; the differences in time-frames; and the differences in econometric methods used. With better access to sectoral data combined with the development of more sophisticated econometric models, recent studies have begun evaluating the exchange rate volatility-export connection from a sectoral perspective. The results of the studies that make use of sectoral data may be more revealing than aggregate studies given that different trade sectors would be impacted differentially by exchange rate volatility.

This study focuses on export flows from each of the three countries selected (Estonia, Latvia, and Lithuania) to its top 20 exports destinations to uncover the nature and sensitivity of the relationship between exchange rate volatility and exports. In each country, the top 20 export destinations selected account about 90% of its total exports to the world. We use both the panel co-integration and the method of bounds testing or the Autoregressive Distributed Lag (ARDL) approach to co-integration analyses for this purpose. Using these approaches we investigate the effects of exchange rate volatility on exports over a period of 22 years using quarterly data from 1993Q1 to 2014Q4. The paper is organized as follows: We provide a brief review of the literature in Section 2. Thereafter, in Section 3 we lay the empirical framework of our study by specifying our model. In Section 4 we discuss variable definitions and outline our data sources. Empirical results from the panel co-integration, bounds testing approach to co-integration, and error-correction model estimates are presented in Section 5. The final section presents a summary and conclusion of the results obtained in this study.

LITERATURE REVIEW

In this section we present a brief overview of studies that examine the exchange rate volatility-trade nexus. We begin by discussing the most recent and sophisticated studies, employing co-integration techniques and error-correction models, to older, less complex studies. For a comprehensive review of empirical studies, see Bahmani-Oskooee and Hegerty (2007). Bahmani-Oskooee and Harvey (2011) investigate the effects of exchange rate fluctuations on trade flows between the U.S. and Malaysia using disaggregated, industry-level annual export and import data for 17 export industries and 101 importing industries from 1971 to 2006. They conclude that while exchange rate volatility exerts short-run effects in trade flows of almost two-thirds of the industries, these effects last into the long-run in 38 U.S. exporting industries and in 10 U.S. importing industries. Bahmani-Oskooee and Hegerty (2009) investigate the effects of exchange rate fluctuations on trade flows between the U.S. and Mexico using disaggregated, industry-level annual export and import data for 102 industries from 1962 to 2004. They analyze both the short- and long-term effects of volatility in the peso/dollar real exchange rate on Mexican-United States trade. They conclude that in the short-term increased volatility negatively affects trade flows in most industries. Long-term effects however, are significant for only one-third of the industries studied, and of this, only two-thirds are negative. They speculate that increased Mexican integration and liberalization of economic policies allow for greater adjustments in the long-term so that volatility is less of a problem in the long-term than in the short-term.

Byrne, Darby, and MacDonald (2008) analyze the impact of exchange rate volatility on the volume of bilateral U.S. trade flows using homogenized and differentiated sectoral annual data over the period 1989-2001 for a cross-section of 6 EU countries and 22 industries. Their study finds that clustering all industries together provides evidence of a negative effect on trade from exchange rate volatility, which confirms findings of other studies using aggregate data. However, when investigating sectoral trade differences, the effects of exchange rate volatility on trade is negative and significant for differentiated goods and insignificant for homogeneous goods, confirming recent studies that sectoral differences are in fact crucial to explaining the differential impact of volatility on trade. They suggest that a greater degree of disaggregation at the industry level may provide more worthwhile results, which is what we do in this study. Bahmani-Oskooee and Kovyryalova (2008) investigate the effect of exchange rate fluctuations on trade flows between the U.S. and the United Kingdom using disaggregrated annual export and import data for 177 commodities industries from 1971 to 2003. They analyze both the short- and long-term effects of real exchange rate volatility on trade between the U.S. and the UK. Their results reveal that the volatility of the real dollar–pound rate has a short-term significant effect on imports of 109 industries and on exports of 99 industries. In most cases, such effects are unfavorable. In the long run, however, the number of significant cases is somewhat reduced: only 62 import and 86 export industries are significantly and adversely affected by exchange rate volatility. The industries affected involve both durable and non-durable goods, and include small as well as large industries, supporting findings by aggregate studies.

In another study, Bahmani-Oskooee and Mitra (2008), investigate the effects of exchange rate volatility on trade flows between the U.S. and India, an emerging economy. Using annual data from 40 industries from 1962–2004, their results demonstrate that exchange rate volatility has more short-run than long-run effects. In the short-run, 17 industries were affected on the import side and 15 on the export side. The industries affected show India's increasing ability to produce import substitutable goods. However, in the long run, only a few industries are affected because the increasing dependence on trade between India and the US cause industries to respond inelastically to exchange rate volatility.

Using both the nominal and the real exchange rate between the United States dollar and the currencies of Canada and Japan, Choudhury (2005) investigates the influence of exchange rate volatility on U.S. real exports to Canada and Japan using aggregate monthly data ranging from January 1974 to December 1998. The study uses conditional variance from the GARCH (1, 1) model as a measure of exchange rate volatility, and finds significant and mostly negative effects of exchange rate volatility on real exports.

As in the above studies, Sukar and Hassan (2001) investigate the relationship between U.S. trade volume and exchange rate volatility using co-integration and error-correction models. Their study uses quarterly aggregate data covering the period 1975Q1 – 1993Q2 and a GARCH model to measure the exchange rate volatility. Paralleling other studies, the authors find evidence for a significantly negative relationship between U.S. export volume and exchange rate volatility. However, unlike other findings, they reveal that the short-run dynamics of the exchange rate volatility -trade relationship is insignificant. They argue that this result may be due to the existence of avenues for hedging against exchange risks so as to neutralize the negative impact of exchange rate volatility. Other scholars argue that this short-run insignificant relationship may be because of the investigators' use of aggregate data, which ignores sectoral differences. For example, while one sector may exhibit a negative relationship, another may exhibit an equal but opposite effect so that they offset each other.

Finally, Arize (1995), using monthly series from February 1978 to June 1986 analyzes the effects of real exchange rate volatility on the proportions of bilateral exports of nine categories of goods from the U.S. to seven major industrial countries. The volatility measure employed is the standard deviation of the monthly percentage change in the bilateral exchange rate between the U.S. and the importing country from t to $t-12$. The study reveals differential effects of exchange rate volatility across different categories of exports. The study also concludes that exchange rate uncertainty has a negative effect on U.S. real exports, and that it may have a major impact on the allocation of resources to different industries depending on trade elasticities. One major problem with most of the studies above is that the sample period includes the period prior to the end of the fixed exchange regime, so results may include the lag effects of fixed exchange rates on trade before 1973 lingering on during the transition period after the implementation of the floating exchange rate regime. The current study corrects for this potential bias by using quarterly exports data covering a 22-year period from 1993Q1 to 2014Q4. The methodology used in this study incorporates the recent developments in the literature, namely, the panel co-integration method and the ARDL approach to co-integration analysis, which may uncover the nature and sensitivity of the real exchange rate volatility-exports nexus.

METHODOLOGY

Model Specification

The objective of this study is to assess the effects of exchange rate volatility on exports. The study uses quarterly exports data of three countries in the Balkan region, namely, Estonia, Latvia, and Lithuania. For each country, quarterly exports data for top 20 export destinations were selected. Drawing on the existing empirical literature, we specify that a standard long-run reduced-form export demand function to take the following functional form (see, for example, Pino, Das and Sharma, 2016; Ozturk and Kalyonku, 2009; Choudhry, 2005; Arize, 1998, 1996, 1995; and Asseery and Peel, 1991):

$$\ln X_t = \beta_0 + \beta_1 Trend + \beta_2 lnY_t + \beta_3 lnP_t + \beta_4 lnV_t + \beta_5 lnRER_t + \varepsilon_t \quad (1)$$

where X_t is the real export volume in period t, Trend represents the linear trend, Y_t is the real foreign income in period t, P_t is the relative price of exports in period t, V_t is a measure of exchange rate volatility, RER_t is the real exchange rate in period t, and ε_t is a white-noise disturbance term. Economic theory posits that the real income level of the domestic country's trading partners would have a positive effect on the demand for its exports. Therefore, *a priori*, we would expect that $\beta_2 > 0$. On the other hand, if the relative price of exports rise (fall), domestic goods become less (more) competitive than foreign goods, causing the demand for exports to fall (rise). Therefore, *a priori*, one would expect that β_3, which measures the competitiveness of a given Balkan country's exports relative to trading partner's domestic production, is negative. The third explanatory variable is a measure of exchange rate volatility. Various measures of real VOL have been proposed in the literature. Some of these measures include (1) the averages of absolute changes, (2) the standard deviations of the series, (3) the deviations from the trend, (4) the squared residuals from the ARIMA or ARCH or GARCH processes, and (5) the moving sample standard deviation of the growth rate of the real exchange rate. In this study, two alternative measures of exchange rate volatility were used. Since the effects of V on exports have been found to be empirically and theoretically ambiguous (Bredin, *et al.* 2003), β_4 could be either positive or negative. An increase (a decrease) in real exchange rate indicates an appreciation (a depreciation) of the domestic currency which depresses (boosts) exports. Therefore, *a priori*, one would expect that β_5 to be negative.

Equation (1) shows the long-run relationships among the dependent and independent variables in our model. Given the recent advances in time-series analysis, in estimating the long-run model outlined by equation (1), it is now a common practice to distinguish the short-run effects from the long-run effects. For this purpose, equation (1) should be specified in an error-correction modeling (ECM) format. This method had been used in many recent studies including Pino, Tas and Sharma (2016), Bahmani-Oskooee and Hegerty (2009), Bahmani-Oskooee and Wang (2008, 2009), Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006). According to Bahmani-Oskooee and Wang (2008), such an approach is warranted given that the measure of exchange rate volatility is a stationary variable (see, for example, De Vita and Abbot, 2004; Bahmani-Oskooee & Payesteh, 1993; and Doyle, 2001), whereas the other variables in equation (1) could be non-stationary. Therefore, following Pesaran, Shin, and Smith (2001) and their method of bounds testing or the Autoregressive Distributed Lag (ARDL) approach to co-integration analysis, we rewrite equation (1) as an ARDL-ECM model in equation (2) below.

$$\Delta lnX_t = \rho_0 + \rho_1 Trend + \sum_{i=1}^{n} a_i \Delta lnX_{t-i} + \sum_{i=0}^{n} b_i \Delta lnY_{t-i} + \sum_{i=0}^{n} c_i \Delta lnP_{t-i} + \sum_{i=0}^{n} d_i \Delta lnV_{t-i} + \sum_{i=0}^{n} e_i \Delta lnRER_{t-i} + \pi_0 X_{t-1} + \pi_1 Y_{t-1} + \pi_2 P_{t-1} + \pi_3 V_{t-1} + \pi_4 RER_{t-1} + \epsilon_t \quad (2)$$

where Δ is the difference operator and the other variables are as defined earlier, n is the lag length, and ϵ_t is a random error term. Pesaran, Shin, and Smith's (2001) bounds testing approach to cointegration is based on two procedural steps. The first step involves using an F-test or Wald test to test for joint significance of the no cointegration hypothesis H_o: $\pi_0 = \pi_1 = \pi_2 = \pi_3 = \pi_4 = 0$ against an alternative hypothesis of cointegration, H_1: $\pi_0 \neq 0, \pi_1 \neq 0, \pi_2 \neq 0, \pi_3 \neq 0, \pi_4 \neq 0$. This test is performed using equation (2). The advantage of this approach is that there is no need to test for unit roots, as is commonly done in co-integration analysis. Pesaran, Shin, and Smith (2001) provide two sets of critical values for a given significance level with and without time trend. One assumes that the variables are stationary at the levels or I(0), and the other assumes that the variables are stationary at the first difference or I(1). If the computed F-values exceed the upper critical bounds value, then H_0 is rejected signaling co-integration among the independent variables. If the computed F-value is below the critical bounds values, we fail to reject H_0. Finally, if the computed F-statistic falls within the boundary, the result is inconclusive. After establishing co-integration, the second step involves estimation of the following error-correction model to examine short-run effects.

$$\Delta lnX_t = \alpha_0 + \alpha_1 Trend + \beta\varepsilon_{t-1} + \sum_{i=1}^{k}\beta_i \Delta lnX_{t-i} + \sum_{i=0}^{k}\gamma_i \Delta lnY_{t-i} + \sum_{i=0}^{k}\delta_i \Delta lnP_{t-i} + \sum_{i=0}^{k}\theta_i \Delta lnV_{t-i} + \sum_{i=0}^{k}\vartheta_i \Delta lnRER_{t-i} + \omega_t \quad (3)$$

where X_t is the real export volume, Y_t is the real foreign income, P_t is the relative price of exports, V_t is a measure of exchange rate volatility, RER_t is the real exchange rate, ε_{t-1} is the lagged residual of the co-integration relationship from the model in Equation (1), and ω_t is a white-noise disturbance term. The lag length k is initially set to 4 lags but insignificant coefficients were successively dropped until the best fit model was found.

Variables and Data Sources

Our export data series for each country span a 22-year period from 1993Q1 through 2014Q4, leading to 88 quarterly observations. Quarterly data on export were taken from the International Monetary Fund, *Direction of Trade Statistics Database*. Quarterly data on nominal export volumes have been converted into real export volumes using export price indices with 2010 serving as the base (=100). The study focuses on the top twenty export destinations for each of the three countries selected. The top 20 export destinations of Estonia are: Sweden, Finland, Latvia, Russian Federation, Lithuania, Germany, Norway, the United States, Netherlands, Denmark, the United Kingdom, Belgium, Poland, France, Peoples' Republic of China, Turkey, Italy, Spain, Mexico, and Canada. These 20 export destinations accounted for 90.1% of total exports of Estonia in 2014. The top 20 export destinations of Latvia are: Lithuania, Russian Federation, Estonia, Germany, Poland, Sweden, the United Kingdom, Denmark, Norway, Netherlands, Finland, Belarus, France, Czech Republic, Italy, Turkey, Spain, Belgium, the United States and Peoples' Republic of China. These 20 export destinations accounted for 87.5% of total exports of Latvia in 2014. The top 20 export destinations of Lithuania are: Russian Federation, Latvia, Poland, Germany, Belarus, Netherlands, Estonia, the United Kingdom, the United States, Ukraine, Sweden, France, Denmark, Norway, Italy, Kazakhstan, Belgium, Finland, Iran, and Czech Republic. These 20 export destinations accounted for 89.2% of total exports of Lithuania in 2014.

The real income variable for export destinations is proxied by the industrial production index (2010=100) The underlying series are obtained from the International Monetary Fund's *International Financial Statistics database* and from the Organization for Economic Cooperation and Development's online database. The relative price ratio for exports of each country is calculated as the ratio of the export price index of each origin country to the price level of the destination country, proxied by the consumer price index (2010=100). For those countries that do not have quarterly export price indexes, they were proxied by the consumer price index. The export price index and the consumer price index for each country are also obtained from the International Monetary Fund's *International Financial Statistics database*.

Following Bahmani-Oskooee and Wang (2008, 2009), and Sekkat and Varoudakis (2000), the real exchange rate between country i and j, RER_{ij}, is constructed as:

$$RER_{ij} = \left(\frac{ER_{ij} \times P_j}{P_i}\right) \tag{4}$$

where RER_{ij} is the real exchange rate, ER_{ij} is the bilateral nominal exchange rate between country i and country j, P_i is the consumer price index (2010=100) country i, and P_j is the consumer price index (2010=100) of country j. The quarterly data on nominal exchange rates are taken from the International Monetary Fund's *International Financial Statistics database*. This study uses two alternative measures of exchange rate volatility each of which is derived using the real exchange rate. Our first measure of exchange rate volatility was derived using the estimated conditional variance of a GARCH(1,1) model. Real exchange rates have been used in this study in the measurement of our measure of exchange rate volatility, though some previous studies have used nominal exchange rates. The GARCH model has dominated the literature on volatility since the early 1980s. The model allows for persistence in conditional variance by imposing an autoregressive structure on squared errors of the process. According to Choudhry (2005), the ARCH-type models capture the time-varying conditional variance as a parameter generated from a time-series model of the conditional mean and variance of the growth rate, and thus are very useful in describing volatility clustering. Other measures of exchange rate volatility could potentially ignore information on the stochastic processes by which exchange rates are generated. The $\mathrm{GARCH}(1,1)$ model we estimate is based on an autoregressive model of order 2 ($\mathrm{AR}(2)$) of the first difference of the real exchange rate and it takes the following form:

$$\ln RER_t = \beta_o + \beta_1 \ln RER_{t-1} + \beta_2 \ln RER_{t-2} + e_t, \qquad \text{where} \quad e_t \sim N(0, u_t^2) \tag{5}$$

$$u_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 u_{t-1}^2 \tag{6}$$

The estimated conditional variance (u_t^2) from Equation (6) is used as our measure of exchange rate volatility. Finally, our second measure of volatility is constructed following Bredin, Fountas, and Murphy (2003), Weliwita, Ekanayake, and Tsujii (1999), Chowdhury (1993), Lastrapes and Koray (1990), and Koray and Lastrapes (1989). Following these authors the real exchange rate volatility measure is constructed as:

$$VOL_t = \left[\frac{1}{m}\sum_{i=1}^{m}(\ln RER_{t+i-1} - \ln RER_{t+i-2})^2\right]^{1/2} \tag{7}$$

where VOL_t is the volatility of real exchange rate, RER_t is the real exchange rate and *m* = 4 is the order of the moving average. According to Koray and Lastrapes (1989), this measure can capture general movements in real exchange rate volatility and exchange rate risk over time.

EMPIRICAL RESULTS

In this section, we discuss the study's findings and empirical results. First we present the results of the unit root tests and co-integration tests. Then we present the results of the long-run and short-run estimates of our specified model.

Unit root tests: The starting point of our econometric analysis is to check whether the variables included in Equation (1) contain unit roots. While there are several unit root tests available, this study uses the Augmented Dickey-Fuller test, the Phillips-Perron test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The ADF and PP tests use the null hypothesis of unit root (non-stationary) while KPSS test uses the null hypothesis of stationary. Table 1 reports the results of these unit root tests for three selected Balkan countries.

Table 1: Unit Root Tests Statistics

	ADF Test			PP Test		KPSS Test	
Level	**ADF**	**k**	**Case**	**PP**	**Case**	**KPSS**	**Case**
Estonia							
$\ln X$	-1.85	4	1	-2.90	2	1.18***	1
$\ln Y$	-1.33	5	3	-3.45*	2	1.00***	1
$\ln P$	-6.43***	2	2	-4.36***	2	0.94***	1
$\ln RER$	-1.99	2	3	-2.15**	3	0.82***	1
$\ln VOL_1$	-1.55	0	2	-1.51	2	0.17**	2
$\ln VOL_2$	-2.39	0	1	-2.38	1	0.69**	1
Latvia							
$\ln X$	-2.47	0	2	-2.53	2	1.18***	2
$\ln Y$	-2.14	8	2	-2.13	3	1.09***	1
$\ln P$	-1.66	4	1	-1.69	1	0.74***	1
$\ln RER$	-1.04	4	1	-2.19	1	1.09***	1
$\ln VOL_1$	-0.44	1	3	-0.53	3	0.38*	1
$\ln VOL_2$	-0.12	0	3	-0.13	3	0.17**	2
Lithuania							
$\ln X$	-1.21	4	1	-2.11	1	1.20***	1
$\ln Y$	-2.23	9	1	-1.95	1	1.09***	1
$\ln P$	-0.16	4	1	-6.05***	3	0.13*	2
$\ln RER$	-6.01***	0	3	-5.39***	3	1.00***	1
$\ln VOL_1$	-0.81	0	3	-0.77	3	1.16***	1
$\ln VOL_2$	-0.35	4	3	-0.16	3	0.85***	1
	ADF Test			**PP Test**		**KPSS Test**	
First Difference	**ADF**	**k**	**Case**	**PP**	**Case**	**KPSS**	**Case**
Estonia							
$\Delta\ln X$	-4.07***	3	1	-11.25***	2	0.41	1
$\Delta\ln Y$	-3.10***	4	3	-16.99***	2	0.35	1
$\Delta\ln P$	-4.93***	1	2	-9.82***	2	0.64**	1
$\Delta\ln RER$	-7.17***	1	3	-8.29***	3	0.57**	1
$\Delta\ln VOL_1$	-8.28***	0	2	-8.27***	2	0.05	2
$\Delta\ln VOL_2$	-9.93***	0	1	-9.93***	1	0.03	1
Latvia							
$\Delta\ln X$	-4.26***	3	2	-9.88***	2	0.09	2
$\Delta\ln Y$	-3.87**	4	2	-11.65***	3	0.40	1
$\Delta\ln P$	-2.98**	3	1	-9.94***	1	0.12	1
$\Delta\ln RER$	-3.72***	3	1	-11.29***	1	0.25	1
$\Delta\ln VOL_1$	-11.17***	0	3	-11.25***	3	0.36*	1
$\Delta\ln VOL_2$	-9.36***	0	3	-9.40***	3	0.04	2
Lithuania							
$\Delta\ln X$	-4.40***	3	1	-8.80***	1	0.23	1
$\Delta\ln Y$	-2.11**	9	3	-10.15***	1	0.05	1
$\Delta\ln P$	-7.82***	0	1	-7.84***	3	0.44*	1
$\Delta\ln RER$	-6.26***	0	3	-6.13***	3	0.45*	1
$\Delta\ln VOL_1$	-6.32***	1	3	-7.98***	3	0.25	1
$\Delta\ln VOL_2$	-7.45***	3	3	-9.55***	3	0.25	1

*Notes: ADF represents the Augmented Dickey-Fuller test statistic, PP represents the Phillips-Perron test statistic and KPSS represents Kwiatkowski-Phillips-Schmidt-Shin test statistic. The ADF and PP tests use the null hypothesis of unit root (non-stationary) while KPSS test uses the null hypothesis of stationary. K represents the optimal lag length based on Akaike information criterion (AIC). Cases 1, 2, and 3 correspond to constant, constant and trend, and neither constant nor trend are incorporated in the specification, respectively. *, **, and *** indicate the statistical significance at the 10, 5, and 1 percent level of significance, respectively.*

Based on the ADF test and PP test, relative price variable is stationary at the level for Estonia while real effective exchange rate is stationary at the level for Lithuania. The majority of the variables are stationary at the first difference. Thus, the unit root tests indicate that almost all of the variables are integrated of order one. Having tested for the unit roots of each variable, the next step is to test whether the variables included in Equation (1) are co-integrated. As discussed in the previous section, this will be accomplished using the ARDL approach to co-integration.

Co-integration tests: Applying the ARDL approach to co-integration to quarterly data from 1993Q1 to 2012Q4, we assess the co-integrating relationships for the three Balkan countries selected. First, we estimate equations (2) and following Bahmani-Oskooee and Mitra (2008) we impose a maximum of eight lags on each first differenced variable and employ Akaike's Information Criterion (AIC) to select the optimum lag length. Choosing a combination of lags that minimizes the AIC, we then test whether the variables for each country are co-integrated. The results of the co-integration analysis are presented in Table 2. Table 2 reveals that all three countries encompass an F-statistic above the upper bound, implying that the four variables are co-integrated in all three cases. The same results hold regardless of which measure of real exchange rate volatility measure used. Therefore, all three countries exhibit co-integrating relationships among variables that are used to analyze the effects of volatility on exports. It is concluded that either there exists a long-run relationship among the variables, or that the four variables in our models are co-integrated. The estimated coefficients for the long-run relationships for three countries are presented in Table 3.

Table 2: Co-integration Test Results

Model 1: $\ln X_t = \beta_0 + \beta_1 Trend + \beta_2 lnY_t + \beta_3 lnP_t + \beta_4 lnV_{1t} + \beta_5 lnRER_t + \varepsilon_t$							
	Lags	**F- Statistic**	**Cointegrated?**	**Critical values:**	**10%**	**5%**	**1%**
Estonia	8	4.25**	Yes	I(0)	2.68	3.05	3.81
				I(1)	3.53	3.97	4.92
Latvia	4	4.02**	Yes	I(0)	2.20	2.56	3.29
				I(1)	3.09	3.49	4.37
Lithuania	4	5.28***	Yes	I(0)	2.68	3.05	3.81
				I(1)	3.53	3.97	4.92
Model 2: $\ln X_t = \beta_0 + \beta_1 Trend + \beta_2 lnY_t + \beta_3 lnP_t + \beta_4 lnV_{2t} + \beta_5 lnRER_t + \varepsilon_t$							
	Lags	F- Statistic	Cointegrated?	Critical values:	10%	5%	1%
Estonia	4	4.50**	Yes	I(0)	2.68	3.05	3.81
				I(1)	3.53	3.97	4.92
Latvia	4	4.09**	Yes	I(0)	2.68	3.05	3.81
				I(1)	3.53	3.97	4.92
Lithuania	4	4.65***	Yes	I(0)	2.20	2.56	3.29
				I(1)	3.09	3.49	4.37

*Notes: This table summarizes the results of the bounds testing approach to co-integration. The critical values for bounds testing are taken from Pesaran, Shin, and Smith (2001, Table CI(iii) Case III, p. 300). **, and *** indicate the statistical significance at the 5 and 1 percent level of significance, respectively.*

In the case of Estonia, all estimated coefficients have the expected signs. When the first measure of exchange rate volatility is used, all variables are statistically significant at either 1% or 5% level of significance. Regardless of the measure of exchange rate volatility used, it has a negative effect on exports of Estonia. In the case of Latvia, all variables are statistically significant when the second measure of volatility is used. Regardless of the measure of exchange rate volatility used, in the long-run, exchange rate volatility has a positive effect on exports in Latvia. In the case of Lithuania, all variables are statistically significant except for the volatility measure. In addition, exchange rate volatility has a mixed effect on exports of Lithuania in the long-run. The results of the error-correction model are presented in Table 4. The error-correction term is highly statistically significant in all cases. In the case of Estonia, exchange rate volatility has a positive effect on exports in the short-run. In the case of Latvia, exchange rate volatility has a negative effect on exports while it has mixed effects on exports of Lithuania in the short-run.

Table 3: Long-Run Relationship Estimates

Country	Volatility Measure	Constant	Y_t	P_t	V_t	$REER_t$
Estonia	Vol_1	-15.838***	2.929***	-1.528**	-0.469***	2.026***
		(0.000)	(0.000)	(0.027)	(0.000)	(0.007)
	Vol_2	-20.433***	4.268***	-0.882	-0.258	2.269**
		(0.000)	(0.000)	(0.416)	(0.172)	(0.049)
Latvia	Vol_1	-6.653***	1.770***	1.410	0.259***	-2.684***
		(0.000)	(0.000)	(0.187)	(0.004)	(0.000)
	Vol_2	-5.594***	1.242***	2.632**	0.311**	-3.175***
		(0.000)	(0.000)	(0.019)	(0.035)	(0.000)
Lithuania	Vol_1	1.960	0.690**	2.037***	-0.010	-3.079***
		(0.154)	(0.020)	(0.000)	(0.905)	(0.000)
	Vol_2	1.457	0.848***	2.259***	0.059	-2.830***
		(0.295)	(0.005)	(0.000)	(0.574)	(0.000)

*Notes: This table summarizes the results of the long-run relationship estimates. The figures in parentheses are p-values. ** and *** indicate the statistical significance at the 5 and 1 percent level of significance, respectively.*

Table 4: Error-Correction Model Estimates

	Estonia		Latvia		Lithuania	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
ε_{t-1}	-0.379***	-0.495***	-0.216***	-0.304***	-0.327***	-0.197***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔlnX_{t-1}	0.194*	0.254**			0.128	0.243***
	(0.082)	(0.023)			(0.129)	(0.006)
ΔlnX_{t-2}		0.190*			-0.323***	-0.438***
		(0.056)			(0.000)	(0.000)
ΔlnY_t	0.913***	0.759***	1.216***	1.217***	1.337***	1.248***
	(0.000)	(0.000)	(0.000)	(0.082)	(0.082)	(0.000)
ΔlnY_{t-1}	-0.313	-0.378*	0.516***	0.577***	0.101	-0.081
	(0.166)	(0.068)	(0.000)	(0.000)	(0.387)	(0.475)
ΔlnY_{t-2}	0.243		0.238*	0.363**	0.273**	0.301***
	(0.200)		(0.083)	(0.014)	(0.013)	(0.008)
ΔlnY_{t-3}	0.084			0.167		
	(0.661)			(0.228)		
ΔlnP_t	-0.545	-1.044***	-1.203***	-1.436***	-2.264***	-1.278***
	(0.146)	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)
ΔlnP_{t-1}			-0.279	-0.189	0.587*	0.609*
			(0.490)	(0.591)	(0.169)	(0.064)
ΔlnP_{t-2}			0.074	0.120	-1.078***	-1.253***
			(0.835)	(0.725)	(0.000)	(0.000)
ΔlnP_{t-3}			-1.200***	-1.235***	-0.701***	-0.250
			(0.000)	(0.000)	(0.000)	(0.101)
$\Delta lnRER_t$	-0.019*	0.079	0.688***	0.743***	0.019	-0.216
	(0.814)	(0.725)	(0.002)	(0.002)	(0.922)	(0.922)
$\Delta lnRER_{t-1}$			0.360	0.339	-0.424**	-0.658***
			(0.100)	(0.127)	(0.042)	(0.007)
$\Delta lnRER_{t-2}$			-0.476**	-0.512**		
			(0.022)	(0.012)		
ΔlnV_{1t}	0.194*		-0.004		-0.008	
	(0.082)		(0.875)		(0.749)	
ΔlnV_{1t-1}					-0.024	
					(0.371)	
ΔlnV_{1t-2}					0.093***	
					(0.000)	
ΔlnV_{1t-3}					0.036	
					(0.156)	
ΔlnV_{2t}		0.022		-0.018		0.014
		(0.627)		(0.530)		(0.545)

*Note: The figures in parentheses are p-values. ***, ** and * indicate the statistical significance at the 1%, 5% and 10% levels, respectively. Model 1 and Model 2 are outlined in Table 2.*

Since the results of the error-correction models do not provide significant results, a detailed analysis of 20 trading partners for each of the three countries were carried out using the ARDL approach to co-integration. Due to the large number of countries involved, the results of the unit-root tests and bounds tests for co-integration analysis are not reported. Following the studies by Bahmani-Oskooee and Harvey (2011), Bahmani-Oskooee and Hegerty (2009), Bahmani-Oskooee and Wang (2008, 2009), Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006), we report only the short-run volatility coefficients and all the long-run coefficients. The estimated results for individual trading partners for Estonia, Latvia, and Lithuania are presented in Tables 5, 6, and 7, respectively.

Table 5: Short-Run and Long-Run Coefficient Estimates: Estonia

	Short-Run Coefficient Estimates					**Long-Run Coefficient Estimates**			
Country	$\Delta \ln V_t$	$\Delta \ln V_{t-1}$	$\Delta \ln V_{t-2}$	$\Delta \ln V_{t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln V_t$	$\ln RER_t$
Belgium	-0.510**				4.552	4.617***	-74.161	-0.424	75.392
	(0.024)					(0.000)	(0.238)	(0.173)	(0.232)
Canada		-0.344			-8.903	1.836	-5.384**	-0.803*	-0.662
		(0.563)				(0.499)	(0.046)	(0.090)	(0.810)
China, P.R.	0.420	0.218	0.583**		-3.479	1.610**	7.336	-0.515*	-5.292**
	(0.855)	(0.347)	(0.018)			(0.024)	(0.207)	(0.096)	(0.014)
Denmark	-0.482**	0.389*			3.596	2.019	11.558	-0.303	-15.308
	(0.019)	(0.065)				(0.119)	(0.648)	(0.351)	(0.548)
Finland	-0.082	0.277**	0.173		5.824	0.879	5.490	-0.162	-7.061
	(0.440)	(0.016)	(0.117)			(0.292)	(0.305)	(0.282)	(0.214)
France	0.056				35.022	5.955**	14.641	-1.231**	-17.683
	(0.993)					(0.020)	(0.374)	(0.024)	(0.282)
Germany	0.008	-0.164**	0.169**		77.427	2.071*	86.254	0.015	-87.604
	(0.909)	(0.021)	(0.019)			(0.062)	(0.296)	(0.941)	(0.288)
Italy	-0.602*	-0.645*	0.274	0.887***	-23.547	5.083*	-2.844	-1.122**	1.373
	(0.074)	(0.085)	(0.428)	(0.006)		(0.056)	(0.577)	(0.016)	(0.803)
Latvia	-0.146***	0.037	0.114***	0.074*	-3.035	2.140***	-0.795	-0.857**	-2.926
	(0.000)	(0.393)	(0.008)	(0.087)		(0.000)	(0.517)	(0.015)	(0.118)
Lithuania	-0.025				-8.084	3.074***	2.226	-0.053	-1.347*
	(0.441)					(0.000)	(0.145)	(0.452)	(0.075)
Mexico	0.783	-2.141	-1.934	-3.859**	-73.149	4.102	-42.999	2.037	5.697
	(0.606)	(0.152)	(0.190)	(0.017)		(0.181)	(0.145)	(0.492)	(0.178)
Netherlands	0.115	0.063	-0.375**		-7.743	7.742***	10.854	0.136	-11.064
	(0.464)	(0.686)	(0.022)			(0.000)	(0.792)	(0.331)	(0.787)
Norway	0.158**	-0.152**			36.909	7.622	-4.419	0.049	5.271
	(0.036)	(0.046)				(0.109)	(0.347)	(0.928)	(0.403)
Poland	-0.010				-8.116	2.931***	-1.994	0.091	-0.087
	(0.867)					(0.000)	(0.137)	(0.651)	(0.914)
Russian Federation	0.123**	-0.095*			18.015	1.824	1.562**	0.142	4.141***
	(0.026)	(0.074)				(0.304)	(0.015)	(0.343)	(0.001)
Spain	0.306				75.473	2.241**	-26.257**	1.525***	19.843*
	(0.371)					(0.013)	(0.010)	(0.000)	(0.052)
Sweden	-0.080*				12.203	3.299	-5.166**	-1.035*	0.227
	(0.069)					(0.147)	(0.020)	(0.078)	(0.905)
Turkey	0.269				-1.093	4.875***	-1.219***	-0.218	-8.914***
	(0.354)					(0.000)	(0.000)	(0.563)	(0.000)
United Kingdom	-0.229**	0.584***	0.519***	0.187***	9.779	2.672**	-3.144***	-0.881***	0.447
	(0.030)	(0.000)	(0.000)	(0.000)		(0.014)	(0.000)	(0.000)	(0.268)
United States	-0.265				-6.993	8.482***	4.678**	2.436*	-4.734***
	(0.522)					(0.004)	(0.049)	(0.058)	(0.000)

*Note: This table summarizes the results obtained using the error-correction model defined in Equation (3). The figures in parentheses are absolute value of t-statistic. ** and * indicate the statistical significance at the 1% and 5% levels, respectively.*

Estonia: Short-Run Effects of Exchange Rate Volatility on Exports The short-run estimated coefficients on exchange rate volatility presented on the left panel in Table 5 reveal a mixture of negative and positive signs. There is also a variation in the significance of the exchange rate volatility on exports among individual countries in the short-run. Some of the coefficients are negative and statistically significant. Of the 20 countries, 13 of the countries have at least one statistically significant coefficient. In the case of the

United Kingdom, all coefficients are statistically significant up to 3 lags. Only four countries, namely, China, France, Spain and Turkey, have positive coefficients for all lags but most of these coefficients are statistically insignificant in the short-run.

Estonia: Long-Run Effects of Exchange Rate Volatility on Exports The long-run coefficient estimates for Estonia are shown in the right panel of Table 5. As economic theory postulates, the real income variable renders a positive sign in all cases. This coefficient is statistically significant in thirteen of the 20 countries. The relative price variable displays the expected negative sign in twelve of the 20 countries and is statistically significant at the 1% or 5% level in seven of the 20 countries. This result is similar to those of Bahmani-Oskooee and Harvey (2011), Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006). The estimated coefficients on exchange rate volatility show a mixture of negative and positive signs but the majority of the coefficients are negative. This coefficient is negative and statistically significant for Canada, China, France, Italy, Latvia, Sweden, and the United Kingdom. Our findings are somewhat similar to those of Bahmani-Oskooee and Hegerty (2009) and Bahmani-Oskooee and Wang (2008, 2009). Finally, the estimated coefficients on the real exchange rate show a mixture of negative and positive signs but the majority of the coefficients are negative. In general, in the long-run, exchange rate volatility appears to have mixed effect on the Estonian exports.

Latvia: Short-Run Effects of Exchange Rate Volatility on Exports The short-run estimated coefficients on exchange rate volatility presented on the left panel in Table 6 reveal a mixture of negative and positive signs. There is also a significance variation of the exchange rate volatility on exports among individual countries in the short-run. Some of the coefficients are positive but only a very small number of coefficients are statistically significant. The countries that have negative coefficients show that most of the coefficients are statistically insignificant in the short-run.

Latvia: Long-Run Effects of Exchange Rate Volatility on Exports The long-run coefficient estimates are shown in the right panel of Table 6. As hypothesized, the real income variable renders a positive sign in all cases. This coefficient is statistically significant at the 1% level in nine of the countries and significant at the 5% level in two countries. The relative price variable displays the expected negative sign in seventeen countries and is statistically significant in thirteen of the 20 countries. The estimated coefficients on the real exchange rate show a mixture of negative and positive signs but the majority of the coefficients are negative. Finally, the estimated coefficients on volatility also show a mixture of negative and positive signs and only six of the twenty are statistically significant. In general, in the long-run, exchange rate volatility appears to have mixed effect on the Latvian exports.

Lithuania: Short-Run Effects of Exchange Rate Volatility on Exports The short-run estimated coefficients on exchange rate volatility for Lithuania presented on the left panel in Table 7 reveal a mixture of negative and positive signs. As in the case of Estonia and Latvia, there is also a significance variation of the exchange rate volatility on exports among individual countries in the short-run. Only a very small number of the coefficients are statistically significant. The countries that have negative coefficients show that these coefficients are statistically insignificant in the short-run, except Germany, Italy, and Sweden.

Lithuania: Long-Run Effects of Exchange Rate Volatility on Exports The long-run coefficient estimates for Lithuania are shown in the right panel of Table 7. As expected, the real income variable renders a positive sign in all cases and it is statistically significant in most of the countries. The relative price variable displays the expected negative sign in all countries except China, Italy and the United States. The estimated coefficients on the real exchange rate show a mixture of negative and positive signs but the majority of the coefficients are negative. Finally, as in the case of Estonia and Latvia, the estimated coefficients on volatility show a mixture of negative and positive signs and only six of the twenty are statistically significant. Finland, France, Italy, Spain, and the United Kingdom have both negative and statistically significant coefficients on exchange rate volatility. In general, as in the case of Estonia and Latvia, the exchange rate volatility appears to have mixed effect on the Lithuanian exports in the long-run.

Table 6: Short-Run and Long-Run Coefficient Estimates: Latvia

Country	Short-Run Coefficient Estimates				Long-Run Coefficient Estimates				
	$\Delta \ln V_t$	$\Delta \ln V_{t-1}$	$\Delta \ln V_{t-2}$	$\Delta \ln V_{t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln V_t$	$\ln RER_t$
Belarus	-0.007				-10.033		-0.336***	-0.034	-0.245
	(0.468)					2.792***	(0.001)	(0.429)	(0.543)
						(0.000)			
Belgium	0.089				-1.792		-3.196***	0.043	1.494**
	(0.636)					2.812***	(0.000)	(0.714)	(0.019)
						(0.001)			
China, P.R.	0.119				-33.638		8.437	-0.335	-6.069
	(0.753)					4.492***	(0.277)	(0.743)	(0.102)
						(0.005)			
Czech	-0.089				-19.414	4.473*	-2.711	-0.383	-0.376
Republic	(0.317)					(0.052)	(0.386)	(0.582)	(0.866)
Denmark	-0.057				-3.241		-5.247***	-0.133	2.979
	(0.413)					3.020***	(0.000)	(0.403)	(0.103)
						(0.002)			
Estonia	-0.027				-3.056		-4.452**	-0.114	1.608
	(0.413)					2.564***	(0.012)	(0.651)	(0.448)
						(0.000)			
Finland	0.175	-0.104	0.305**		-1.025	0.580	-2.345**	-0.568***	-1.660
	(0.279)	(0.543)	(0.048)			(0.484)	(0.033)	(0.000)	(0.248)
France	-0.182				-5.744	1.005	-1.729*	-0.512***	-0.659
	(0.441)					(0.117)	(0.056)	(0.000)	(0.375)
Germany	-0.121**	0.028	-0.062		-4.590		-1.939***	0.026	0.744**
	(0.014)	(0.543)	(0.168)			2.217***	(0.000)	(0.688)	(0.040)
						(0.000)			
Italy	-0.244*				-27.454	0.771	1.451	-0.945***	-3.507*
	(0.087)					(0.542)	(0.522)	(0.000)	(0.087)
Lithuania	0.051				-5.524	2.479	-3.681	-0.046	0.951
	(0.229)					(0.108)	(0.271)	(0.873)	(0.790)
Netherlands	0.100				-0.767	0.888	-2.716***	-0.111	-0.592
	(0.429)					(0.133)	(0.001)	(0.264)	(0.412)
Norway	0.042				-26.691	1.717	-2.565	-0.366	-7.834
	(0.597)					(0.942)	(0.556)	(0.903)	(0.805)
Poland	-0.010				-8.116		-1.994	0.091	-0.087
	(0.867)					2.931***	(0.137)	(0.651)	(0.914)
						(0.000)			
Russian	-0.068	-0.161***	-0.079**		-25.972		-4.959**	0.623	-9.393
Federation	(0.203)	(0.002)	(0.020)			6.012***	(0.014)	(0.289)	(0.122)
						(0.000)			
Spain	-0.487				-5.102		-8.962***	-0.575**	2.387*
	(0.269)					3.909***	(0.000)	(0.012)	(0.058)
						(0.000)			
Sweden	-0.234**				3.008	0.058	-3.083***	-0.553	0.919
	(0.013)					(0.968)	(0.002)	(0.166)	(0.375)
Turkey	0.338	-0.605**	0.208	0.622**	-57.780		-0.671**	1.091***	-2.274
	(0.225)	(0.024)	(0.456)	(0.021)		4.218***	(0.024)	(0.001)	(0.356)
						(0.000)			
United	0.032				41.428	8.223**	-2.663*	-0.278***	2.299*
Kingdom	(0.451)					(0.029)	(0.071)	(0.009)	(0.094)
United	0.148	0.194	-0.216	0.172	-19.306	5.076**	0.289	0.027	-0.965
States	(0.295)	(0.245)	(0.129)	(0.231)		(0.019)	(0.911)	(0.928)	(0.629)

*Note: This table summarizes the results obtained using the error-correction model defined in Equation (3). The figures in parentheses are absolute value of t-statistic. ** and * indicate the statistical significance at the 1% and 5% levels, respectively.*

SUMMARY AND CONCLUSIONS

In this paper we have examined the dynamic relationship between exports and exchange rate volatility in Baltic countries, in the context of a multivariate error-correction model. Estimates of the long-run export demand functions were obtained by employing the bounds testing approach to co-integration using quarterly data for the period 1993Q1 – 2014Q4.

Table 7: Short-Run and Long-Run Coefficient Estimates: Lithuania

	Short-Run Coefficient Estimates					Long-Run Coefficient Estimates			
Country	$\Delta \ln V_t$	$\Delta \ln V_{t-1}$	$\Delta \ln V_{t-2}$	$\Delta \ln V_{t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln V_t$	$\ln RER_t$
Belarus	-0.033***				-17.159	3.994***	-0.676***	-0.106**	-0.476
	(0.000)					(0.000)	(0.000)	(0.012)	(0.262)
Belgium	-0.260				-10.062	2.191***	1.081	-0.252***	-0.923
	(0.142)					(0.002)	(0.143)	(0.004)	(0.147)
Czech	-0.073	0.167	-0.155**	0.286**	-9.103	2.412	-0.081	-0.747	-1.295
Republic	(0.528)	(0.168)	(0.207)	(0.020)		(0.365)	(0.986)	(0.263)	(0.606)
Denmark	0.032				-4.241	1.167	-0.581	-0.246***	-1.474*
	(0.451)					(0.255)	(0.588)	(0.000)	(0.091)
Estonia	0.044				-12.015	2.904***	0.480	-0.078	-1.731
	(0.451)					(0.002)	(0.909)	(0.673)	(0.483)
Finland	-0.045				-28.869	6.910	2.579	-0.454	4.620
	(0.396)					(0.427)	(0.612)	(0.224)	(0.541)
France	0.020				-4.794	1.142	0.637	-0.212**	-3.533***
	(0.709)					(0.569)	(0.703)	(0.010)	(0.004)
Germany	-0.021	0.026	-0.071*	-0.080**	7.040	0.152	-3.774	0.280	-0.152
	(0.595)	(0.498)	(0.068)	(0.047)		(0.992)	(0.780)	(0.906)	(0.877)
Italy	-0.154				-0.175	3.868***	-5.156***	-0.710***	3.106***
	(0.426)					(0.000)	(0.000)	(0.000)	(0.000)
Latvia	0.045				-6.482	1.984	4.511*	0.058	1.677
	(0.432)					(0.128)	(0.071)	(0.768)	(0.515)
Netherlands	-0.097	-0.088	0.089	-0.357***	-6.862	3.181	4.456	-0.101	-8.228*
	(0.247)	(0.280)	(0.268)	(0.000)		(0.312)	(0.440)	(0.667)	(0.086)
Norway	0.028				42.818	9.202***	9.500***	0.283	-8.018***
	(0.676)					(0.001)	(0.001)	(0.496)	(0.000)
Poland	-0.045	-0.040	-0.101	-0.237***	-10.516	3.390***	-0.471	0.083	-0.228
	(0.382)	(0.519)	(0.135)	(0.000)		(0.000)	(0.375)	(0.648)	(0.846)
Russian	-0.029***	0.030***	0.036***		16.056	0.301	1.479***	-0.193	4.412***
Federation	(0.001)	(0.005)	(0.000)			(0.848)	(0.003)	(0.114)	(0.000)
Spain	0.138	0.537**			-12.871	6.272***	-6.269**	-0.966***	5.174**
	(0.593)	(0.039)				(0.006)	(0.045)	(0.000)	(0.033)
Sweden	0.481	0.702	-0.562	-1.627*	-6.630	1.995	2.016	0.008	-2.515
	(0.725)	(0.601)	(0.652)	(0.070)		(0.691)	(0.655)	(0.986)	(0.414)
Turkey	-0.102	-0.097	0.008	-0.287***	-0.664	1.136	1.073**	0.185	2.125
	(0.313)	(0.396)	(0.939)	(0.008)		(0.390)	(0.024)	(0.705)	(0.480)
Ukraine	-0.061				-1.134	2.567	3.117***	-0.023	5.151***
	(0.467)					(0.173)	(0.001)	(0.939)	(0.002)
United	0.001	-0.139***	0.008	-0.149***	-7.818	4.606	-5.476	2.225	-1.535
Kingdom	(0.997)	(0.002)	(0.859)	(0.001)		(0.814)	(0.845)	(0.844)	(0.913)
United States	-0.062	0.072	-0.285**		-11.516	4.017*	3.974**	-0.122	-3.483***
	(0.645)	(0.589)	(0.029)			(0.054)	(0.019)	(0.499)	(0.002)

*Note: This table summarizes the results obtained using the error-correction model defined in Equation (3). The figures in parentheses are absolute value of t-statistic. ** and * indicate the statistical significance at the 1% and 5% levels, respectively.*

The co-integration results clearly show that there exists a long-run equilibrium relationship between real exports, real foreign income, relative prices, real exchange rate, and real exchange rate volatility, in all three countries selected. In the long-run, all the specifications yielded expected signs for the coefficients. Most of our estimated coefficients are statistically significant either at the 1% or 5% levels. There is also a significance variation of the exchange rate volatility on exports among countries in the short-run. Some of the coefficients are negative and statistically significant while others are positive and statistically insignificant in the short-run. There is also a significant variation of the exchange rate volatility on exports among countries in the short-run. Some of the coefficients are negative and statistically significant. These results point out to the increasing competitiveness of Baltic countries' exports in the global economy as a result of the depreciating value of the local currency over time. It underscores the degree to which transition countries such as Estonia, Latvia and Lithuania have succeeded in finding alternative markets in Europe and especially in Asia in the last decade. One of the limitations of the present study is the limited number of countries included in the study. While the current study considered only top 20 export destinations for each of the three Baltic countries, more meaningful conclusions would have been attained if the number of countries is increased. Future research on the topic will cover all export destinations. Future research will also carry out the analysis by including all countries in the Central Europe and Baltic countries.

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