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Research Article

Exchange Rate Volatility and Aggregate Exports: Evidence from Two Small Countries

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This paper examines the effect of exchange rate volatility for two small countries, Croatia and Cyprus, on aggregate exports during the period of first quarter of 1990 to first quarter of 2012. It is claimed by some researchers that exchange rate volatility causes a reduction on the overall level of trade. Empirical researchers often utilize the standard deviation of the moving average of the logarithm of the exchange rate as a measure of exchange rate fluctuation. In this study, we propose a new measure for volatility. Overall, our results suggest that there is a positive effect of volatility on exports of Croatia and Cyprus.

1. Introduction

The relationship between exchange rate volatility and export flows has been studied in a large number of theoretical and empirical papers. The main notion, suggested by some theoretical models, is that a rise in exchange rate volatility increases uncertainty of profits on contracts denominated in foreign currency and force risk averse agents to redirect their activity to the lower risk home market. Other models suggest that higher levels of exchange rate movements offer greater opportunity for profit and therefore might lead to an increase in exports. Alternatively, some researchers have suggested that it is possible to offset potential unexpected movements of the exchange rate by investing at the forward market causing producers to be unaffected by movements of the exchange rate. These different ranges of results have been supported by a large variety of empirical studies causing the effects of exchange rate volatility on exports to be one of the most controversial topics of international trade.

This paper aims to model the effects of exchange rate volatility for Croatia and Cyprus for which empirical evidence is both limited and ambiguous and to utilize a new measure of volatility which captures unexpected movements of the exchange rate. Overall, our results contribute to the

existing literature in the following ways: first, our investigation has attempted to shed some light on a topic for which the empirical literature is ambiguous. Second, our investigation examines a sample which is comprised of two countries, Croatia and Cyprus, for which the empirical literature is limited. Third, we model the effects of exchange rate volatility on exports taking into account data sample properties such as unit roots and cointegration and estimate the results with the use of a recently developed method: the ARDL methodology. Fourth, in addition to the common measure of volatility (logarithm of the moving average of the exchange rate), we will also examine a second new measure which allows us to capture high and low values of the exchange rate.

The results suggest that exchange rate volatility does produce a mixed and significant long-run effect, when measured as a moving average. However, when an alternative measure is used which captures high and low values of the exchange rate, the long-run effect of volatility to exports is significant for one of the sample countries, Croatia, and with a negative coefficient. This finding indicates that extremely high and low values of the exchange rate do effect the level of exports for some countries.

The paper is organised as follows: first, the existing literature is analyzed; second, the model is presented; third, various measurement issues of exchange rate volatility are

discussed; fourth, the data is presented; fifth, the methodological framework is discussed; sixth, the results of the utilised statistical tests, the estimated equations, and an analysis of the main empirical findings are discussed. Finally, the last section addresses the issue of policy implications and presents a brief summary as well as the main conclusions.

2. Literature Review

The literature on the issue is quite large. Both theoretical as well as empirical studies provide ambiguous effects of volatility on exports. An extensive review of both theoretical and empirical literature is well surveyed in McKenzie [1]. However in this section the main arguments are survived with an emphasis on key aspects pertaining to this study. Early empirical work, utilising the OLS methodology, favoured the negative hypothesis of Clark [2] as well as an insignificant relationship between export quantity and volatility [3]. Hooper and Kohlhagen (*op.cit.*) investigated bilateral and multilateral trade among developed countries using the standard error of nominal exchange rate fluctuations as their volatility measure.

In the 1980s the empirical evidence continues to be mixed and often differs with samples and estimation methods. Therefore, there is no consistent pattern when the same method is applied to different countries. While many suggest that the exchange rate uncertainties such as depress trade, J. Thursby and M. Thursby [4] others provide evidence that exchange rate uncertainties affect international trade positively [5]. In an attempt to explain these different ranges of results, some researchers have turned to the measure of exchange rate volatility. Cushman [6] used the moving average of the real exchange rate as his volatility measure and found a negative relationship between volatility and exports. In his 1988 study, Cushman added the absolute difference between spot, forward, and current rates as an alternative measure of volatility and found mixed effects of volatility on exports. Akhtar and Hilton [7] concluded that exchange rate uncertainty is detrimental to the international trade. P. de Grauwe [8] captured the ambiguity of the debate by modelling a producer who must decide whether selling in the domestic or the foreign market. By providing some basic assumptions, his model assumes that the only source affecting the exporter's behaviour is the local currency price of exports as well as his risk preferences. In his model, exchange rate is measured as the percentage change of export quantity as a measure of volatility. Following de Grauwe's study, Perée and Steinherr [9] proposed the average absolute difference between the previous forward rate and the current spot rate as better indicator of exchange rate volatility to bilateral exports.

Even though new empirical statistical techniques are applied in the 1990s ambiguity of the estimated relationships continues to dominate the empirical literature. Several authors used the ARCH-GARCH method in order to model and measure exchange rate volatility [10, 11]. Others follow the VAR and VECM methodology allowing them to examine and model the properties of the samples such as unit roots and cointegration [12]. Asseery and Peel [13] emphasized the

importance of examining the characteristics of the data being used and examined for stationarity as well as seasonality. Chowdhury [14] investigated the impact of exchange rate trade volatility on trade flows for the G-7 countries utilizing an error correction model. His study found exchange rate volatility measure as an eight-period moving sample standard deviation of the growth rate of the real exchange rate and found a significant negative impact. Despite all these developments, the traditional measure of exchange rate still remains the moving average of the standard deviation.

Recent empirical studies have confirmed that exchange rate volatility has a negative effect on exports, especially for developing economies [15, 16]. However, in addition to the literature which suggests a negative [17] relationship there are studies that have suggested a positive [18] or no effects at all [19]. The literature, however, for the most part, continues to overlook additional measures of volatility. Awokuse and Yuan [20] tried to apply three measures of volatility which included the variance of the spot exchange rate around the preferred trend to sectorial exports and revealed mixed effects.

Overall, three conclusions can be drawn from the literature. First, some studies rely mainly on the OLS methodology which proves to be inadequate to cope and account with some of the statistical properties that the samples often may contain, such as unit roots and cointegration [21, 22]. As a result, inadequate estimates might be obtained. Second, the empirical research has provided limited or no evidence of the effects of exchange rate volatility on exports for Croatia and Cyprus. Thirdly, for the most part the empirical research uses the standard deviation of the moving average of the logarithm of the exchange rate as a measure of exchange rate volatility.

3. Methodology for the Measurement of the Exchange Rate Volatility

3.1. *The Model.* The model underling the empirical analysis is that of Goldstein and Khan [23] which has been extended in such a way to account for volatility as well as seasonality effects. The model can be summarised by

$$\ln X_t = \lambda_0 + \lambda_1 \ln \left(\frac{P_X}{P_w} \right)_t + \lambda_2 \ln \text{GDP}_t + \lambda_3 V_t + \lambda_4 D_1 + \lambda_5 D_3 + \lambda_6 D_4 + \lambda_7 T + \omega_t \quad (1)$$

where X is real exports; P_X and P_w are the relative prices; GDP is real world GDP; V is volatility (defined as the standard deviation of the moving average of the logarithm of real exchange rate), as well as a dummy capturing the amount of times the exchange rate moves above and below the average values of the real effective exchange rate in predetermined intervals, D_1 , D_3 and D_4 are seasonal dummies; T is a time trend, and ω is an error term.

The real export value is created using the unit value method. The first explanatory variable is the relative prices and it is constructed by the division of the export price of each sector to an index comprised of world export prices for each corresponding sector. The second right-hand variable is real world GDP, and the third right-hand variable is volatility

TABLE 1: Phillips-Peron unit root test results.

	Croatia			Cyprus			
ln VEX	-7.1141*	-12.275*	-14.542*	ln VEX	-7.1775*	-10.358*	-11.259*
ln GDP	-2.8248	-7.7070*	-14.233*	ln GDP	-2.869	-7.5172*	-13.571*
V1	-9.1703*	-20.558*	-31.843*	V1	-6.075*	-13.327*	-21.997*
ln P	-3.0787	-8.4785*	-18.235*	ln P	-2.1747	-8.788*	-20.660*
ln V2	-0.3383	-4.4482*	-11.305*	ln V2	-2.2604	-7.2409*	-11.305*

Note: all tests are performed using the 5% level of significance; VEX is the logarithm of export quantity, GDP represents the logarithm of the real gross domestic product, V1 is volatility measured as the moving average of the standard deviation of the exchange rate, P is the logarithm of relative prices of each country to the world price, and V2 is the amount of times the value of the exchange rate moves above and below its average value at predetermined intervals. All tests are performed to a maximum of three lags. The null hypothesis of a unit root is tested against the alternative. The asterisk denotes significance at least at 5% level. Source: authors' calculations.

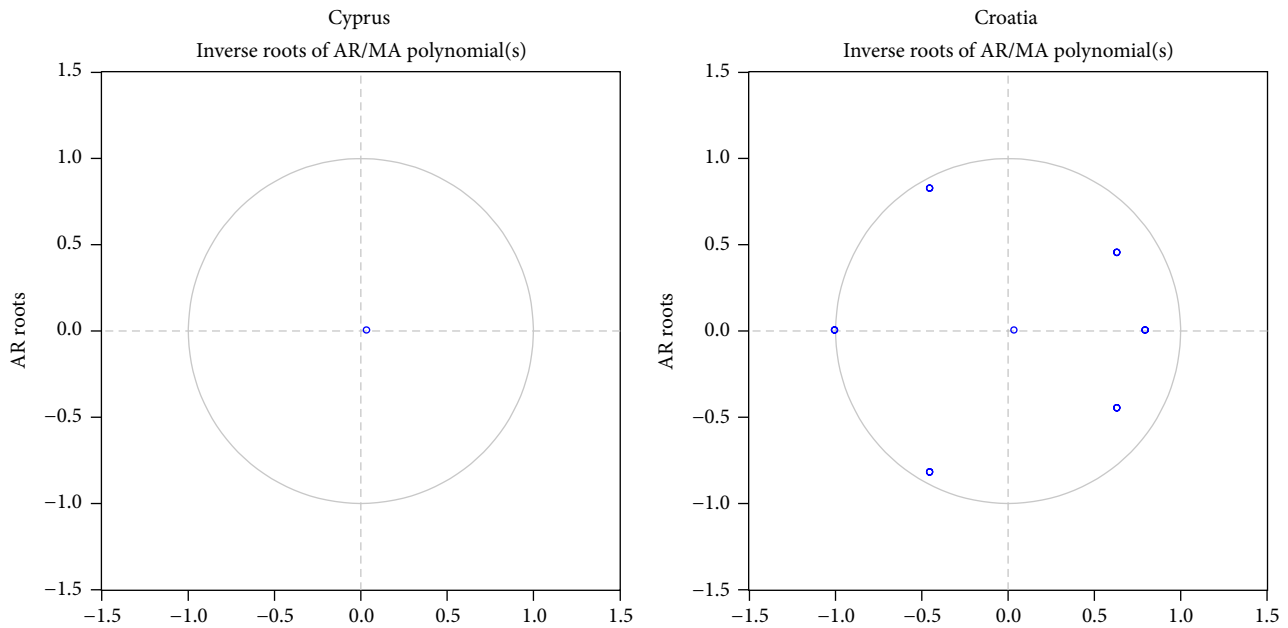


FIGURE 1: Measure 1.

which is measured in two ways. Firstly, as a measure of time **varies** exchange rate volatility, the standard deviation of the moving average of the logarithm of real effective exchange rate is used. Secondly, we utilize a dummy variable capturing the amount of times **for** which the exchange rate moves above and below the average value of the real effective exchange rate for each sectoral trade flow at predetermined intervals [22]. Our estimation of each of the reduced form export equations for each country will be consistent with the autoregressive distributed lags (ARDL) methodology.

3.2. Exchange Rate Volatility Measurement. One of the most fundamental issues of the topic in question is volatility measure. Exchange rate volatility is a measure that is not directly observable; thus, there is no clear, right, or wrong, measure of volatility. Most empirical studies have utilized the

standard deviation of the moving average of the logarithm of the exchange rate:

$$V_{t+m} = \left(\frac{1}{m} \sum_{i=1}^m (R_{t+i-1} - R_{t+i-2})^2 \right)^{1/2}, \quad (2)$$

where: R is the nominal or real effective exchange rate and M is the number of periods which usually ranges between 4 and 12.

The main criticism for the application of the standard deviation of the moving average of the logarithm of the exchange rate is that it fails to capture the potential effects of high and low peak values of the exchange rate. According to some economic models, these high and low values refer to the unpredictable factor which affects exports. Our investigation will be comprised of two measures of volatility: the first is the standard deviation of the moving average of the logarithm of real effective exchange rate, while the second is comprised of a dummy variable capturing the unexpected variation of the exchange rate. This dummy variable is constructed in the following way: first, the values of the exchange rate are

TABLE 2: ARDL results for the effects of ER volatility (measures 1 and 2) on exports of Croatia and Cyprus.

Country, Sector	ARDL order	Regressor, coefficient	$\hat{\gamma}_i$	F-statistic, Wald bound test	F-statistic LM test	$\hat{\epsilon}$	Confidence intervals for $\hat{\gamma}_i$	Dynamic stability
		$\ln VEX(-1)$: -0.134						
		$\ln P(-1)$: -1.428*						
		$\ln GDP(-1)$: -0.466						
		$V1(-1)$: -62.532*						
		$\Delta(\ln(VEX(-1)))$: -0.725*						
		$\Delta(\ln(VEX(-2)))$: -0.530*						
		$\Delta(\ln(VEX(-3)))$: -0.469*						
		$\Delta(\ln(VEX(-4)))$: -0.425*						
		$\Delta(\ln(VEX(-5)))$: -0.493*						
		$\Delta(\ln(VEX(-6)))$: -0.092						
		$\Delta(\ln(VEX(-7)))$: -0.307						
		$\Delta(\ln(P))$: -1.303						
		$\Delta(\ln(P(-1)))$: 0.652						
		$\Delta(\ln(P(-2)))$: 0.712						
		$\Delta(\ln(P(-3)))$: 2.265*						
		$\Delta(\ln(P(-4)))$: -0.406						
		$\Delta(\ln(GDP))$: 2.400*						
		$\Delta(\ln(GDP(-1)))$: 1.260						
		$\Delta(\ln(GDP(-2)))$: 2.358*						
		$\Delta(\ln(GDP(-3)))$: 2.457*						
		$\Delta(\ln(GDP(-4)))$: 1.222						
		$\Delta(\ln(GDP(-5)))$: 1.918*						
		$\Delta(\ln(GDP(-6)))$: 1.786						
		$\Delta(V1)$: -7.827						
		$\Delta(V1(-1))$: 49.049*						
		$\Delta(V1(-2))$: 50.896*						
		$\Delta(V1(-3))$: 45.363*						
		$\Delta(V1(-4))$: 36.609*						
		$\Delta(V1(-5))$: 25.189*						
		$\Delta(V1(-6))$: 16.707*						
Croatia—ER volatility measure 1	(7, 4, 6, 6)		$\ln P$: -10.65773* $\ln GDP$: -3.47714 $V1$: -466.39183*	5.5103*	0.66372	-0.2343*	[-17.4177, -3.8978] [-8.4090, 1.4547] [-818.935, -113.851]	Yes

TABLE 2: Continued.

Country, Sector	ARDL order	Regressor, coefficient	$\hat{\gamma}_i$	F-statistic, Wald bound test	F-statistic LM test	$\hat{\epsilon}$	Confidence intervals for $\hat{\gamma}_i$	Dynamic stability
Cyprus—ER volatility measure 1	(1, 4, 6, 0)	$\ln \text{VEX}(-1)$: -1.033337*						
		$\ln(P(-1))$: -0.415671*						
		$\ln(\text{GDP}(-1))$: 0.485851						
		$V1(-1)$: 15.78140*						
		$\Delta(\ln(\text{VEX}(-1)))$: 0.183368						
		$\Delta(\ln(P))$: 0.150960						
		$\Delta(\ln(P(-1)))$: 0.759289 ⁺						
		$\Delta(\ln(P(-2)))$: 0.706178						
		$\Delta(\ln(P(-3)))$: 0.616798						
		$\Delta(\ln(P(-4)))$: 0.710739 ⁺						
		$\Delta(\ln(\text{GDP}))$: 3.480582*						
		$\Delta(\ln(\text{GDP}(-1)))$: 0.983846						
		$\Delta(\ln(\text{GDP}(-2)))$: 3.100975 ⁺						
		$\Delta(\ln(\text{GDP}(-3)))$: -0.797226						
$\Delta(\ln(\text{GDP}(-4)))$: 2.530708								
$\Delta(\ln(\text{GDP}(-5)))$: 1.420947								
$\Delta(\ln(\text{GDP}(-6)))$: 4.071522*								
$\Delta(V1)$: 13.62624*			$\ln P$: -0.402260* $\ln \text{GDP}$: 0.470177 $V1$: 15.272268*	9.4420*	1.4896	-0.433*	[-0.64803, -0.15649] [-1.0730, 2.0134] [1.7265, 28.818]	Yes
Croatia—ER volatility measure 2	(1, 2, 4, 0)	$\ln \text{VEX}(-1)$: -1.817775*						
		$\ln(P(-1))$: 117.8602*						
		$\ln \text{GDP}(-1)$: 5.340606*						
		$\ln(V2(-1))$: -1.468365*						
		$\Delta(\ln(\text{VEX}(-1)))$: 0.685608*						
		$\Delta(\ln(P))$: 33.34486*						
		$\Delta(\ln(P(-1)))$: 8.323432*						
		$\Delta(\ln(P(-2)))$: 23.46942 ⁺						
		$\Delta(\ln(\text{GDP}))$: 3.586092*						
		$\Delta(\ln(\text{GDP}(-1)))$: -4.255792*						
		$\Delta(\ln(\text{GDP}(-2)))$: 1.802907 ⁺						
		$\Delta(\ln(\text{GDP}(-3)))$: 0.801685						
		$\Delta(\ln(\text{GDP}(-4)))$: -0.283179						
		$\Delta(V1)$: -0.451535			$\ln P$: 64.83765* $\ln \text{GDP}$: 2.93799* $\ln V2$: 0.80778*	168.678*	2.1006	-1.1017

TABLE 2: Continued.

Country, Sector	ARDL order	Regressor, coefficient	$\hat{\gamma}_i$	F-statistic, Wald bound test	F-statistic LM test	$\hat{\epsilon}$	Confidence intervals for $\hat{\gamma}_i$	Dynamic stability
		$\ln VEX (-1)$: -1.131485*						
		$\ln P (-1)$: -0.585692*						
		$\ln GDP (-1)$: 2.275066*						
		$\ln V2 (-1)$: 0.386714						
		$\Delta (\ln (VEX (-1)))$: 0.150424						
		$\Delta (\ln (P))$: 0.838574 ⁺						
		$\Delta (\ln (P (-1)))$: 0.731348 ⁺	$\ln P$: -0.517631*					
		$\Delta (\ln (P (-2)))$: 0.391101	$\ln GDP$: 2.01069*					
		$\Delta (\ln (P (-3)))$: 0.524350	$\ln V2$: 0.341775					
		$\Delta (\ln (P (-4)))$: 0.889837 ⁺						
		$\Delta (\ln (GDP))$: -2.046932		8.6375*	0.7455	-0.6401*	[-0.5395, -0.4958] [1.1367, 2.8847] [-1.3772, 2.0608]	Yes
		$\Delta (\ln (GDP (-1)))$: 1.149470						
		$\Delta (\ln (GDP (-2)))$: 2.460438						
		$\Delta (\ln (V2))$: 0.352926						

Notes: the asterisk and the cross denote at least 5% level of statistical significance and 10% level of statistical significance, respectively. Confidence intervals indicating statistically significant long-run coefficients ($\hat{\gamma}_i$ s) are presented in bold. The plot of the inverse roots of the AR polynomials for examining the dynamic stability of the model is presented in the Appendix.

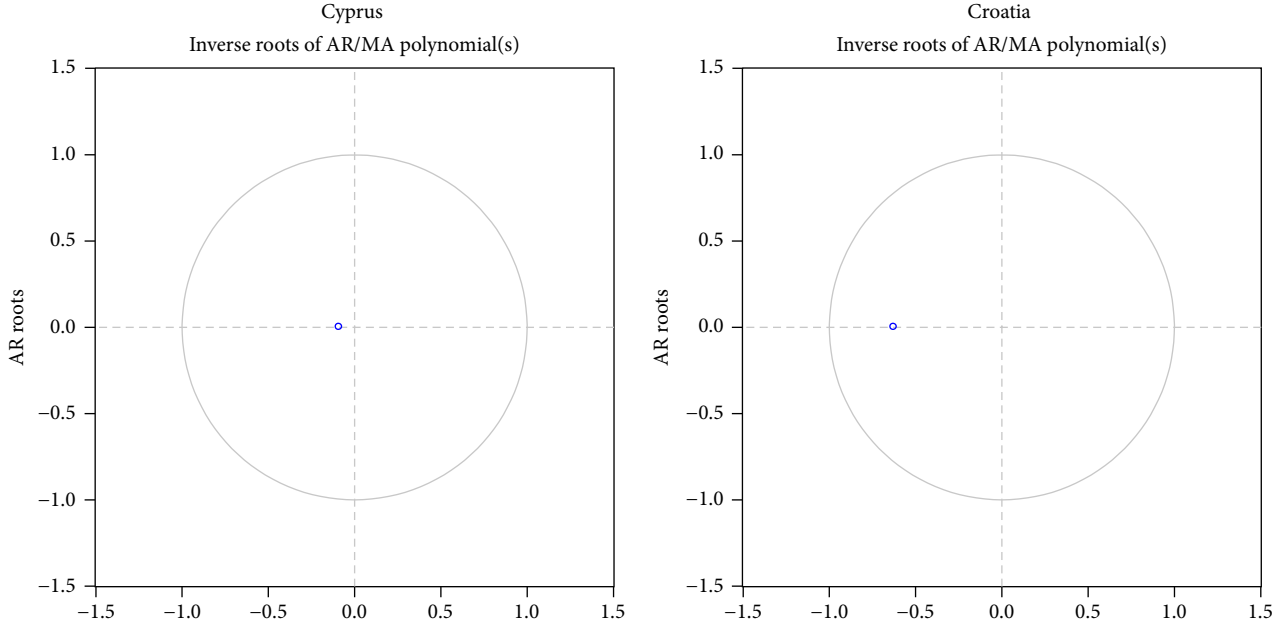


FIGURE 2: Measure 2.

divided by its average value in an attempt to capture the amount of times where each variable exceeds the average value; second, with the use of a dummy variable we capture only the previously calculated values which correspond to the cases for which the exchange rate falls above and below 4%–7% of its average value. This calculation is to determine the amount of times that the exchange rate moves above and below its average value as a measure of unexpected fluctuation. However, since for each country different values above and below the average value (of the exchange rate) affect exporter’s behavior, various cases are examined for which the exchange rate fluctuates above and below its average value from 4% to 7%. Since these ranges might be different for each country, therefore only the first significant cases obtained irrespective of the percentage used will be reported.

4. Estimating Methodology and Results

This study examines the effects of exchange rate volatility for two countries, Cyprus and Croatia. All the data are derived from Eurostat with the exception of GDP and real effective exchange rate figures which are derived from the IFS (International Financial Statistics). All the data are collected quarterly and extend from 1990: q1 to 2012:q1.

Before examining the existence of a long-run relationship (cointegration) between the variables, we must analyse first, the order of integration of the variables considered. This analysis is usually done using the ADF [24] or the P-P [25] unit root test. The P-P unit root test was used to test the series for stationarity.

The values of the P-P test are presented in Table 1. The bandwidth length is four lags; both a trend and intercept

were used in the test equation and the critical values were determined using the Bartlett Kernel estimation method.

From Table 1, it is seen that the $\ln VEX$ and the $V1$ series for both countries is $I(0)$, while the remaining variables are $I(1)$ in both countries examined here. As one would expect, the null hypothesis of a unit root is rejected for volatility when measured as the moving average, partly due to the fact that it is already different. When there are $I(1)$ variables, the maximum likelihood approach of Johansen and Juselius [26] can be used. However, the requirement is that all the variables are $I(1)$. In our case, the system contains variables with different orders of integration and therefore the autoregressive distributed lag modeling (ARDL) suggested by Pesaran et al. [27, 28] will be used. The ARDL method can be applied on a time series data irrespective of whether the variables are $I(0)$ or $I(1)$ [29], and it generally provides unbiased estimates of the long-run model and validates the t -statistics even when some of the regressors are endogenous [30]. However, it is necessary to check that the variables are not $I(2)$ because, in this case, ARDL would produce spurious results [31]. In our case, none of the variables are $I(2)$.

Following [27, 28], the ARDL representation of (1) can be formulated as follows:

$$\begin{aligned} \Delta \ln X_t = & a_0 + \vartheta \ln X_{t-1} + \sum_{i=1}^{\mu} \theta_i G_{i,t-1} + \sum_{j=1}^p a_j \Delta \ln X_{t-j} \\ & + \sum_{i=1}^{\mu} \sum_{j=0}^p \beta_{ij} \Delta G_{i,t-j} + \tau T + \delta_1 D_1 \\ & + \delta_3 D_3 + \delta_4 D_4 + \omega_t, \end{aligned} \tag{3}$$

where Δ is the first-difference operator, X is export quantities, and $G = (\ln P, \ln GDP, V1)$ is the vector with the explanatory

6

7

variables; P is the relative prices, GDP is real domestic GDP, $V1$ and $V2$ represent the first and second measures of exchange rate volatility, D_1 , D_3 , and D_4 are seasonal dummies, T is a time trend, ω is a white noise error term, $\mu = 3$ is the number of explanatory variables, ϑ, θ_i are the coefficients that represent the long-run relationship, α_j, β_{ij} are the coefficients that represent the short-run dynamics of the model, and p is the number of lag length. The ARDL method to co-integration requires the following steps:

Step 1. Equation (3) is estimated after establishing that all the variables are either $I(0)$ or $I(1)$ and not $I(2)$. The lag order of the ARDL was determined using the appropriate lag selection criterion. In the literature, three criteria are alternatively used. In our case, the Akaike information criterion (AIC) will be used.

Step 2. After finding, in Step 1, the order of the ARDL model, a test was conducted that the errors in (3) are serially independent. The Lagrange multiplier (LM) test was used to test the null hypothesis that the errors in (3) are serially independent against the alternative that there are autoregressive or moving average relationships in the errors.

Step 3. When a model has autoregressive (AR) terms, it will be stationary (i.e., dynamically stable) when the inverse roots of the AR polynomials lie strictly inside the unit circle. In our case, after finding the AR order of the ARDL model, in Step 1, the plot of the inverse roots of the AR polynomial was made.

Step 4. From (3) a test for the existence of long-run relationship was made. This is called the “bounds testing” approach to cointegration and it is associated with the hypothesis testing $H_0 : \vartheta = \theta_1 = \dots = \theta_i = 0$; i is the number of explanatory variables; that is, the long-run relationship does not exist against the alternative $H_1 : \vartheta \neq \theta_1 \neq \dots \neq \theta_i \neq 0$; that is, the long-run relationship exists. This hypothesis is tested by the use of the F -statistic. However, the distribution of the F -statistic is nonstandard and the critical values are available in Pesaran et al. [28]. In our case, a Wald test was computed in the E-views programme and the F -statistic was compared to that given by the appropriate upper bound critical value.

Step 5. Assuming that the bound test in Step 5 is conclusive and there is a cointegrating relationship, the coefficient and its statistical significance of the error correction term (ECT) can be found by estimating

$$\Delta \ln X_t = a_0 + \sum_{j=1}^p a_j \Delta \ln X_{t-j} + \sum_{i=1}^{\mu} \sum_{j=0}^p \beta_{ij} \Delta G_{i,t-j} + eECT_{t-1} + \omega_t. \quad (4)$$

Step 6. Once the model is obtained in Step 2, the long-run impact of the explanatory variables to the dependent variable is calculated using the expression [32]:

$$\hat{\gamma}_i = -\frac{\hat{\theta}_i}{\hat{\vartheta}}, \quad (5)$$

where $\hat{\theta}_i$ and $\hat{\vartheta}$ are the estimated long-run coefficients in (3). However, the $\hat{\gamma}_i$ s provide a single value to quantify the long-run effect and they do not provide any information about the degree of variability associated to them [33]. Following Efron and Tibshirani [34], the bootstrap method, which is a nonparametric method, can be used in order to calculate empirically confidence intervals without assuming a specific distribution of the γ_i s. The calculation of the confidence intervals for each $\hat{\gamma}_i$ was made with the use of the STATA programme for 95% level of statistical significance. If the zero is contained in the interval, then the effect of the explanatory variable will not be statistically significant.

The estimation results of the ARDL model are presented in Table 2; dependent variable is export quantity (VEX). The order of the ARDL model, the F -statistic for the LM test of serial correlation, the F -statistic Wald bound test, the long-run impact of the explanatory variables to the dependent variable $\hat{\gamma}_i$, the coefficient of the error correction term e , and the confidence intervals of the $\hat{\gamma}_i$ s calculated using the bootstrap method are presented. The test for dynamic stability is presented in the Appendix.

The lag order of the ARDL model is presented in second column of Table 2. It was determined using the Akaike selection criterion. The F -statistic of the Wald “bound” test of cointegration is presented in the fifth column of the same Table. As it can be seen, the F -statistic is higher than the upper bound critical value (5.119 and 5.872 for the ER volatility measure 1 and the ER volatility measure 2 model, resp.) indicating a long-run relationship between exports (ln VEX) and the explanatory variables (ln P , ln GDP and $V1$). Further, the LM test was used to test the null hypothesis that the errors in (3) are serially independent against the alternative that there are autoregressive or moving average relationships in the errors. The F -statistic from the LM test is presented in the sixth column. Serial correlation is not detected in all cases.

The results from the examination of the effects of exchange rate volatility (measures 1 and 2) on exports are shown in Table 2. The fourth column shows the long-run impact of the exchange rate on the dependent variable and it is statistically significant. The results show that the effects of exchange rate volatility on sectoral exports are mostly positive (except for Croatia when measure 1 was used). They indicate that exchange rate volatility has statistically significant effects for both exports of Croatia and Cyrus.

The relative price variable is, for the most part, negatively related with the export volume and it has a larger value in Croatia when measure 2 is used. The relative prices are statistically significant in all of the four cases examined here.

The GDP variable, in the cases that it is statistically significant, presents a more mixed effect than relative prices. The estimated coefficient is significant for all of the cases

examined here with the exception of Cyprus when measure 2 is used and ranges from -4.255792 to 4.071522 showing that it may affect export volume either positively or negatively.

The coefficients of the error correction term were estimated using (4) and they are shown in the seventh column of Table 2. They are negative and statistically significant for all cases indicating that there is a cointegration between the dependent and the explanatory variables. The coefficient of the error correction term (in absolute value) ranges from approximately 0.2343 in Croatia when measure 1 is used and Croatia when measure 2 is used to a high of 1.1017. This results shows that any disequilibrium between the exports and the explanatory variables is corrected in a year or less. For the most part, the error correction term (in absolute value) seems to be larger for the cases where measure 2 is used, compared to the cases where measure 1 is used for each country. This indicates that for measure 1 any deviation in exports resulting from the selected variables takes longer time to fine tune back to its long-run equilibrium when compared with the results of measure 2.

The results of this paper add to the literature in several ways. First, there is a limited amount of empirical studies concentrating on the effects of volatility on exports. Second, in addition to the ambiguity as to samples, time periods, and variables, there is also an ambiguity with regard to the exchange rate volatility measure. Third, in addition to the common measure of volatility we calculated a new measure capturing fluctuations between 4% and 7% of the average value of the exchange rate to estimate the effect of high exchange rate fluctuations from volatility to exports.

5. Summary, Conclusion, and Policy Implications

In this study, an explicit account of nonstationarity has been taken into account and a multivariate cointegration error correction model has been applied for Cyprus and Croatia and two different measures of volatility. Each model satisfies several commonly utilised econometric tests in the analysis of time-series data such as cointegration and unit roots. Our empirical analysis suggests that exchange rate volatility when measured as the simple standard deviation of the log effective exchange has an effect on the level of exports for both Croatia and Cyprus. However, when an alternative measure is used, there is also an indication of an effect from movements of the exchange rate to the level of exports. As a result, a mixed statistical significant relationship is estimated, for both countries in our sample. Overall, the empirical findings are quite important. First, they suggest that additional measures of volatility can be used to model the effects of exchange rate volatility to exports, thus indicating that there is no specific way of measuring volatility. Second, the results prove that high and low fluctuation produce a significant negative long-run effect on the real exports for some countries. The effects of these high and low values can be attributed to the unexpected factor which, as suggested by some models, since it cannot be hedged, it affects the exporter behavior. From a policy prospective, the results are important: they suggest

that policy makers should consider volatility for some but not all countries when applying economic policy, especially, for those like Cyprus and Croatia, that it was found that the exchange rate volatility had a positive impact on exports.

Appendix

Dynamic Stability Test

For more details see Figures 1 and 2.

Conflict of Interests

The author(s) declare(s) that there is no conflict of interests regarding the publication of this article.

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