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HYSTERESIS IN THE TRADE FLOWS OF SOME EU MEMBER COUNTRIES

Abstract

The paper tests for the existence of hysteresis in the net export development patterns of five EU member countries - the Czech Republic, Latvia, Hungary, Slovakia and Slovenia. Based on the quarterly data samples from 1996q1 to 2017q2, country-specific estimates are obtained and tested. Time series estimates point to the fractionally integrated series of net exports for the Czech Republic and Latvia, while the net exports of Hungary, Slovakia and Slovenia are best explained by SETAR (1) model specification. The research results indicate long memory property in the net export series for the Czech Republic and Latvia, thus supporting the existence of hysteresis. The net export dynamics of Hungary, Slovakia and Slovenia are found to be nonlinear and threshold dependent but still slightly different. The paper also found heterogeneity in the dynamics and properties of net exports for the countries examined in this paper. Furthermore, the paper showed an indicative similarity in the change of the contemporary net export development patterns in the sample countries.

Keywords: Net exports, fractional integration, nonlinearities, European Union

1. Introduction

Export performance of a country has been the focus of scholarly interest since the age of mercantilism. Contemporary global environment and regional integration make the issue of net exports extremely important from a country perspective as well as from the perspective of the European Union (EU). It is well known that persistent and unsustainable trade deficit violates international budget constraints over time and if the trade deficits persist, the domestic interest rates could increase considerably. Therefore, an economy with a persistent trade deficit can transform into a heavily indebted country that may adversely affect the welfare of the citizens. Eventually, the persistent trade deficit may become a problem, not only of the country, but also of the EU. Some of the countries considered in this research are part of the Economic and Monetary Union (EMU). Therefore, a similar net export pattern among the EMU members would be at least a desirable property. Furthermore, international trade is a channel of macroeconomic spillovers and net exports present a good synthetic measure that captures the change in exports as well as the change in imports. Baldwin (1986) pointed to the weak understanding of how the determinants of trade patterns change over time. Baldwin's assertion is still true and is becoming more and more important in the global as well as regionally integrated environments. It is a well-documented fact that the terms-of-trade shocks represent a major source of business cycles in emerging and developing countries; however, the persistence of shocks has been under-examined. Therefore, the main research question in this paper is the following: is there hysteresis in the international trade flows of the EU member countries? The paper aims to obtain country-specific estimates and provide a comparison among sample countries. To achieve that, the paper investigates the dynamics and properties of the net export development patterns for the five EU member countries.

The remainder of the paper is organized as follows: Section 2 briefly summarizes the existing literature related to the topic under consideration and illustrates hypothesis development. Section 3 presents the empirical procedure, methodology and research data, while Section 4 contains the empirical results and discussion. The final section provides an overview of the main findings of the research.

2. Literature review and hypothesis development

This paper presents another approach to examining the sustainability of trade flows. Therefore, the baseline literature for this paper relies on the foundations laid down by Husted (1992) who examined the relation between imports and exports and reported that there is cointegration between them. Following Husted's work (1992), cointegration between exports and imports has been identified for many countries and groups of countries using various econometric time series approaches. Antwi-Boateng (2015) examined the case of Ghana and presented an extensive literature review on different estimation methods. Balaz and Hamara (2016) established a long-term equilibrium relationship between Slovak exports and imports of goods to Germany. Bošnjak et al. (2018) used a panel co-integration approach and reported the unsustainable merchandise trade between Croatia and other EU member countries. Franc and Peulić (2017) reported a long-run equilibrium in Slovenian exports and imports. However, the topic of net exports is insufficiently examined for the countries considered in this research. Baek (2016) reported cointegration between exports and imports for seven G-7 countries. Del Barrio Castro et al. (2016) examined a group of OECD countries and found a long-run relationship between exports and imports for the majority of them. Some recent papers reported a nonlinear and regime-dependent relationship between exports and imports. Topalli and Dogan (2016) employed the Markov-switching model specification to explain the relationship between Turkish exports and imports from 1990 to 2014. Khadaroo (2016) used a self-exciting threshold autoregressive (SETAR) model on a seasonally adjusted series to establish the relationship between Mauritian exports and imports. One strand of literature pointed to the link between financial and trade liberalization to explain the trade deficit of European post-communist economies. European transition countries experienced current account deficits often explained by a rise in the domestic demand financed by the inflow of foreign loans and the real appreciation of domestic currencies (Aristovnik, 2008; Bakker, Gulde, 2010; Obadić et al., 2014; Zakharova, 2008). However, contemporary literature has extensively examined the topic of international trade. Jensen et al. (2018) found that shipping appears to be a barrier to international trade. Larue (2018) discusses the new (anti)integration issue, the winners and losers of economic integration, and reports that there is no economic justification for maintaining international trade barriers in some of Canada's agri-food industries. Degiannakis et al. (2014) examined the time-varying correlation among the EU12 in terms of business cycle, and reported de-synchronization of their business cycles in the period following the Great Recession of 2007. Foellmi et al. (2018) provided evidence for the theory of international product cycle as proposed by Vernon (1966). Haidar (2012) explained how a currency crisis can be transmitted through the channel of international trade. Zervoyianni and Anastasiou (2009) showed that trade flows affect the cross-country transmission of shocks in Europe. However, aside from very few seminal papers, the persistence of shocks in international trade flows is under-examined. Ljungqvist (1994) pointed out that temporary exchange rate fluctuations can have persistent effects on trade flows. Campa (2004) documented the phenomenon of hysteresis for Spanish manufacturing firms; the paper found sunk costs hysteresis in entry and exit to be an important factor in determining export market participation, but unrelated to exchange rate uncertainty. The mentioned research paper focused mainly on exports and its determinants. Kannebley (2008) found nonlinear and threshold dependent adjustment between relative price changes and Brazilian industrialized exports, thus supporting the existence of hysteresis in Brazilian industrial exports. Belke and Kronen (2016) found the hysteresis in the effects of real exchange rates on Greek exports. Belke et al. (2015) found export hysteresis to exchange rate dynamics for many

Eurozone countries. Evidently, hysteresis in international trade flows is under-examined and there is a gap in the international trade literature. This paper tests for the existence of hysteresis based on the analytical framework provided by Husted (1992). Thus, the research hypothesis of this paper states: there is hysteresis in the net exports of the EU member states. The paper tests for the existence of hysteresis in the net exports and determines its development patterns for the five EU member states - the Czech Republic, Latvia, Hungary, Slovakia and Slovenia. In doing so, the paper contributes to literature dealing with trade sustainability and issues relating to the EU.

3. Empirical procedure and methodology

The research is based on the quarterly data on imports and exports from the first quarter of 2000 to the second quarter of 2017. The series are obtained from national bureaus of statistics, X-13 ARIMA seasonally adjusted and taken in (natural) log values. (Figure 1 in the Appendix). The observed series (NX) for each sample country is given by the equation (1):

$$NX_t = \log(EXP_t) - \log(IMP_t) \quad (1)$$

where net export (NX_t) is given as the difference between exports (EXP_t) and imports (IMP_t) in its log levels.

The unit root tests are well known for their low power. Therefore, to improve the validity of the results, the paper employs several different unit root tests - the Augmented Dickey Fuller (1979) (ADF) test, the Phillips–Perron (1988) (PP) test, the Generalized Least Squares and Dickey-Fuller (DF-GLS) test developed by Elliott et al. (1996), the Kwiatkowski et al. (1992) (KPSS) test and the Zivot-Andrews (1992) unit rot (ZA) test. The ADF test, the PP test and the DF-GLS test under null hypothesis assume the presence of a unit root, while the KPSS test assumes the stationary under the null hypothesis and the presence of a unit root as the alternative hypothesis. The standard unit root tests are biased towards non-rejection of unit root, in case of a structural break in the series under consideration. The null hypothesis of the ZA test assumes that the data follow a unit root process and the alternative hypothesis is a trend stationary process that allows for a one-time break in the level, the trend, or both.

The mixed results of unit root tests for net exports of some countries raise the question of long memory in net exports series and strength of the long-range dependence. The literature recognizes two measures of the long-range dependence - the Hurst or self-similarity parameter (H), originally introduced by Mandelbrot and van Ness (1968), and the fractional integration parameter (d), introduced by Granger and Joyeux (1980). The fractionally integrated autoregressive moving average (ARFIMA) model is presented by the equation (2):

$$\phi_p(B)\,(1-B)^d x_t = \theta(B)a_t \quad (2)$$

where:

d – fractional integration parameter allowed to assume any real value,

B – the backward operator and

a_t – need to be independent and identically distributed with finite variance.

The relationship between the self-similarity parameter (H) and the fractional integration parameter (d) is given by the equation (3):

$$H = d + 1/2 \quad (3)$$

The estimates of the self-similarity parameter (H) and the fractional integration parameter (d) can be obtained using a number of developed estimators. This paper employs the GPH estimator by Reisen (1994) and Reisen et al. (2001), first developed by Geweke and Porter-Hudak (1983), the Whittle estimator for fractional Gaussian noise (Beran, 1994) and the Beran estimator, introduced by Beran (1993) and Beran (1994). Other employed estimators can be found in Taqqu et al. (1995) and Montari et al. (1999). Eventually, diagnostic checks are performed to examine invertibility, stationarity, and identifiability of a given set of parameters. However, unit root test results show that net export for some countries is a stationary time series. Based on the unit root test results using a univariate time series approach, several models were estimated and tested. First, the ARMA model specification in equation (2) with assumed fractional integration parameter (d=0) was estimated and tested. Diagnostic checks indicated misspecification and pointed to integrated series and ARIMA model. Considering the results of unit root tests, ARIMA estimates could be biased due to over-differencing. Consequently, several nonlinear specifications were estimated and tested - the Markov Switching specification (Hamilton, 1989), the Smooth Transition Autoregressive specification (Van Dijk et al., 2002) and the Self-Exciting Threshold Autoregressive specification (Tong, 1986). Given that Tong's model specification (1986) was the only one that passed the diagnostic checks, the remaining sections provide more details on this approach.

The Self-Exciting Threshold Autoregressive model (SETAR) represented by the following equation (4) is the only one that passed the diagnostic checks.

$$NX_t = \mu_1 I(NX_{t-k} > nx) + \mu_2 I(NX_{t-k} \leq nx) + [\alpha_1 I(NX_{t-k} > nx) + \alpha_2 I(NX_{t-k} \leq nx)]NX_{t-k} + [\beta_1 I(NX_{t-k} > nx) + \beta_2 I(NX_{t-k} \leq nx)]t + u_t \quad (4)$$

where k and nx represent delay and threshold, respectively. The equation (4) illustrates the specification for the two-regime SETAR process. The delay value is obtained by minimizing the sum of squared errors among values between 1 and 10, while the threshold value is given by the variation of the variable under consideration. As already stated, in the SETAR procedure Tong's model specification (1986) was used.

4. Empirical results and discussions

Based on the presented empirical procedure and methodology, Table 1 summarizes linear unit root test results.

Table 1 Unit root test (ADF test, PP test, DF-GLS test and KPSS test) results

Variable and test (Country)	Levels		First difference	
	Constant	Constant and trend	Constant	Constant and trend
ADF test	**t-stat.**			
NX (Czech Republic)	-2.020681	-3.021837	-10.25495	-10.25494
NX (Hungary)	-0.594320	-3.297262	-11.27681	-8.568201
NX (Latvia)	-1.979371	-2.330311	-10.36255	-10.42012
NX (Slovakia)	-2.681080	-4.822021	-11.11103	-11.03450
NX (Slovenia)	-1.139591	-4.937236	-9.406286	-9.417045
PP test	**Adj. t-stat.**			
NX (Czech Republic)	-1.952020	-2.972442	-10.29727	-10.32016
NX (Hungary)	-0.692785	-3.120029	-11.96950	-13.46647
NX (Latvia)	-2.044586	-2.347012	-10.30084	-10.37880
NX (Slovakia)	-2.420910	-4.839902	-18.12502	-17.70542
NX (Slovenia)	-1.425096	-4.869987	-17.37895	-19.69646
DF-GLS	**Adj. t-stat.**			
NX (Czech Republic)	-0.162942	-2.485535	-9.875864	-10.16815
NX (Hungary)	-0.725829	-1.577520	-10.91516	-11.53222
NX (Latvia)	-1.864718	-2.018040	-1.862514	-2.854431
NX (Slovakia)	-0.973586	-4.733331	-1.433231	-2.944516
NX (Slovenia)	-0.734220	-4.598878	-12.33928	-9.132649
KPSS test	**LM-stat.**			
NX (Czech Republic)	1.138033	0.143808	0.097551	0.044200
NX (Hungary)	0.909535	0.236238	0.341504	0.138465
NX (Latvia)	0.400479	0.237248	0.103960	0.045588
NX (Slovakia)	1.084542	0.061998	0.500000	0.500000
NX (Slovenia)	1.131084	0.182595	0.225452	0.118306

Source: Authors

The Czech Republic ADF, PP and DF-GLS test results indicate I(1), while KPSS test results indicate trend stationary series. ADF, PP, DF-GLS and KPSS test results indicate I(1) series for Hungary. Latvia ADF, PP and DF-GLS test results indicate I(1), while KPSS test results indicate stationary series around the constant. ADF, PP, KPSS and DF-GLS test results indicate trend stationary series for Slovakian and Slovenian net exports. It is a well-documented fact that unit root tests may be biased in the presence of a structural break. Table 2 provides the results of the ZA test that takes into account the possibility of structural breaks in the observed series.

Table 2 ZA test results

Country	Alternative	Test statistic	Critical values (significance level)		
Czech Republic	Level	-4.589	-5.34 (1%)	-4.8 (5%)	-4.58 (10%)
	Slope of the trend	-4.3402	-4.93 (1%)	-4.42 (5%)	-4.11 (10%)
	Level and slope of the trend	-4.4898	-5.57 (1%)	-5.08 (5%)	-4.82 (10%)
Hungary	Level	-4.3024	-5.34 (1%)	-4.8 (5%)	-4.58 (10%)
	Slope of the trend	-4.6474	-4.93 (1%)	-4.42 (5%)	-4.11 (10%)
	Level and slope of the trend	-5.1895	-5.57 (1%)	-5.08 (5%)	-4.82 (10%)
Latvia	Level	-4.2548	-5.34 (1%)	-4.8 (5%)	-4.58 (10%)
	Slope of the trend	-3.1939	-4.93 (1%)	-4.42 (5%)	-4.11 (10%)
	Level and slope of the trend	-4.2585	-5.57 (1%)	-5.08 (5%)	-4.82 (10%)
Slovakia	Level	-5.4078	-5.34 (1%)	-4.8 (5%)	-4.58 (10%)
	Slope of the trend	-4.9924	-4.93 (1%)	-4.42 (5%)	-4.11 (10%)
	Level and slope of the trend	-5.7317	-5.57 (1%)	-5.08 (5%)	-4.82 (10%)
Slovenia	Level	-5.9797	-5.34 (1%)	-4.8 (5%)	-4.58 (10%)
	Slope of the trend	-6.0376	-4.93 (1%)	-4.42 (5%)	-4.11 (10%)
	Level and slope of the trend	-6.4023	-5.57 (1%)	-5.08 (5%)	-4.82 (10%)

Source: Authors

Based on the Zivot and Andrews (1992) unit root test results, the net export of the Czech Republic is stationary with a break in the level or trend at a 10% significance level. In the Hungarian case, the series is stationary with a break in the slope of the trend. The results for Latvia revealed non-stationary series, while Slovakia and Slovenia are stationary series in all of the tested forms.

In the case of the Czech Republic and Latvia, the ADF test for the observed series in levels does not reject the null hypothesis, so there is evidence that net exports series of these countries behave as I(1) processes. The KPSS tests for the observed series do not reject the null hypothesis of I(0). Thus, modeling these series either as I(0) or I(1) is too restrictive and shows characteristics typical of fractionally integrated processes. The Hungarian case is completely different. The ADF, PP and KPSS test results indicate that the series is integrated of order one (I(1)). However, the ZA test showed that the series is stationary with a break in the slope of the trend. The Slovakian and Slovenian cases are more clear and for these countries the net export series are found to be stationary (I(0)). The presented unit root test results lead to the conclusion that the net exports of the Czech Republic and Latvia might be fractionally integrated. The net exports of Hungary might be stationary with a break in the slope of the trend, while the Slovakian and Slovenian net exports are trend stationary series.

A large peak in the periodogram of seasonally adjusted series across zero frequency indicates possible fractionally integrated structure of the net export series for Latvia and the Czech Republic. Furthermore, the correlograms also provide additional evidence of possible fractional integration of the net export series for both Latvia and the Czech Republic Autocorrelation for the series under consideration decreases slowly as the lag length increases, indicating that current values are dependent on its own past distant values.

The aim of the ARFIMA models is to estimate d or H parameter. One of the estimators most frequently used in the literature is the Geweke and Porter-Hudak (GPH) Estimator (Geweke, Porter-Hudak, 1983). The GPH estimator is based on the regression equation using the periodogram function as an estimate of the spectral density. Estimates of the fractional or memory parameter d for the net exports of the Czech Republic and Latvia are summarized in Table 3.

Table 3 GPH estimates for net export series of the Czech Republic and Latvia

Country	GPH estimate (d)	Asymptotic standard deviation	Standard error deviation	Diagnostics
Czech Republic	0.6743327	0.317623	0.1574761	FALSE
Latvia	0.7575384	0.317623	0.1597435	FALSE

Source: Authors

The results in Table 3 show that 0.5<d<1, suggesting that shocks in the net exports of both countries are highly persistent. However, diagnostic checks indicate that estimates cannot be accepted. The results in Table 3 are consistent with Labys (2016), who pointed out that regression-based GPH estimates in levels tend to be higher and therefore biased. Another frequently used estimator of H is the Whittle estimator for fractional Gaussian noise (see Beran, 1994). The estimates for the net export series of the Czech Republic and Latvia obtained using the Whittle estimator are given in Table 4.

Table 4 Whittle estimates of fractional Gaussian noise for the net export series of the Czech Republic and Latvia

Country	Estimate (H)	Std. Error	z value	p-value	Diagnostics
Czech Republic	0.98293591	0.07329122	13.41137	< 2.22e-16	TRUE
	d = H - 1/2 = 0.483 (0.073)				
Latvia	0.98444224	0.07329957	13.4304	< 2.22e-16	TRUE
	d = H - 1/2 = 0.484 (0.073)				

Source: Authors

The estimates obtained using the Whittle estimator presented in Table 4 show that 0<d<0.5, suggesting that both series display a long-term memory but also have a tendency to revert to the mean. Furthermore, diagnostic checks indicate no misspecification.

The Beran estimator, introduced by Beran (1993) and Beran (1994), was also employed, and the results are summarized in Table 5.

Table 5 Beran's Fractional EXP estimates for the net export series of the Czech Republic and Latvia

Country		Estimate	Std. Error	t value	p-value	Diagnostics
Czech Republic	intercept	-8.6123455	0.1122076	-76.75370	< 2.22e-16	FALSE
	1 - 2*H	-1.9477688	0.1457652	-13.36238	2.4539e-16	
	H = 1.474 (0.073)					
	d = H - 1/2 = 0.974 (0.073)					
Latvia	intercept	-7.4351143	0.1437682	-51.71600	< 2.22e-16	FALSE
	1 - 2*H	-1.8333568	0.1867645	-9.81641	3.2865e-12	
	H = 1.417 (0.093)					
	d = H - 1/2 = 0.917 (0.093)					

Source: Authors

The results presented in Table 5 indicate that the estimates obtained using the Beran estimator are similar to the estimates obtained using the GPH estimator. Diagnostic checks indicate misspecification.

Given the mixed results obtained from the three presented tests, more estimates needed to be made. Table 6 summarizes the results obtained using various other estimators that can be found in Taqqu et al. (1995) and Montari et al. (1999).

Table 6 Self-similarity parameter estimates for the net export series of the Czech Republic and Latvia

Method	Country	Estimate (H)	Std. Error	t -value	p-value	Diagnostics
Aggregated Variance	Czech Republic	0.9590563	0.0155772	61.56796	2.461977e-47	TRUE
		β = -0.08188734				
	Latvia	0.8242079	0.07653461	10.76909	2.118252e-14	TRUE
		β = -0.3515842				
Differenced Aggregated Variance	Czech Republic	1.625766	0.5422815	2.99801	0.01712353	FALSE
		β = 1.251531				
	Latvia	1.4217836	0.3621807	3.925619	0.002014558	FALSE
		β = 0.8435672				
Aggregated Absolute Value/ Moment	Czech Republic	1.1107106	0.03855989	28.80482	6.02621e-32	FALSE
		β = 0.1107106				
	Latvia	0.90033865	0.06104119	14.74969	1.864663e-19	TRUE
		β = -0.09966135				
Higuchi or Fractal Dimension	Czech Republic	0.6263314	0.05112957	12.24989	2.204283e-16	TRUE
		β = -1.3736686				
	Latvia	1.077646	0.1058935	10.1767	1.423005e-13	FALSE
		β = -0.9223536				
Peng or Variance of Residuals	Czech Republic	1.533734	0.0810637	18.9201	6.156417e-19	FALSE
		β = 3.067468				
	Latvia	1.134875	0.1076667	10.54063	6.15534e-12	FALSE
		β = 2.269749				
The R/S Method	Czech Republic	0.9386678	0.02065782	45.43885	9.910894e-35	TRUE
		β = 0.9386678				
	Latvia	0.8124809	0.04259175	19.07602	4.649364e-21	TRUE
		β = 0.8124809				
The Periodogram Method	Czech Republic	1.469797	0.3255098	4.515367	0.006309685	FALSE
		β =-1.939593				
	Latvia	1.731015	0.3049846	5.675746	0.002363764	FALSE
		β = -2.462030				
The Boxed or Modified Periodogram Method	Czech Republic	1.592605	0.08004514	19.89634	6.780113e-37	FALSE
		β = -2.185210				
	Latvia	1.568580	0.08275256	18.95507	3.352545e-35	FALSE
		β = -2.137161				

Source: Authors

Diagnostic checks examine invertibility, stationarity, and identifiability of a given set of parameters. The results show that fractional integration parameter ranges between 0 and 0.5 ($0<d<0.5$), suggesting that the net exports series displays a long-term memory and that it will revert to the mean. The process is considered to be stationary with long memory. It can be concluded that the net exports of the Czech Republic and Latvia are weakly stationary and exhibit persistence, long memory, mean reversion and covariance stationarity with no significant short-term effects. Therefore, there is hysteresis in the net exports of the Czech Republic and Latvia and the research hypothesis is supported in these two cases.

Unit root test results for Hungary indicate stationary series with a break. Therefore, nonlinear models need to be considered. Nonlinear models are piecewise linear models that capture the dynamics of a series before and after a certain point in time.

Table 7 SETAR Hyper parameters for net exports of Hungary, Slovakia and Slovenia

Country	SETAR Hyper parameters						Number of Possible Threshold Value	Number of Threshold Values tested with Hyper Parameters
	m	Threshold Delay	mL	mH	Threshold Value	Pooled AIC		
Hungary	1	0	1	1	0.04469050	-433.2192	58	58
Slovakia	1	0	1	1	0.02558082	-316.8609	55	55
Slovenia	1	0	1	1	-0.00179273	-355.7206	58	58

Source: Authors

Note: m denotes the autoregressive level of the whole model; Threshold Delay denotes the delay level of the Self-exciting model and mL denotes low regime level, mH: High regime level.

The results in Table 7 indicate lag one in low and high regime for each of the three countries. In the light of these hyper parameters the SETAR model was estimated. Following the equation (4), SETAR estimates for the Hungarian net exports are summarized in Table 8.

Table 8 SETAR model with one threshold for the Hungarian net exports dynamics

Regime	Variable	Coefficient	t- Statistic	p-value
Low	μ_1	-0.0030634 (0.0028132)	-1.0889	0.279406
	α_1	0.8392533 (0.0727939)	11.5292	< 2.2e-16
High	μ_2	0.0353410 (0.0127332)	2.7755	0.006843
	α_2	0.5978437 (0.1520015)	3.9331	0.000176
Threshold Value = 0.03584	Residuals variance = 0.0002922	AIC = -682	**Proportion of points in each regime**	
			Low regime = 63.86%	High regime = 36.14%
Diagnostic tests for the estimated SETAR specification:				
ARCH Test statistic: 0.018879			p – value: 0.891100	
Ljung-Box Test statistic (12): 0.7707			p – value: 0.380000	
Jarque-Bera Test statistic:1.307505			p – value: 0.520090	

Source: Authors

Based on the results presented in Table 8, SETAR specification passed the diagnostic checks in the Hungarian case. Trend component is not found to be significant either in low or in high regime. Hungarian net export converges either to deficit in low regime dynamics or to surplus in high regime dynamics. Figure 2 in the Appendix illustrates the dynamics of net exports for Hungary.

In contrast, the net export series for Slovakia and Slovenia are found to be trend stationary series. Consistent with unit root test results, SETAR estimates indicate a significant trend in the low regime of Slovakian net export. For Slovenia, the trend component is significant in both the low and high regime. SETAR estimates and corresponding diagnostic tests for the Slovakian net exports are provided in Table 9.

Table 9 SETAR model with one threshold for the Slovakian net exports dynamics

Regime	Variable	Coefficient	t-statistic	p-value
Low	μ_1	-0.14521111 (0.02958150)	-4.9088	5.107e-06
	β_1	0.00277193 (0.00054666)	5.0706	2.719e-06
	α_1	0.19302130 (0.16078110)	1.2005	0.233665
High	μ_2	-0.03223104 (0.01953045)	-1.6503	0.103009
	β_2	0.00057554 (0.00037288)	1.5435	0.126858
	α_2	0.65381217 (0.20447523)	3.1975	0.002021
Threshold Value = -0.05321	Residuals variance = 0.001064	AIC = -547	**Proportion of points in each regime**	
			Low regime = 38.27%	High regime = 61.73%
Diagnostic tests for the estimated SETAR specification:				
ARCH Test statistic: 0.021118			p – value: 0.8848	
Ljung-Box Test statistic (12): 0.80972			p – value: 0.3682	
Jarque-Bera Test statistic: 3.317910			p – value: 0.190338	

Source: Authors

The results in Table 9 show that the constant and trend are significant in the low regime, while the autoregressive component obtains no significance at the usually accepted significance level. In the high regime, the autoregressive component is the only one that appears with significance. Diagnostic test results indicate that the SETAR model is not misspecified in the case of Slovakia. Slovakian net export converges to deficit in both high and low regimes. Figure 3 in the Appendix illustrates the dynamics of net exports in the case of Slovakia. The estimates of the SETAR model specification for Slovenia are presented in Table 10.

Table 10 SETAR model with one threshold for the Slovenian net exports dynamics

Regime	Variable	Coefficient	t- Statistic	p-value
Low	μ_1	-0.03334176 (0.00958637)	-3.4780	0.0008245
	β_1	0.00075955 (0.00024576)	3.0907	0.0027580
	α_1	0.39988748 (0.13181221)	3.0338	0.0032679
High	μ_2	-0.09346728 (0.03048376)	-3.0661	0.0029680
	β_2	0.00207750 (0.00065250)	3.1839	0.0020793
	α_2	0.37022295 (0.24369809)	1.5192	0.1327076
Threshold Value =	Residuals variance = 0.0006332	AIC = -612	**Proportion of points in each regime**	
			Low regime = 60.71%	High regime = 39.29%
Diagnostic tests for the estimated SETAR specification:				
ARCH Test statistic: 0.317382			p – value: 0.5748	
Ljung-Box Test statistic (12): 0.079862			p – value: 0.7775	
Jarque-Bera Test statistic:1.390317			p – value: 0.498995	

Source: Authors

The results presented in Table 10 indicate that Slovenian net exports converge to deficit in both high and low regimes, similarly to the case of Slovakia. The Jarque-Bera test indicates normal distribution of residuals only when the observation from 1999q1 is left out of the sample. Therefore, the sharp decline of Slovenian net exports in 1999q1 can be considered as an outlier that violates the assumption of normality among residuals. Figure 4 in the Appendix illustrates the dynamics of net exports of Slovenia.

The research results support the existence of hysteresis in the net exports of the Czech Republic and Latvia. The net exports of other considered countries exhibit a nonlinear development pattern. Furthermore, the results clearly indicate that the sample countries exhibit different dynamics and properties of net exports series. Therefore, the transmission of shocks from abroad probably differs among the considered countries given that international trade is an important transmission channel. Additionally, the structure of the considered economies might be heterogeneous although all of the countries are in the same regional integration (EU). A potential explanation for this might be the differences in the process of transition among the considered countries (Podkaminer, 2013). The reviewed literature suggests that hysteretic trade flows often arise as a consequence of exchange rate dynamics. Nusair (2016) employed nonlinear approach and documented the existence of J-curve phenomenon within a sample of European transition economies. However, the results of this study show different development patterns of net exports among the sample countries. Nonetheless, there is one obvious similarity. The data series in Figure 1 suggest that all of the countries under consideration experienced an increase in the net exports after the crisis that started in 2007. Another logical explanation that warrants further empirical testing may be the structure of products in exports and imports. Well-known phenomena in the microeconomic theory are income elasticity of demand and price elasticity of demand. Demand for a more sophisticated good often exhibits higher income elasticity of demand for that good. Consequently, there should be lower income elasticity of demand for a less sophisticated good. Therefore, if a country exports less sophisticated products and imports more sophisticated products, the same decrease in income within a country and abroad will result in a higher decrease in imports compared to exports. Based on this assumption, a country with a trade deficit as a consequence of the crisis could move toward the equilibrium. Nonetheless, these assumptions still need to be tested and therefore there is a need for further research on this topic. The balance of payments for the sample countries could be examined using the monetary and absorption approaches. However, this issue also requires further investigation.

5. Conclusions

Several conclusions can be drawn based on the research presented in this paper. The research results support the existence of hysteresis in the net exports of the Czech Republic and Latvia. The net exports of these two countries were found to be fractionally integrated. Their fractional integration parameters range between 0 and 0.5. The net exports of the Czech Republic and Latvia were also found to be weakly stationary, exhibiting persistence, long memory, and mean reversion, as well as covariance stationary with no significant short-term effects. In contrast, the net exports of Hungary, Slovakia and Slovenia exhibit nonlinear and threshold dependent dynamics. The SETAR(1) model specification was found to be the best model for explaining the development pattern of the net exports of Hungary, Slovakia and Slovenia. The results are quite unexpected given that the considered countries share a similar history and a similar position in the EU. External position in terms of trade balance for all of the sample countries has improved after the crisis 2007. This finding may be explained with the role of exchange rates and sticky prices, different structure of products in imports and exports and the elasticity of demand. However, further research is needed to empirically confirm these findings. Future research should focus on the role of exchange rate in the hysteretic nature of net exports. Moreover, given that this paper examines net exports only, future research should examine hysteresis in both imports and exports.

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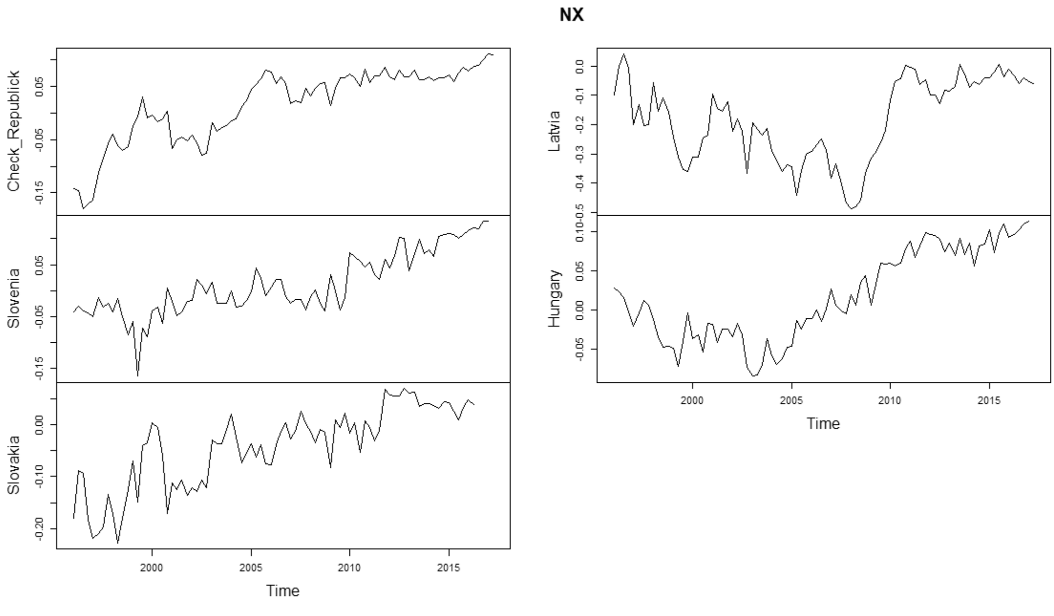
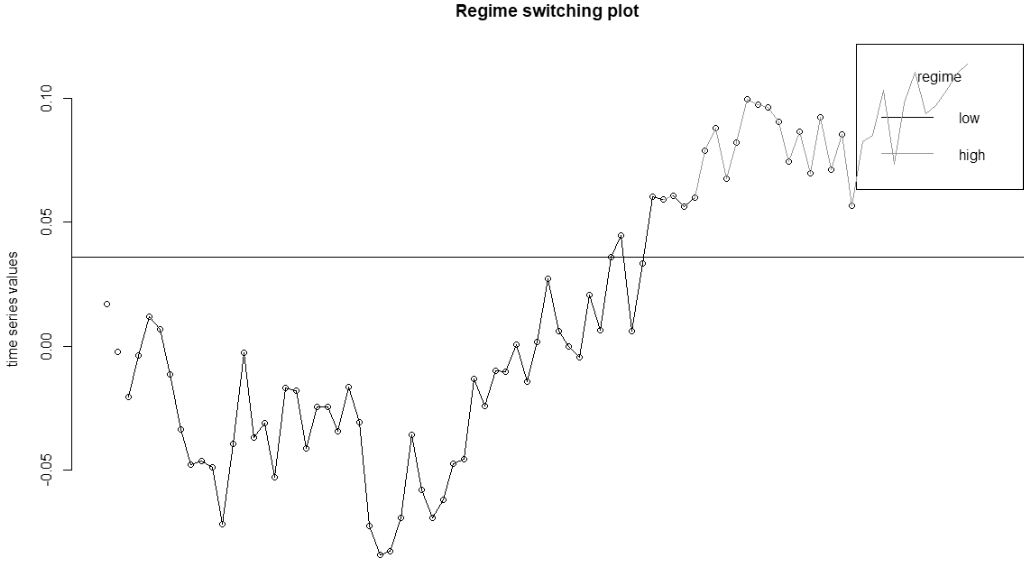
APPENDIX

Figure 1 Net export (NX) of five European countries



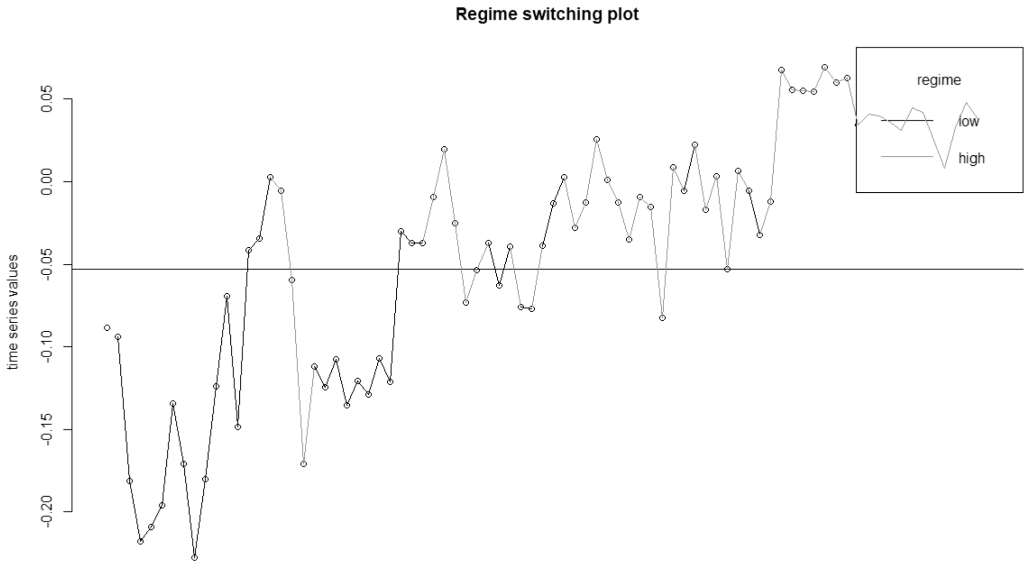
Source: Authors

Figure 2 Hungary SETAR (1)



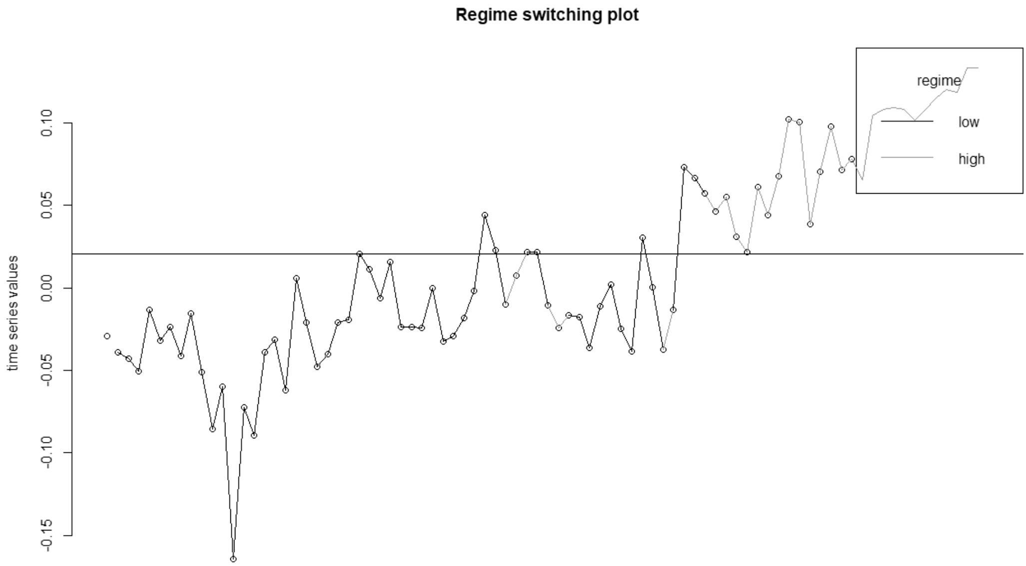
Source: Authors

Figure 3 Slovakia SETAR (1)



Source: Authors

Figure 4 Slovenia SETAR (1)



Source: Authors

Mile Bošnjak
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Histereza u trgovinskim tokovima nekih zemalja članica EU

Sažetak

U radu se ispituje postojanje histereze u obrascima neto izvoza pet zemalja članica EU-a, odnosno Češke, Latvije, Mađarske, Slovačke i Slovenije. Na kvartalnim podatcima od 1996q1 do 2017q2 za svaku zemlju su postignute procjene koje su testirane. Procjene vremenskih serija ukazuju na djelomično integrirani niz neto izvoza za Češku i Latviju, dok se neto izvoz Mađarske, Slovačke i Slovenije najbolje objašnjava specifikacijom modela SETAR (1). Rezultati istraživanja otkrili su obilježje dugotrajnog pamćenja u vremenskim nizovima neto izvoza za Češku i Latviju koji podupiru postojanje histereze. Dinamika neto izvoza u Mađarskoj, Slovačkoj i Sloveniji je nelinearna i ovisna o pragu, ali još uvijek malo drugačija. U radu se otkriva heterogenost dinamike i svojstava neto izvoza za zemlje ispitane u ovom radu. Međutim, rad otkriva indikativnu sličnost u promjeni suvremenog modela razvoja neto izvoza unutar uzoraka zemalja.

Ključne riječi: neto izvoz, frakcijska integracija, nelinearnosti, Europska unija