EURO AREA PRODUCT MARKET INTEGRATION

Irena Raguž Krištić, Lucija Rogić Dumančić

Abstract

The goal of this paper is to determine if there is product market integration in the euro area (EA). The paper employs LM and RALS-LM unit root tests with two breaks on the relative price series, constructed using the seasonally adjusted monthly Harmonized Index of Consumer Prices (HICP), from 1996:01 to 2017:05. The analysis shows EA-accession related breaks in price series for most of the EA11 countries, but, apart from Malta, no such breaks for the later-EA-joiners. However, there are breaks in both EA and non-EA countries at the time of EA formation. There is also evidence of greater product market integration and less adverse effects after negative shocks in the EA12. However, unit root analysis points to a conclusion that EA membership is not a sufficient condition for product market integration and integration is not necessarily related to being an EA member.

Keywords: *prices, euro area, stochastic convergence, unit root, structural breaks*

JEL classification: *E31, F45, O52*

1. Introduction

Euro area (EA) consists of nineteen European Union (EU) member states that have adopted the euro after meeting the five so-called Maastricht criteria. Behind its creation was a need to form a unique and integrated system that would stabilize economic shocks. It was envisioned to function as an optimal currency area (OCA) – the area that is heavily commercially linked and can thus at the same time achieve full employment, low inflation and balance of payments balances (Mundell 1961; McKinnon 1963; Kenen 1969). The Maastricht criteria, also called the convergence criteria, are specific economic conditions that were designed to be met by accessing countries to ensure economic convergence within the EA. These criteria cover the necessity of price stability, the soundness

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and sustainability of public finances, durability of interest rates convergence and exchange rate stability, prior to the EA accession. One of the goals of this economic convergence was to ensure that the EA increases product market integration (Engel and Rogers 2001; Allington et al. 2005). According to the Law of One Price (LOOP), identical tradable goods prices in the same currency were expected to, under competitive conditions, equate across all locations. The tradables' markets should become integrated. But if there is sufficient economic integration (e.g. integrated production factors' markets), which is the promised idea of EA; the same is expected for the non-tradable goods markets as well (Allington et al. 2005).

The recent global financial crisis and the apparent increase in differences among the EA countries made economists question whether the EA really functions as the OCA (Krugman 2009), and placed this issue in the center of the debate. It is argued that the EA is only a monetary union, not an OCA, because EA member states are not affected by symmetric shocks, there is low labor mobility, no common fiscal system, inflation rates are different and salaries and prices are rigid. Krugman (2012) argues that the member states have difficulties adjusting after (asymmetric) shocks precisely because of this failure of the EA to function as the OCA, primarily due to labor market adjustment mechanism failure (ECB 2012). In order to properly investigate whether the EA functions optimally, it is important to analyze whether macroeconomic variables converge and how well they adjust after a shock.

This paper analyzes the price convergence as an indicator of product market integration in the EA. Since the findings of the existing literature on the price convergence in the EA is inconclusive, this paper employs alternative approach, i.e. LM unit root test by Lee and Strazicich (2003) and RALS-LM unit root tests by Meng et al. (2016) with two breaks on the relative price variable, as suggested by Bernard and Durlauf (1995). Namely, Bernard and Durlauf (1995) ration that the variables of interest (in this case prices) should not differ arbitrarily for countries that converge and hence their relative prices should be stationary. This is a novel approach to analyzing the price convergence in the EA. The calculation of the relative prices is based on the seasonally adjusted monthly Harmonized Index of Consumer Prices (HICP), from 1996:01 to 2017:05.

The remainder of the paper is structured as follows; Section 2 provides a literature review; Section 3 discusses data and methodology; Section 4 displays and discusses the results of the analysis; and finally Section 5 concludes.

2. Literature review

This paper focuses on price convergence as an indicator of product market integration in the EA. There are two strands of literature on product market integration in the EA. The first analyzes trade volumes and mostly agrees on the positive effects of euro on trade volumes (Micco et al. 2003; Rose 2016). Interestingly, Micco et al. (2003) found that euro increased trade among EA countries, but also between the EA and non-EA countries. The second strand of literature analyzes price convergence as an indicator of product market convergence. The introduction of the euro should have decreased price dispersion (Wolszczak-Derlacz 2010). However, the evidence is mixed.

There is a body of literature that finds positive effects of EA membership (Estrada et al. 2013; Nikolsko-Rzhevskyy and Ogrokhina 2018) and common currency (Isgut 2004; Allington et al. 2005; Glushenkova and Zachariadis 2014) on price convergence, using differences-in-difference (DID), cross-sectional, panel data approach, and relative price dispersion measures[1]. Alternatively, others find no significant effects of EA membership and euro using panel data analysis (Parsley and Wei 2001; Fischer 2012), cross-sectional and DID approach (Lutz 2003; Parsley and Wei 2008). And finally, there are also studies that find diverging effects of euro on prices using relative price dispersion measures (Engel and Rogers 2004) and DID approach (Ogrokhina 2015). Using a regression analysis, Bergin and Glick (2007) pinpoint the price of oil and transport costs as drivers of this rising price dispersion. Obviously, the existing literature is inconclusive regarding the existence of price convergence in the EA and the role of EA accession in the price convergence. This paper approaches this issue differently, using non-linear unit root tests to analyze stochastic convergence of price indices and the related structural breaks. This enables conclusions on whether there is price convergence in the EA, but also to discern between potential EA creation and EA accession effects based on the break locations, thereby adding valuable new information to the existing literature.

The test of stochastic convergence is conducted using the approach by Bernard and Durlauf (1995) who suggested that the variables of interest should not differ arbitrarily and hence, in this case, the relative prices should be stationary for countries that converge. This approach found its' application in many convergence topics, such as GDP per capita convergence (e.g. Pesaran 2007), unemployment convergence (e.g. Raguž Krištić et al. 2019), fiscal convergence (e.g. Arčabić 2018) as well as price convergence (e.g. Camarero et al. 2000), although not

for the analysis of EA product market integration. To test the stationarity of these relative prices, the two-break LM unit root test by Lee and Strazicich (2003) and RALS-LM test by Meng et al. (2016) is applied. Unit root testing enables us to test whether there is price convergence i.e. product market integration in the EA member countries, while structural break testing endogenously determines the break locations that are then further discussed in light of the EA formation and EA accession, as well as the financial and sovereign debt crisis.

3. Data and methodology

The data used in the analysis are seasonally adjusted monthly Harmonized Index of Consumer Prices (HICP), 2015 = 100, from 1996:01 to 2017:05 from Eurostat for the nineteen EA countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Greece, Germany, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. Annual data on the price convergence indicators from 1995 to 2016 from Eurostat is also used. These price convergence indicators are calculated as the coefficient of variation of price level indices of household final consumption expenditure across the chosen countries. A decreasing convergence indicator indicates price convergence. For a robustness analysis, paper uses monthly data on seasonally adjusted HICP at constant taxes from 2005:01 to 2017:05 from Eurostat.

The analysis consists of two broad parts. First, the HICP price indices are analyzed in search for the persistence of their means and potential break locations around the time of the EA accession which would suggest EA might have had permanent effects on the prices of its member countries. To accomplish this, unit root testing with structural breaks is used on the natural logarithms of each country's price index.

Second, the convergence of the EA countries is addressed. The paper first briefly analyzes the price convergence indicators from Eurostat, followed by the formal convergence testing performed on the relative prices. Namely, the existence of a divergence of the individual countries' price from the average price of the first eleven member countries (EA11)[2] is being formally tested using the approach by Bernard and Durlauf (1995). They suggested that if there is a stochastic convergence across different countries, the variables of interest, in our case prices, should not differ arbitrarily and hence the relative prices should be stationary. Hence, the relative price of country i is defined as the natural logarithm of the ratio of the country i's price

index (P_{it}) and the average price index of the EA11 countries (avg_P_t).

$$lnavg\_P_{it} = \ln \frac{P_{it}}{avg\_P_t} \tag{1}$$

Although technically the rejection of the divergence null hypothesis means non-divergence, the paper follows the phrasing of Pesaran (2007) and concludes that there is a stochastic convergence if $lnavg\_P_{it}$ is trend-stationary and, following a shock, individual country's prices deviate from the EA11 average only temporarily.

In both parts of the analysis, two-break LM unit root test by Lee and Strazicich (2003) and RALS-LM test by Meng et al. (2016) is used. The non-linear tests are preferred to the linear unit root tests because the latter lose power in the presence of structural breaks (Perron 1989).

The two-break LM unit root test tests the non-stationarity null hypothesis. Unit root test statistic is obtained from the following regression:

$$\Delta u_t = \delta' \Delta Z_t + \emptyset \tilde{S}_{t-i} + \varepsilon_t \tag{2}$$

where $\tilde{S}_t$ is a de-trended series $\tilde{S}_t = u_t - \tilde{\psi}_x - Z_t\tilde{\delta}$, $t = 2, \ldots, T$, $\tilde{\delta}$ is a vector of coefficients in the regression of Δu_t on ΔZ_t and $\tilde{\psi}_x = u_1 - Z_1\tilde{\delta}$ and ε_t is the error term, assumed independent and identically distributed with zero mean and finite variance. A Trend Break model is used which assumes two breaks in both constant and a trend. Under the unit root null hypothesis $\emptyset=0$ in Equation (2), the t-statistic is defined as $\tilde{\tau}$. To determine the location of breaks ($\lambda_j = \frac{T_{Bj}}{T}, j = 1,2$) a grid search is used and a break is endogenously determined where t-statistic is minimized.

$$LM_\tau = \underset{\lambda}{\text{Inf }} \tilde{\tau}(\lambda) \tag{3}$$

Critical values depend on the break locations and are available in Lee and Strazicich (2003). This test allows for breaks under both null and alternative hypothesis and its properties are unaffected by the breaks under the null. As a consequence, the rejection of the null indicates trend-stationary with or without breaks and stochastic convergence.

RALS-LM unit root two-break test is an extension of an LM test which incorporates information on non-normal errors and is thus more powerful than the LM test in the presence of non-normal errors ε_t in Equation (2). The transformed RALS-LM test statistic is obtained from the regression:

$$\Delta u_t = \delta' \Delta Z_t + \emptyset \tilde{S}_{t-i} + \gamma \widehat{\omega}_t + v_t \tag{4}$$

where v_t is an error term and an Equation (4) is connected to Equation (2) with $\varepsilon_t = \gamma \widehat{\omega}_t + v_t$, where $\widehat{\omega}_t$ is the RALS-augmenting term that utilizes the information on non-normal errors and is uncorrelated with ε_t. The t-statistic is defined as $\tau^*_{RALS-LM}$ for the null hypothesis $\emptyset = 0$.

RALS-LM test is also free of nuisance parameters that indicate the location of the breaks; it is free of the spurious rejections meaning that the rejection of the null can be considered as a more accurate evidence of stationarity. In addition, since the variance in the error term in Equation (4) is smaller than that in Equation (2), RALS-LM test provides some asymptotic efficiency gains with non-normal errors compared to LM test.

To test the normality of errors, a Jarque-Bera normality test (Jarque and Bera, 1987) is performed on the residuals ε_t in Equation (2). Its test statistic is given by

$$JB = n \left[\frac{\sqrt{b_1}^2}{6} + \frac{(b_2 - 3)^2}{24} \right]$$

where n is the sample size, $\sqrt{b_1}$ is the sample skewness coefficient and b_2 is the kurtosis coefficient. Jarque-Bera tests the null hypothesis that the residuals are normally distributed. If the residuals are normally distributed at 5% significance level, LM unit root test is used, and RALS-LM unit root test otherwise.

4. Results and discussion

4.1. The price trends in the EA19

The results of the LM and RALS-LM unit root test analysis of the EA prices are outlaid in Table 1. The results of the LM test with two structural breaks are graphically shown in Figure 1, since this is a test more commonly used in the literature.

After accounting for Jarque-Bera normality test results, prices are trend-stationary in only a quarter of analyzed countries (Belgium, Finland, Malta, Netherlands, and Slovakia). For the rest of them, the

Table 1. Jarque-Bera, LM and RALS-LM test results for the natural logarithms of HICP

Country	JB statistic	LM		RALS-LM	
		Statistic	Breaks	Statistic	Breaks
Austria	4.9960*	**-4.8029**	**2002:04** 2012:07	-2.8572	**1998:01** 2006:08
Belgium	42.9724***	-5.0581	**2002:03** 2012:05	**-5.0323***	2007:08 2008:08
Cyprus	2.9425	**-5.1965**	*2002:02* 2014:06	-3.8572*	1998:11 2013:05
Estonia	161.1830***	-4.1313	*2002:04* 2009:04	**-2.816**	2007:01 2008:06
Finland	28.0770***	-5.1752	**2003:02** 2010:04	**-6.1094***	2007:11 2008:02
France	5.6968*	**-4.1764**	**2003:05** 2010:02N	-1.9099	**1998:01** 2014:09
Germany	18.9345***	-4.4594	2007:02 2014:10	**-3.456**	**1998:01N** 2006:08
Greece	29.7429***	-4.654	2009:08N 2014:07	**-2.5461**	1998:01 2012:04
Ireland	6.6272**	-4.6711	**2002:07** 2006:11	**-2.5632**	**1998:01** 2008:06
Italy	10.2116***	-6.0139**	2008:06 2010:05	**-2.6069**	**1998:01** 2013:12
Latvia	5.1055*	**-4.1105**	2001:06 2008:12	-3.1372	2006:03 2009:02
Lithuania	44.1271***	-4.411	2001:08 2009:06	**-2.0642**	1998:01 2000:12N
Luxembourg	34.6999***	-3.9594	**2000:01** 2011:05N	**-2.2841**	**1998:01** 2008:11N
Malta	124.8787***	-5.5046*	2000:01 2012:03	**-4.9148***	**2008:05 2008:11**
Netherlands	66.5002***	-5.0526	**2001:11** 2015:06	**-6.5402***	2009:05 2009:08
Portugal	103.7407***	-4.4779	2008:06 2010:05	**-3.3115**	**1998:01** *2004:06N*
Slovakia	2315.2453***	-4.9271	*2002:01* **2009:01**	**-10.9826***	1999:05 1999:08
Slovenia	3.9091	**-5.004**	2001:12N 2011:05	-2.2043	1998:01 *2002:04*
Spain	36.8292***	**-4.6636**	2004:12 2011:05	-1.6673	**1998:01** 2012:09

Notes: *, **, *** denote 10%, 5% and 1% significance respectively. The break dates in bold, italics and underlined are located +/- 2 years from EA, EU and ERMII accession dates, respectively. Test statistics in bold are the reference test statistics according to the normality test results.
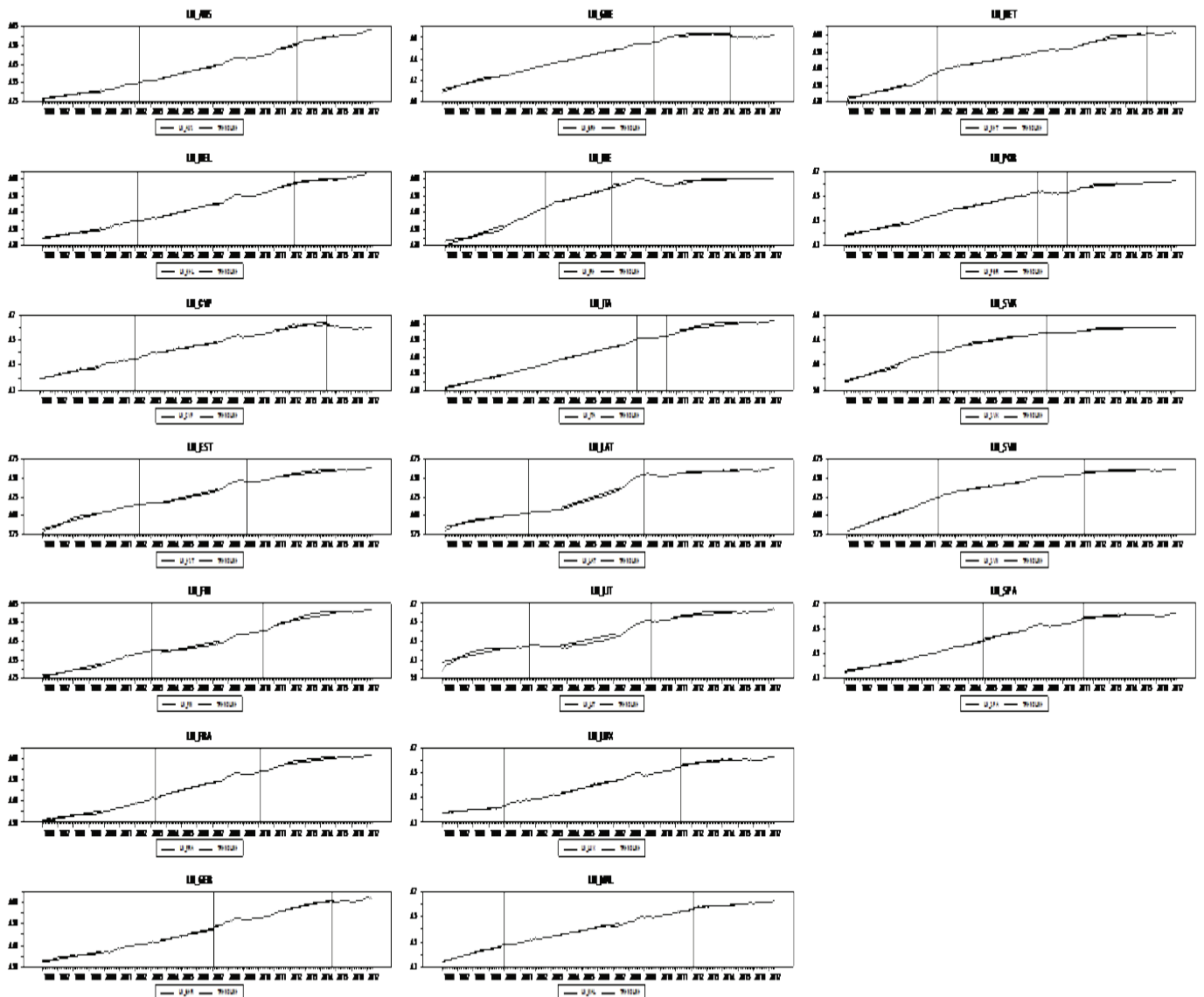
Source: authors' calculation

shocks to their prices appear to have a more permanent, trend-shifting effect (test statistics in bold in Table 1). These results are in line with the existing literature on price persistence (e.g. Camarero et al. 2000).

The structural breaks around the time of the EA accession (+/- 24 months) are presented in Table 1 in bold, EU accession in italics and ERM II accession underlined (these important dates for every country are listed in Table A1 in the Appendix). After accounting for Jarque-Bera test results, there are structural breaks around EA accession in eight countries: Austria, France, Germany (not significant), Ireland, Italy, Luxembourg, Portugal and Malta (in 2008 and 2009), seven of which are EA11 countries and the later-EA-joiners mostly do not display EA-accession-related breaks. However, many of them do display breaks around the time of EA

formation and euro adoption: Cyprus, Greece, Latvia, Lithuania, Slovakia and Slovenia (not significant), making it in total 13 out of 19 (68%) countries with structural breaks in prices around that time. Obviously, EA formation (1999) and euro introduction (2002) possibly played a role in price movements of both joining countries and countries that were at the time outside of the EA.

Regarding the other breaks, there are almost no breaks around EU and/or ERM II accessions for the later-EA-joiners. However, there are breakpoints around the 2008 financial crisis and sovereign debt crisis in the majority of the EA countries, as well as breaks around significant election dates (e.g. 2006 grand coalitions in Austria and Germany, or elections and austerity bailout in Greece in 2012).

Figure 1. Natural logarithms of EA countries' HICP and the LM test breaks

Source: authors' calculation

4.2. The price convergence analysis

4.2.1. The convergence indicators

The price convergence indicators displayed in Figure 2 are calculated as the coefficient of variation of price level indices of household final consumption expenditure across a chosen number of countries. A decreasing convergence indicator indicates thus price convergence.

Figure 2 shows much smaller overall dispersion of prices in the EA12 (EA11+Greece) compared to EA19, and EA19 compared to EU28 countries during the entire observed period. This suggests that the EA members have greater product markets' integration, which is in line with the existing literature on price convergence (e.g. Estrada et al. 2013; Ogrokhina 2015).

Additionally, there is an intensive price convergence between the EU28 countries until the financial crisis, when they start diverging and continue to do so until 2016. These trends are similar within the EA19, although the divergence after 2008 is less pronounced for this group of countries. The trends in the EA12 are somewhat different. The fastest price convergence is before EA formation. After the EA was established, there was a divergence in the prices, followed by convergence once again after the introduction of euro in 2002 which lasted until 2009. So the price divergence after 2008 visible in two other groups of countries, did not happen in the EA12. Furthermore, there was almost no change in convergence indicator for EA12 during the sovereign debt crisis, followed by only a slight divergence from 2013 to 2015. So it appears

that, overall, EA membership is related to less adverse effects of negative shocks on prices and better adjustment after the shocks, all signs of good product market integration.

4.2.2. Econometric analysis

Results of the unit root tests conducted on the relative prices are presented in Table 2. After accounting for the (non-)normality of errors, the divergence from the EA11 average can be found in 7 countries: Austria, Estonia, Germany, Italy, Latvia, Lithuania and Slovenia. Obviously, 3 of them are EA11 countries, which suggests that EA membership is not sufficient condition for a full product market integration. However, for most countries, stochastic convergence of prices can be found.

The analysis of structural breaks presented in Table 2 shows 8 countries with EA-accession-related breaks (Austria, Belgium, France, Germany, Italy, Luxembourg, Malta, Netherlands). However, just as with levels, there are later-EA-joiners with breaks around the time of EA formation and euro adoption: Cyprus (not significant), Estonia, Latvia, Slovakia and Slovenia. EA formation and euro adoption thus seem to have played a role in product markets' integration in many countries, both the initial EA countries and outside. On the other hand, the moment of EA accession for the later-EA-joiners did not seem to pose as a shock.

There are structural breaks around the time of the 2008 financial crisis in some countries as well (Austria, Finland, Germany, Ireland, Latvia, Lithuania, Malta,

Figure 2. Convergence indicators, 1995-2016
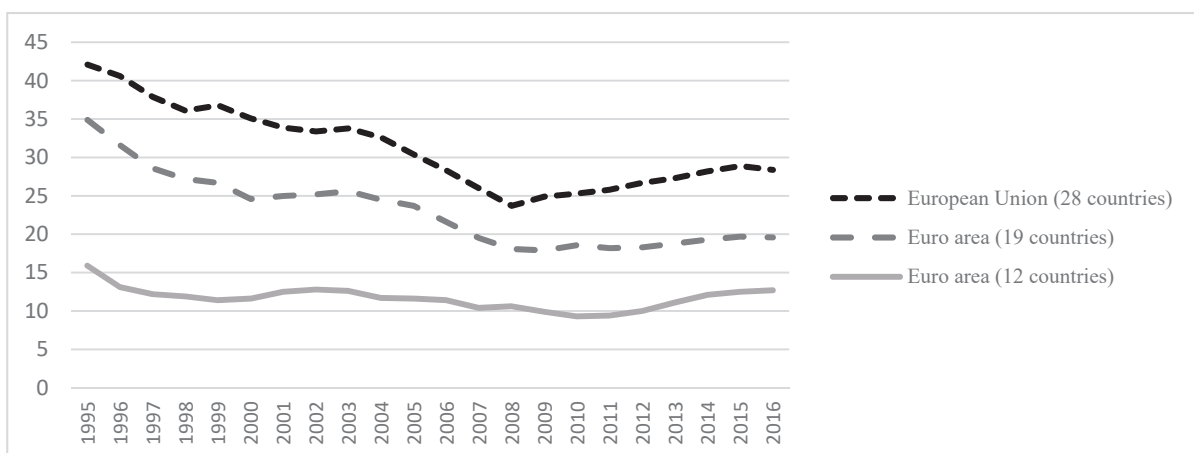
Source: Eurostat

Table 2. Jarque-Bera, LM and RALS-LM test results for the relative prices

| Country	JB statistic	LM		RALS-LM	
		Statistic	Breaks	Statistic	Breaks
Austria	2.7555	**-4.4545**	**2002:06** 2009:05	-3.8893*	2006:09 2012:07
Belgium	10.0148***	-4.787	**2001:07** 2005:02N	**-4.5167****	**1999:12 2000:03**
Cyprus	22.1317***	-5.3637*	2006:05 2012:07N	**-4.1789****	1998:10N 2014:06
Estonia	99.4580***	-4.0989	2000:12 2009:05	**-3.241**	1998:02 2013:06
Finland	114.4131***	-4.5095	2004:01 2011:12	**-6.8536*****	2007:11 2008:02
France	0.9195	**-5.6660****	**1999:12 2003:08**	-2.7111	**1998:01 2003:01**
Germany	1.2348	**-4.0848**	**2002:01** 2008:11	-4.1257*	**1999:09** 2004:02
Greece	62.0586***	-4.5095	**2002:01** 2010:01	**-5.1894*****	2010:07 2014:07N
Ireland	10.8809***	-5.5809*	2005:02 2012:02	**-4.7684*****	2004:04N 2008:10
Italy	2.7652	**-4.7378**	**2000:06** 2011:06	-5.5905***	**2000:09** 2012:08
Latvia	3.4469	**-4.12**	2001:09 2009:06	-3.1931	2006:03 2009:02
Lithuania	66.6410***	-4.4953	2002:01 2009:11	**-3.1434**	2007:03 2009:02
Luxembourg	73.9947***	-5.1684	2004:09 2013:01	**-5.2641*****	**1999:06 2001:01**
Malta	43.7169***	-4.3613	2000:01 *2004:10*	**-4.4500****	**2008:05 2009:05**
Netherlands	181.6297***	-4.2453	**2001:10** 2008:05N	**-5.3003*****	**2000:11 2001:02**
Portugal	179.3862***	-5.3894*	2004:05 2007:04	**-5.6910*****	2004:10 2007:04N
Slovakia	2933.2520***	-5.2127	*2004:02* 2012:07N	**-11.9345*****	1999:05 1999:08
Slovenia	10.0137***	-4.8679	2000:07N **2007:11**	**-2.5095**	1998:01 *2002:04*
Spain	25.7364***	-4.1187	2006:12 2014:03	**-4.4742****	2009:05 2011:02

Notes: *, **, *** denote 10%, 5% and 1% significance respectively. The break dates in bold, italics and underlined are located +/- 2 years from EA, EU and ERMII accession dates, respectively. Test statistics in bold are the reference test statistics according to the normality test results.

Source: authors' calculation

Portugal and Spain). These breaks are followed by more or less pronounced periods of relative prices approaching unity in all of the countries but Spain (Figure 3). These findings speak in favor of the good products' market integration, but one which is not necessarily related to being an EA member. Those countries that were not in the EA, were a part of the EU and ERM II mechanism which reduces exchange rate variability and promotes monetary stability, which could have played a role in their product market integration with the EA11 group. There are structural breaks around the sovereign debt crisis period as well in countries such as Greece, Italy and Spain. These breaks are for the short period of time followed by relative prices moving away from unity, but soon their trend turned back towards it (Figure 3).

Figure 3. EA countries' relative prices and the LM test breaks
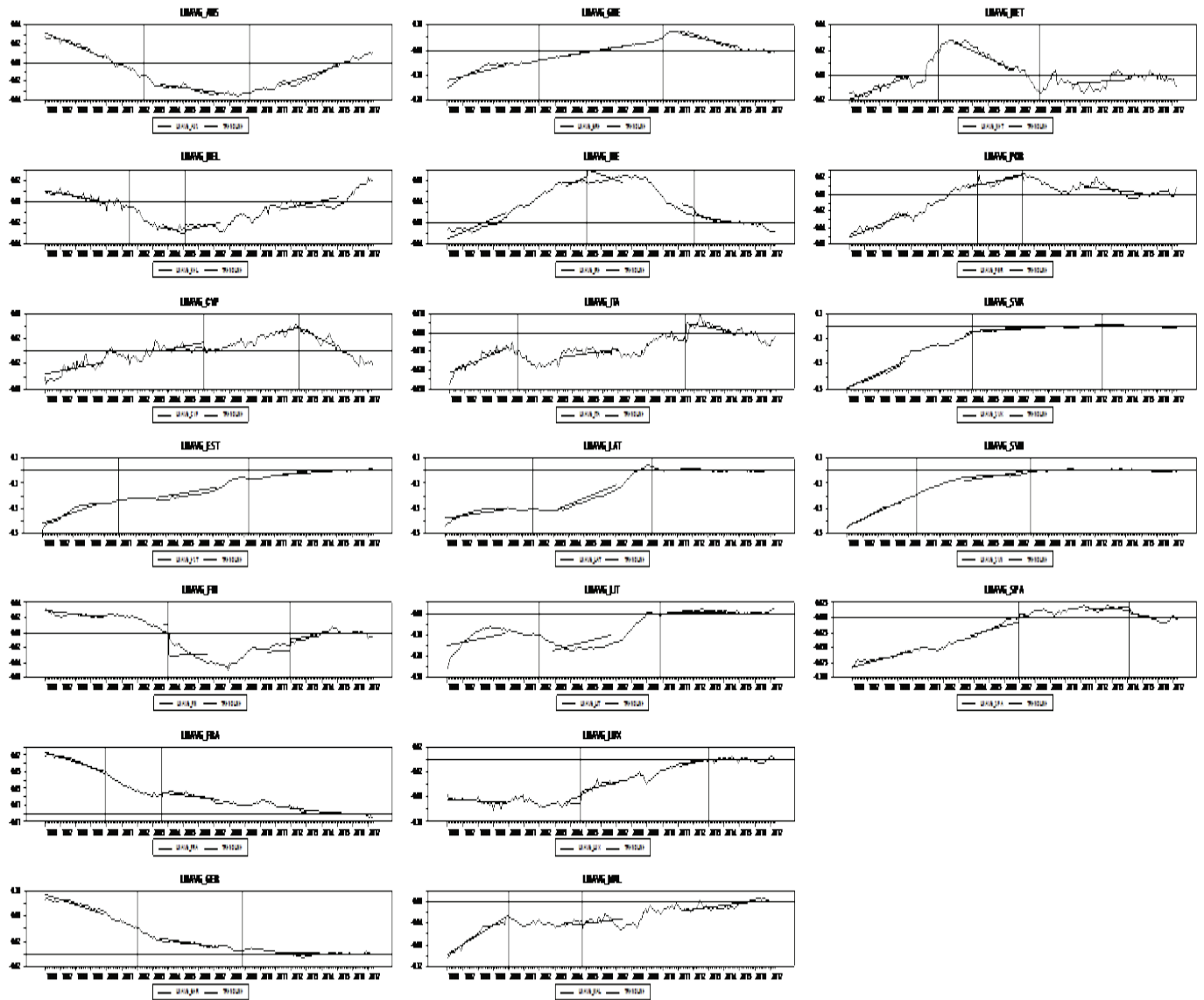
Source: authors' calculation

4.2.3. Robustness analysis

Since the main analysis was conducted on price indices that include taxes, for the robustness analysis, this paper employs LM and RALS-LM unit root tests with two structural breaks on the relative prices variable *lnavg_P*$_{it}$ derived using two sets of data: seasonally adjusted HICP data and HICP at constant taxes data, to see if there are differences in conclusions resulting from differences in individual countries' taxes. Data span from January 2005 to May 2017, and the countries analyzed are EA19 countries minus France, due to the lack of HICP at constant taxes data. The results are presented in Table 3.

For the most of the countries, unit root test results based on two data sets do not match. They only

match for Austria, Latvia and Spain. Comparison of the test results for the two data series is ambiguous for Belgium, Estonia, Ireland, Italy and Slovenia and depend on the chosen significance level for the unit root test. For the remaining 10 countries, the conclusions on convergence and product market integration are not robust. In general, prices converge for 10/18 countries at 10%, i.e. 7/18 countries at 5% significance. Prices at constant taxes series converge for more countries: 12 at 10% and 10 at 5% significance level. So, it appears, based on this very basic robustness analysis, that adjusting for the tax differences and tax changes might reveal more convergence and product markets integration than the main analysis initially suggests. It appears that there are distortions in price indices stemming from taxes that should ideally

Table 3. The robustness analysis

Country	Prices			PricesCT		
	JB	LM	RALS-LM	JB	LM	RALS-LM
Austria	0.6697	**-4.5193**	-4.4249**	3.5395	**-4.4275**	-4.8505***
Belgium	12.8996***	-5.3647*	**-4.2804****	1.2518	**-5.3275***	-6.0515***
Cyprus	2.3961	**-4.7386**	-3.4297	12.9493***	-4.6422	**-4.4944****
Estonia	27.8685***	-5.5092*	**-4.3540****	2.6015	**-5.3606***	-4.7793***
Finland	297.0365***	-4.7536	**-4.4595****	0.0216	**-4.1605**	-4.0013*
Germany	0.9123	**-4.5658**	-4.7425***	9.1257**	-6.4128**	**-5.7452****
Greece	51.0145***	-5.4252*	**-5.7742****	25.8632***	-5.7329**	**-2.7539**
Ireland	1.7270	**-5.3312***	-3.8179	4.6996*	**-5.2640**	-4.3510**
Italy	0.5123	**-5.5661***	-5.3279***	1.0098	**-5.9098****	-5.8973***
Latvia	1.7661	**-6.9183****	-3.4912	7.6694**	-6.5408***	**-6.7187****
Lithuania	14.3952***	-5.0808	**-3.6024**	194.5785***	-5.8206**	**-4.2903****
Luxembourg	1.9352	**-4.8970**	-5.4401***	13.6686***	-4.5685	**-4.1692****
Malta	6.2341**	-5.5640*	**-3.8062**	0.9716	**-5.9889****	-6.3110***
Netherlands	1.8663	**-4.7917**	-4.1314*	5.7109*	**-5.8895****	-4.0964*
Portugal	16.5827***	-6.3065**	**-5.6863****	2.1621	**-5.1369**	-4.4596**
Slovakia	6.3553**	-5.8545**	**-3.7048**	17.1188***	-5.1961	**-4.1699****
Slovenia	1.5515	**-5.3217***	-5.3331***	2.2864	**-5.1218**	-5.3233***
Spain	9.5748***	-4.3247	**-4.6363****	27.1998***	-4.3403	**-5.2950****

Notes: *, **, *** denote 10%, 5% and 1% significance respectively. Test statistics in bold are the reference test statistics according to the normality Jarque-Bera test results.

Source: authors' calculation

be accounted for. Unfortunately, analysis on this data could not have been conducted here due to unavailability of data. Other methodological approaches are required to account for these possible tax distortions.

5. Conclusion

The aim of this paper was to analyze if there is a product market integration in the EA. The paper contributes to the existing empirical literature by providing an analysis of the stochastic convergence of consumer prices in the EA and the related structural breaks to discern between the possible EA creation, EA accession and EA membership effects on national prices and price convergence. The methodologies used are the LM and RALS-LM unit root tests with two structural breaks.

The analysis of consumer prices showed they are trend-stationary in only a quarter of analyzed countries. There are EA-accession related breaks in seven of EA11 countries, but, apart from Malta, no such breaks for the later-EA-joiners. However, most countries

display a break in around the EA formation, suggesting that EA creation might have presented a shock for both EA and non-EA countries at that time.

The price convergence analysis was conducted on the price convergence indicators and the relative prices of every country to the average EA11 prices. The price convergence indicators show greater product market integration and less adverse effects after negative shocks in the country groups that have been EA members longer. However, the analysis of relative prices reveals price divergence in three EA11 countries, suggesting that EA membership is not a sufficient condition for a full product market integration of every country.

Regarding structural breaks in relative prices, there are again the EA-accession-related breaks mostly in EA11 and apart from Malta, no such breaks for the later-EA-joiners. And again the majority of countries display breaks around the time of EA formation and euro adoption.

Based on obtained 2008 financial crisis breaks mostly followed by periods of relative prices approaching unity one can conclude that there is a good

products' market integration, but one which is not necessarily related to being an EA member. The preparation for the EA membership through fulfillment of Maastricht criteria probably played a role in it as well. The good adjustment after the obtained structural breaks around the sovereign debt crisis also speaks in favor of relatively good product market integration.

There are limitations to the study that should be stressed. First, methodologically 10% of the sample is disregarded when performing a grid search for a break. Since Lithuania accessed EA later in the sample, locating the EA-accession-related break was methodologically impaired. Second, Malta accessed EA around the time of the financial crisis making it impossible to discern, using this methodology, if the structural break was EA-accession- or crisis-related. Third, our analysis does not control for factors such as differences in taxes, transport or labor costs between countries, so our conclusions should be taken only as broad generalizations about price convergence. The paper does employ a robustness analysis where controlling for taxes results in more conclusions of price convergence than otherwise. Further analysis in this respect is required. Fourth, the data used are aggregate price indices and although they enable us to find more general patterns in product market integration, the valuable information is potentially lost by aggregation. Future analyses should focus on more disaggregated product markets to complete the conclusions about product market integration in the EA.

Finally, there are implications of our study for the policy makers in countries outside the EA. Namely, the EA accession itself is likely not going to have a significant impact on prices or their convergence to the EA11 average. However, EA membership will probably bring about more integrated product market that will come from a preparation for an EA-membership, through a membership itself or both.

Endnotes

1 EA membership can also have positive effects on the productivity growth of the countries. Padilla (2020) suggest that the productivity growth of the countries that joined in 2004 and adopted the euro was higher compared to those that maintained their own currency. Tica and Šikić (2019) report that the productivity gap reduction is a heterogeneous process and a country specific problem.

2 Bayoumi and Eichengreen (1993) warned that there was a core-periphery divide before the EA was formed, that required the syncronization of both supply and demand shocks. Campos and Machiarelli (2020) later found a decrease of the core-periphery gap post-EA between the first members. This paper acklowledges that there is dynamics involved in classifying a country as a core or a periphery country (Campos and Machiarelli, 2020). However, the methodology applied in this paper does not allow for the dynamic definition of the core. Considering an increased cohesion of the EA11 countries at the time of EA formation, as well as the data shown later in Figure 2 concerning this group's convergence, this paper has opted to use the first eleven EA members as a reference for the convergence analysis. EA11 is considered a core ex ante, and later EA joiners a periphery. EA11 were the first countries to fulfill the accession criteria and had been integrating their markets the longest.

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APPENDIX

Table A1. Important dates for the EA19 countries

Country	EU accession	EA accession	Euro adoption	(ERM) and ERMII participation
Austria	1995:q1	1999:q1	2002:q1	(1995:q1)
Belgium	1951:q1	1999:q1	2002:q1	(1979:q1)
Cyprus	2004:q1	2008:q1	2008:q1	2005:q2
Estonia	2004:q1	2011:q1	-	2004:q2
Finland	1995:q1	1999:q1	2002:q1	(1996:q3)
France	1951:q1	1999:q1	2002:q1	(1979:q1)
Germany	1951:q1	1999:q1	2002:q1	(1979:q1)
Greece	1981:q1	2001:q1	2002:q1	(1998:q1)
Ireland	1973:q1	1999:q1	2002:q1	(1979:q1)
Italy	1951:q1	1999:q1	2002:q1	(1979:q1)
Latvia	2004:q1	2014:q1	-	2005:q2
Lithuania	2004:q1	2015:q1	-	2004:q2
Luxembourg	1951:q1	1999:q1	2002:q1	(1979:q1)
Malta	2004:q1	2008:q1	2008:q1	2005:q2
Netherlands	1951:q1	1999:q1	2002:q1	(1979:q1)
Portugal	1986:q1	1999:q1	2002:q1	(1992:q2)
Slovakia	2004:q1	2009:q1	2009:q1	2006:q1
Slovenia	2004:q1	2007:q1	2007:q1	2004:q2
Spain	1986:q1	1999:q1	2002:q1	(1989:q2)

Source: authors' calculation