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Product market integration in the Euro area

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Abstract

The goal of this paper is to determine if the euro area (EA) accession and membership had a significant impact on the product market integration in the EA countries. The paper employs LM and RALS-LM unit root tests with two breaks on the seasonally adjusted monthly Harmonized Index of Consumer Prices (HICP), from 1996:01 to 2017:05. We find EA-accession related breaks in most of the EA11 countries, but, apart from Malta, no such breaks for the later-EA-joiners. However, EA formation had a significant impact on both EA and non-EA countries at that time. We also find greater product market integration and less adverse effects after negative shocks in the EA member countries. However, based on unit root analysis, we find that EA membership in 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 code: E31, F45, O52

Introduction

Euro area (EA) represents an integration of nineteen European Union (EU) member states that have adopted euro. Behind its creation was a need to create 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 that can thus at the same time achieve full employment, low inflation and balance of payments balances (Mundell, 1961, McKinnon, 1963, Kenen, 1969). Furthermore, due to the lower exchange rate volatility, commitment by member countries to a broader macroeconomic policy coordination, and harmonization of regulation and social policies (Engel and Rogers, 2004), removal of complexities of calculating the prices in foreign currencies and resolving of the issue of sticky nominal prices in consumers' currencies and sluggish domestic and foreign prices adjustment (Engel and Rogers, 2001), the EA was expected to increase product market integration. 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 tradable product markets should become integrated. But if there is sufficient economic integration (e.g. integrated production factors markets), the same is expected for the non-tradable goods markets as well (Allington, Kattuman and Waldmann, 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 a 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. For example unemployment rates convergence is viewed as an indicator of labor market integration, price convergence of product market integration, etc.

We focus on product markets and consumer price indices to find out whether there is product markets integration in the EA. The existing literature is inconclusive regarding the role of EA, its accession and membership on price convergence. We approach this problem in a different way, by analyzing the stochastic convergence of price indices and the related structural breaks, which enables us to discern between EA creation, accession and membership effects, thereby bridging the existing literature gap. We use two-break LM unit root test by Lee and Strazicich (2003) and RALS-LM test by Meng et al. (2016). Unit root testing enables us to relate convergence patterns to the EA membership, while structural break testing endogenously determines the break locations that are then further discussed in light of the EA formation and accession, as well as the financial and sovereign debt crisis.

The remainder of the paper is structured as follows; in Section 2 we provide a literature review; in Section 3 data and methodology outline; in Section 4 results of the analysis; and finally in Section 5 summary remarks.

Literature review

There are two strands of literature on product market integration in the EA. The first analyzes trade volumes as an indicator of product market integration. The available literature 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 as well. 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, Kattuman and Waldmann, 2005; Glushenkova and Zachariadis, 2014) on price convergence, using differences-in-difference (DID), cross-sectional, panel data approach, and relative price dispersion measures. Alternatively, there is literature that finds no significant effects of EA membership and euro using panel data analysis (Parsley and Wei, 2001; Fisher, 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 (Engel and Rogers, 2004; Ogrokhina, 2015). Using a regression analysis, Bergin and Glick (2007) pinpoint the price of oil and transport costs as drivers of this rising dispersion.

Obviously, the existing literature is inconclusive regarding the role of EA accession, membership and euro adoption on price convergence. We approach this issue differently, using non-linear unit root tests to analyze stochastic convergence of price indices and the related structural breaks, which enables us to discern between EA creation, accession and membership effects, thereby adding valuable new information to the existing literature.

Data and methodology

Data

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. We also use annual data on the price convergence indicators from 1995 to 2016 from Eurostat. They 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, we use monthly data on HICP at constant taxes from 2005:01 to 2017:05 from Eurostat that are seasonally adjusted before the analysis.

Methodology

The analysis consists of two parts. First, we analyze the price indices and look for the persistence of their means and potential break locations in order to detect whether EA accession had some 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 indices. Second, we test whether there is a divergence of the individual countries' prices from the average prices of the first eleven member countries (EA11). To test this hypothesis, we use the approach by Bernard and Durlauf (1995) who 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, we define the relative price of country i 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).[1]

$$lnavg\_P_{it} = ln\frac{P_{it}}{avg\_P_t} \quad (1)$$

Although technically the rejection of the divergence null hypothesis means non-divergence, we follow the phrasing of Pesaran (2007) and conclude 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 we use two-break LM unit root test by Lee and Strazicich (2003) and RALS-LM test by Meng et al. (2016).

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

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

where $\tilde{S}_t$ is a de-trended series $\tilde{S}_t = u_t - \tilde{\psi}_x - Z_t\tilde{\delta}, t = 2, \dots, T$, $\tilde{\delta}$ 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. We use a Trend Break model 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.

$$LM_{\tau} = \inf_{\lambda} \tilde{\tau}(\lambda) \quad (3)$$

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:

$$\Delta u_t = \delta' \Delta Z_t + \emptyset \tilde{S}_{t-i} + \gamma \hat{\omega}_t + v_t \quad (4)$$

where v_t is an error term and an Equation (4) is connected to Equation (2) with $\varepsilon_t = \gamma\hat{\omega}_t + v_t$, where $\hat{\omega}_t$ 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

[1] Approach used by Pesaran (2007) and many others.

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.

In our analysis we conduct a Jarque-Bera normality test (Jarque and Bera, 1987) 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, we use LM unit root test, and RALS-LM unit root test otherwise.

Results and discussion

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. We graphically show in Figure 1 the results of the LM test with two structural breaks, since this is a test more commonly used in the literature.

After accounting for Jarque-Bera normality test results, we see that prices are trend-stationary in only a quarter of analyzed countries (Belgium, Finland, Malta, Netherlands and Slovakia). For the rest of them, the shocks to their prices appear to have a more permanent, trend-shifting effect (test statistics in bold in Table 1).

The structural breaks around EA accession (+/- 24 months) are presented in Table 1 in bold, EU accession in italics and ERM II accession underlined[2]. After accounting for Jarque-Bera results, the EA accession periods contain structural breaks 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 and euro introduction had a significant impact on prices of both joining countries and countries that were at the time outside 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).

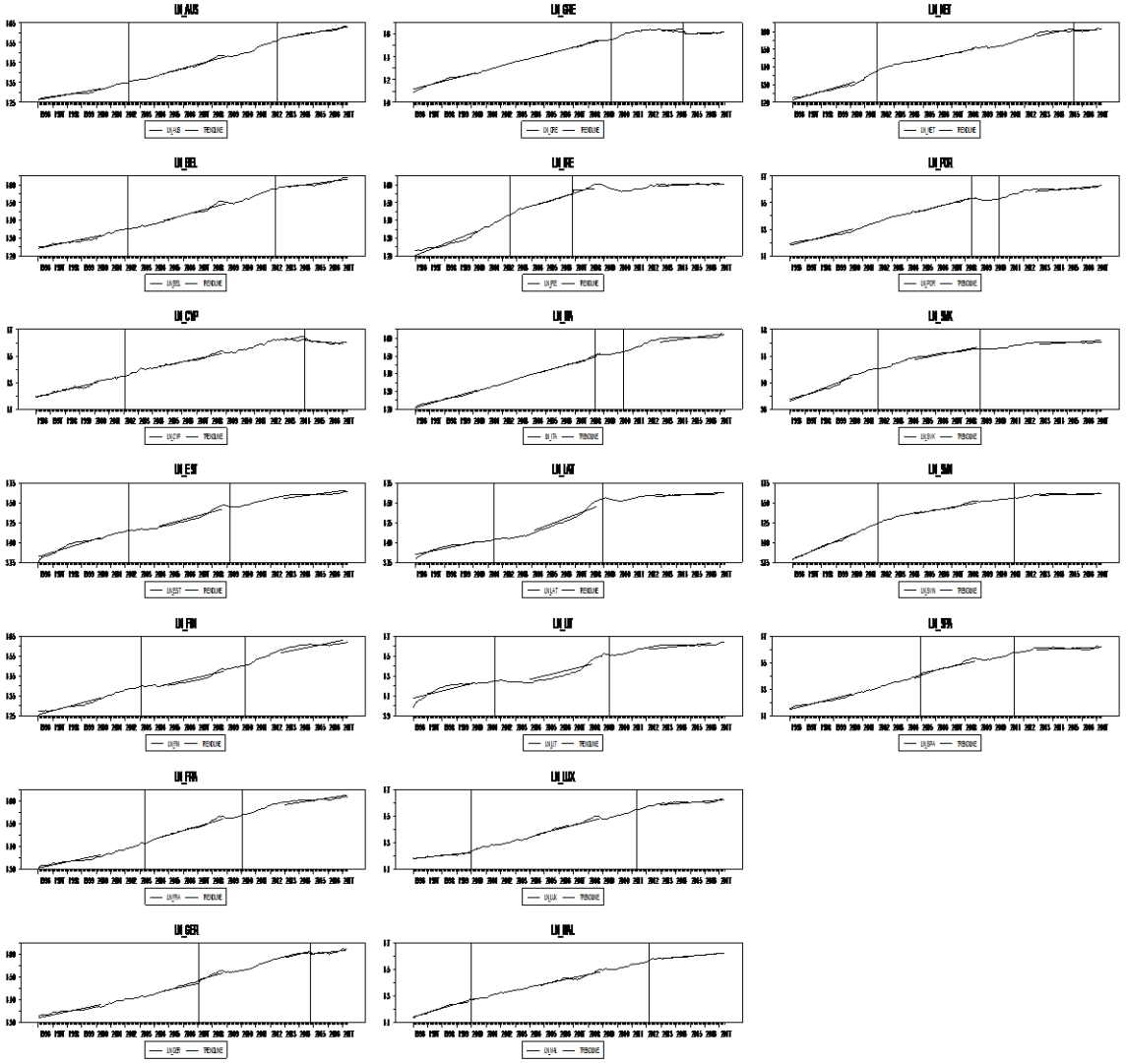
[2] These important dates for every country are listed in Table A1 in the Appendix.

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

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



Source: authors' calculation

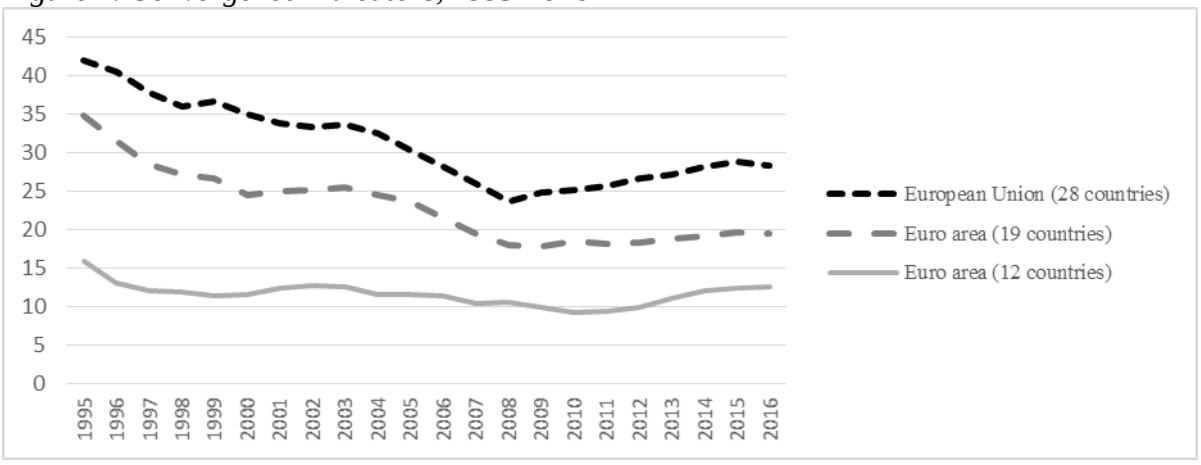
The price convergence analysis

In order to analyze price convergence first we briefly analyze the price convergence indicators. Next, we perform the convergence analysis on the relative prices.

The convergence indicators

The price convergence indicators 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 means price convergence.

Figure 2. Convergence indicators, 1995-2016



Source: Eurostat

In Figure 2 we see 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 membership is generally positively related with greater product markets integration.

Additionally, we see 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. The trends in the EA12 are somewhat different. We see the fastest price convergence 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 that we see in two other groups of countries from 2008, 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 is related to less adverse effects of negative shocks on prices and better adjustment after shocks, all signs of good product market integration.

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, we find the divergence from the EA11 average 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, we do find stochastic convergence of prices.

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. The divergence/convergence patterns following EA-formation-related breaks are not uniform (Figure 3), and reasons behind that should be inspected in some future analyses. What is concluded here is that EA and euro had a significant impact on product markets in many countries, both EA and outside. On the other hand, the EA accession did not pose as a shock for the later-EA-joiners.

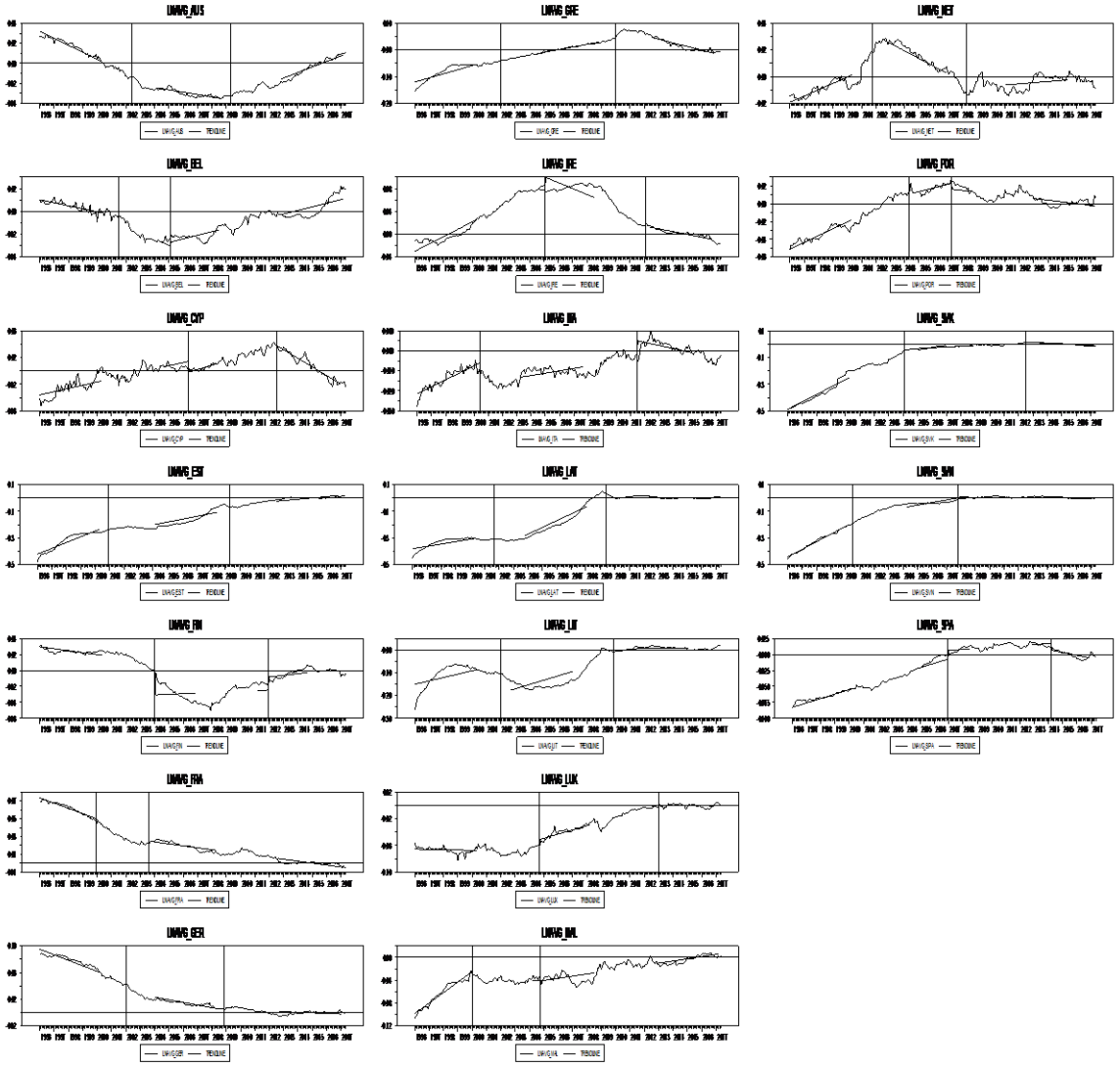
The 2008 financial crisis seems to have caused structural breaks in some of the countries as well (Austria, Finland, Germany, Ireland, Latvia, Lithuania, Malta, Portugal and Spain). These breaks are followed by more or less pronounced convergence periods in all of the countries but Spain (Figure 3). 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 EA11. There are structural breaks surrounding the sovereign debt crisis period as well in countries such as Greece, Italy and Spain. In those countries, the sovereign debt crisis led to a short period of price divergence, which soon turned back towards convergence (Figure 3).

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

Figure 3. EA countries' relative prices and the LM test breaks



Source: authors' calculation

The robustness analysis

Since the main analysis was conducted on price indices that include taxes, for the robustness analysis, we perform 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.

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

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 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 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.

Conclusion

The aim of this paper was to analyze if there is a product market integration in the EA. It contributes by filling the gap in the existing empirical literature by providing an analysis of the stochastic convergence of the consumer prices in the EA and the related structural breaks to discern between EA creation, EA accession and EA membership effects on national prices and price convergence. The methodology 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. We find 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 presented a shock for both EA and non-EA countries at that time.

The price convergence analysis is 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, we again find EA-accession-related breaks mostly in EA11 and apart from Malta, no such breaks for the later-EA-joiners. And again we see that the majority of countries display breaks around the time of EA formation and euro adoption, which were not necessarily followed by price convergence. The reasons behind no uniform convergence following EA formation are not provided by this analysis, and should be a subject of some future research.

Based on obtained 2008 financial crisis breaks mostly followed by convergence periods we 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 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, some countries accessed EA around the time of the crises making it impossible to discern, using this methodology, if the structural breaks were EA-accession- or crisis-related. Third, in our analysis we do 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. We do 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 most bring about more integrated product market that will come from a preparation for an EA-membership, through a membership itself or both.

Appendix

Table A1. Important dates for the EA19 countries

Country	EU accession	EA accession	Euro addoption	(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)

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