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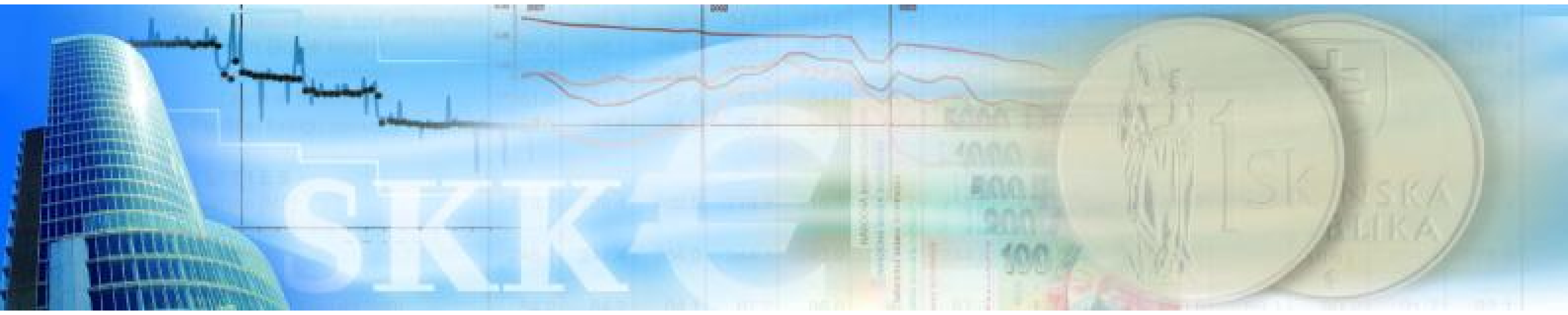

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ULC Dynamics of Euro Area Countries and SR in the Long Run

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Abstract

In this paper we analyse the ability of national unit labor costs of euro area countries to converge to the weighted average of the EMU and in the case of SR also to the weighted average of V4 countries. Co-integration between individual and average nominal ULC indices was examined through static (OLS) and dynamic (VEC) tests and estimates. We discovered a significant co-integration under an absolute convergence of the ULC for almost all countries (incl. SR) to the equilibrium, which was determined mainly by the weighted average of the euro area. In general, a significant convergence would enable different levels of nominal ULC but not long-term differences in their development, which is an important criterion for sustaining the competitiveness of a country without an exchange rate mechanism.

Key words: ULC, competitiveness, convergence, co-integration, VEC
JEL classification: C22, F15, J30

Referee: Juraj Valachy

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1 Introduction

Unit labor costs ("ULC"), apart from indicating the quality of economic growth, are also an important indicator of a particular country's competitiveness. When expressed nominally, they correlate current labor costs to the unit of real output produced, providing us with a picture of the price development in the wage area. This means that when the given indicator increases, labor costs grow faster than production itself. If this growth is also applied to the international comparison, the export position of a country with a higher increment of ULC becomes less favourable than that of its trading partners due to its wage costs being higher than in these competing countries. A long-term occurrence of such situation in a country without the exchange rate mechanism leads to pressures on the inflation, to a continuous appreciation of the exchange rate and, should the country lose its competitiveness, to an overall impairment of its economic growth. This means that a long run divergence of national ULC brings about real economic costs.

Those euro area countries that implemented an effective wage policy after the introduction of the common currency and directed their investments efficiently (such as, for instance, Germany as a key country), managed to improve their competitiveness over time owing to a lower growth in nominal labor costs relative to other EMU countries. By doing this, they placed the position of importing euro area countries at a disadvantage as these were no longer able to react to the above-average growth in nominal ULC by devaluating their domestic currencies so as to support their export activity. At present, they suffer from a loss of competitiveness due to the continuously appreciating real exchange rate (this applies particularly to the southern countries of Spain, Italy, Greece and Portugal). In an analysis of Spain's competitiveness, D. Choyleva (2008) found that if the euro area wants to grow in the future towards convergence rather than divergence, it will be necessary to increase interest rates as well as German wage inflation while decreasing real wages in Spain.

It should be noted that the strength of automatic stabilizers for eliminating the existing divergences in the euro area became less, one reason being the variety of tax systems and deduction reforms in the unemployment insurance. This has caused a significant delay in the individual countries' adaptation back to equilibrium. The introduction of uniform European taxes and unemployment insurance contributions is currently being discussed in view of supporting the moderation of fluctuations in the economic cycles. The USA serve an example, having been able to mitigate 15 to 20 percent of regional upturn divergences through this mechanism. (Schwarzer D., 2007)

Above-average growths in unit labor costs following the introduction of the common currency posed a problem especially for the catching-up economies of the southern EMU. According to the Balassa-Samuelson Hypothesis ("BS hypothesis"), the lower competitiveness of countries such as Italy, Spain, Greece and Portugal, could be explained through an effort to increase productivity in the industrial sector. This sector should simultaneously be the main source of wage inflation and above-average growth in nominal unit labor costs in general, as the growth in nominal wages in the tradable sector will create pressure on a higher growth in wages in the non-tradable sector (provided a sufficient labor force mobility) and, given sufficient competition, this increased growth will effect a rise in the prices of non-tradable sector products as well. Since, as we know, the concept of purchasing power parity ("PPP") does not apply to this sector, the divergence from or convergence to the inflation trend of the euro area in the coming periods will also depend on the development of nominal wages in the market services sector which comprises an average 34% of the total GDP. The BS hypothesis, however, is disproved by the fact that the above four countries rank last in the tradable sector's productivity level compared to other euro area countries and their catching-up process is very slow due to their below-average growths. Additionally they also have problems with faster-growing labor costs and, should they fail to confirm their co-integration with the euro area, we envisage a threat to the stability of the EMU if the ULC dynamics of these countries continues with its current development.

In general, divergences in correctly functioning market economies in both the short and the long run should theoretically disappear. We know two market mechanisms that determine a particular country's ability to adapt to new market conditions, i.e. real interest rate and the above-mentioned real exchange rate. On one hand, for a catching-up country such as the SR with a higher inflation and a stable nominal interest rate, this means a decrease in the real interest rate which encourages the increase in investments and consumption. On the other hand, however, the appreciation of the real exchange rate adds to the deterioration of the particular country's export position, generally implying a fall in foreign demand for domestic products and a lower growth in GDP in the short as well as in the long run. And, as Dullien and Fritsche (2007) observed, a long-term positive effect of above-average inflation does not sufficiently compensate the negative impact of the country's loss of competitiveness.

Therefore, our aim was to find whether the difference in the dynamism of ULC on the national level causes a long-term divergence or whether this is just a short-term problem. If convergence is confirmed, it would enable different levels of nominal ULC but not long-term differences in their development, which is an important criterion for sustaining the competitiveness of a country that can no longer avail of the exchange rate mechanism. In this paper we shall try to give a general picture of the approaches in the identification of long-term convergence or divergence of logarithmed nominal ULC indices ("ULCI") using static co-integration testing through OLS and the dynamic VEC model with two variables. We specifically tested the relationship between national unit labor costs in EMU countries and the weighted average of the euro area and, in the case of SR, we also analysed its convergence to the weighted average of V4 countries. We used quarterly data for the following 6 economic sectors: business sector excluding agriculture, construction sector, the sectors of market services, industry, manufacturing and the entire economy. Generally speaking, our paper provides a more detailed evaluation of convergence in the individual sectors compared to other papers (Dullien S. and Fritsche U., 2007; Gabrisch H., 2007), whose scope of observation was limited to the economic sector as a whole, to EMU countries and the USA, and which were based on annual data.

A positive discovery according to our results was that we recorded the significance of co-integration of nominal ULCI for almost all euro area and V4 countries to equilibrium with a possibility of absolute convergence, proceeding mainly from the weighted average of the euro area. This means that we could expect a further decrease in the divergences between national and euro area ULC in the future, provided their mutual dynamics will proceed from their development ex post.

The paper is divided into five parts. The individual approaches to the identification of long-term convergence or divergence are described in the second and third chapters. Specific results are presented in the fourth and the last chapters of our work, emphasizing the influences of the introduction of euro in euro area countries and the possible consequences of its introduction in SR in 2009.

2 Literature Overview

It is generally known that many macroeconomic variables are non-stationary, I(1), as is the case of ULCI or CPI. A shock in these cases has a permanent effect on their value and the theoretical autocorrelation moves over infinite time towards one. A co-integration between non-stationary variables only arises where the estimated residuals are stationary in their original form, I(0), with zero average, finite variance and with autocorrelation being also finite and having a declining tendency away from one. Co-integration means that a linear combination of two non-stationary variables brings about a stationary relationship. (Engle a Granger, 1987)

We have analysed the question whether to use panel or individual estimations. It should be noted that commonplace panel co-integration estimations presume a possibility of differences in the average, trend, and short-term dynamics, but relations in the long run are common for all countries. However, there is a notable probability here that each country will follow its own catching-up process (Breitung, 2005). We shall elucidate the various tests of common or individual adaptation later on.

Barro and Sala-i-Martin (1991) have defined two concepts of convergence towards equilibrium, namely the concepts of β-convergence and σ-convergence that have been analysed in this paper. The concept of β-convergence defines the convergence of time series to average. In this paper, its speed estimated through the vector error correction (VEC) model is defined through the symbols γ_y or γ_x. On the other hand, the concept of σ-convergence implies the reduction of the variance over time. This means that the occurrence of some shocks brings about an increase in the variance in estimated errors, resulting in σ rising above its usual value which should converge over time back towards its equilibrium.

We also have to mention the difference between absolute and relative convergence. In the case of absolute convergence, ULC indices would converge directly to the weighted average of the euro area or V4 countries which, in the long run, means a total elimination of their mutual differences. On the other hand, a relative convergence of national ULCI to equilibrium means that the particular country's ULC indices are constantly apart from the equilibrium, which could deepen the suspicion that this country is unable to effectively react to shocks over time and, at the same time, encourage the likelihood of lasting growth differences in the given indicators.

As co-integration has only been tested here between two endogenous variables, we could use the two-step estimation as per the methodology by Engle and Granger (1987) because we presume no more than one co-integration relationship to two co-integration vectors. As long as the estimated errors remain uncorrelated, the co-integration coefficient may be effectively estimated for each country separately through the OLS regression. In the case of both absolute and relative convergences, this coefficient should converge towards one.

In establishing the significance and nature of convergence, we included the dynamic VEC model based precisely on the possibility of co-integration in addition to the above mentioned static approach. The main function of the VEC-model is the moderation of fluctuations from equilibrium during some period in the subsequent period. The VEC model, typical for a system with two variables, would be defined by changes in one variable relative to deviations from equilibrium in the past as well as by changes in both variables.

We have drawn our inspiration from a paper of the German Institute for Economic Research written by Dullien and Fritsche (2007) in which they analysed the spread of annual ULC indices within the euro area and compared it to the spread in regions in Germany and the USA. They found that the size of spread in countries within the euro area generally became less after the adoption of euro but remained higher compared to Germany or USA. They also examined co-integration relationships arising from convergence to the average and the speed of adapting towards equilibrium. They also found that although still slower than in USA or Germany, this speed improved within the euro area. Euro area countries tended to adapt over time to changes in the values of euro area average rather than the other way round. The main difference between our paper and theirs is that we use quarterly data, which enables us to use more observations after the introduction of euro. We have also used sector data on ULC indices, which provides us with a more detailed assessment of the situation within both the EMU and the V4.

3 Methodology and Data Used

In our paper, we have processed quarterly data of nominal unit labor costs for the period of 1990Q3-2007Q2, obtained from the OECD database. ULC's are given as indices (2000=100), seasonally adjusted and have the following form:

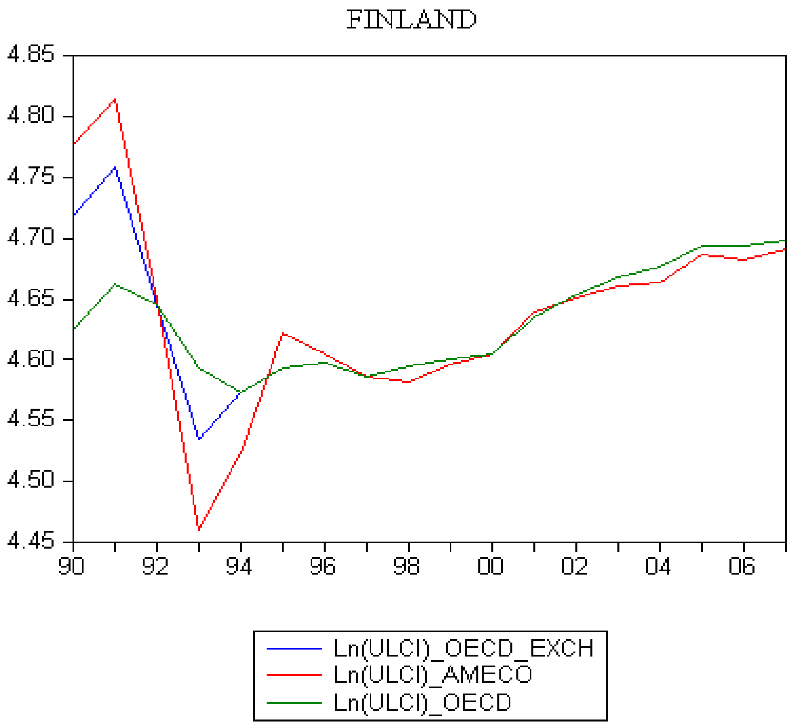
$$ULCI_t = \left[\left(\frac{\dfrac{compensation\ of\ employees_t}{total\ hours\ worked\ by\ employees_t}}{\dfrac{real\ output_t}{total\ hours\ worked\ by\ employment_t}} \right) : \left(\frac{\dfrac{comp.\ of\ employees_{2000}}{total\ hours\ worked\ by\ employees_{2000}}}{\dfrac{real\ output_{2000}}{total\ hours\ worked\ by\ employment_{2000}}} \right) \right] * 100$$

We monitored the ULC indices of 11 euro area countries (Austria AT, Belgium BE, Spain ES, Finland FI, France FR, Germany GE, Ireland IE, Italy IT, Luxemburg LU, The Netherlands NL and Portugal PT) and V4 countries (Czech Republic CZ, Hungary HU, Poland PL, Slovakia SK). We compared the divergence from or convergence to the weighted average of the euro area ULCI and, in the case of SR, we considered the possibility of convergence to the weighted average of other V4 countries, for which reason we analysed this option as well.

In order to achieve better informative ability of our results, we had to include into the OECD data also the exchange rate effect that slightly influenced the dynamics of indices in the euro area countries prior to the introduction of euro and in V4 countries throughout the entire period. We could avail of this modification on the basis of a comparison with the annual ULC index data provided by the AMECO database that also include the exchange rate (ECU/EUR). Even though their methodology for the calculation of unit labor costs was different from that of the OECD and they included employed persons in the denominator instead of hours worked, the development of ULC indices in euro area countries after the introduction of euro was almost identical and mutual deviations (*ulci_AMECO – ulci_OECD*) were insignificant.

In the implementation of the effect of the exchange rate, we identified significant deviations outside the standard band whose minimum and maximum were set by the values of positive and negative standard deviations respectively. We have defined these fluctuations as points where the weakening or strengthening of the domestic currency against euro excessively influenced the ULC index value compared to data in the domestic currency. Throughout the entire period, the exchange rate had a varying effect for each particular V4 country and its impact in EMU countries was most significant especially during the period of 1992-1994. The differences between standard deviations and projecting values were included in the quarterly data observed, subsequently making them more volatile. For clarification, we have provided a chart with unit labor costs of Finland that shows what *ln(ULCI)* had looked like prior to their modification (*_OECD*) and how they changed after the addition of the exchange rate effect (*_OECD_EXCH*).

Chart 1 Logarithmed Annual Unit Labor Costs Indices of Finland Subject to Different Methodologies



Explanatory notes: *ln(ULCI)_OECD* represents data without any exchange rate adjustment, *ln(ULCI_OECD_EXCH*) are data after the exchange rate adjustment and *ln(ULCI_AMECO)* represents data, which are already exchange rate adjusted ECU/EUR
Source: Own calculations, OECD, AMECO

We avoided the inclusion of statistically insignificant deviations into our modified OECD data, since in each database they were calculated using a different methodology. The chart clearly shows that deviations persist even after the introduction of euro, despite a single currency. Hence we tried to find a compromise between both databases and we only included significant deviations caused predominantly by an excessive strengthening or weakening of the nominal exchange rate. The reason why we preferred to use data obtained from the OECD database was that the AMECO database only contains annual data on the manufacturing sector and on the total economy, which would prevent us from analysing co-integration relationships and possible consequences efficiently as we were also interested in other sector-related economic groupings and, in the case of SR, quarterly data are of primary importance due to the scarcity of annual observations. That is to say that OECD statistics provide observations for 5 other sectors as well[1]. The following table shows the industrial classification of the business sector excluding agriculture into separate sectors and their share of the GDP:

Table 1 Industrial Classification of the Business Sector Excluding Agriculture and the Share of GDP

	SECTOR	Share of GDP ca (in SR)	(in EMU)
BUS:	**Business excluding Agriculture**	**72 %**	**68%**
CON:	Construction	7 %	6 %
IND:	Industry	31 %	23 %
MAN:	*Manufacturing*	*26 %*	*19%*
MRS:	Market Services	34 %	39%

Source: OECD

Model

As we have already mentioned, we make a difference between the absolute (Model I) and relative (Model II) convergence, for which reason we have worked with two models with the following forms:

Model I: $y_t = bx_t + e_t$ (1)

Model II: $y_t = c + bx_t + e_t$ (2)

where y_t are logarithmed nominal ULC indices of a particular country, x_t represents the weighted average (of monitored euro area or V4 countries) based on the amount of GDP of the particular countries cleaned from the influence of the country currently monitored and c is a constant included in Model II. In the case of absolute convergence (Model I), c should be insignificant, i.e. equal to zero, and the coefficient b should approximate one.

The estimated residuals, $e_t = \rho e_{t-1} + u_{,t}$, should demonstrate a stationary nature, I(0), for the possibility of co-integration. This means that in the case of a homogenous co-integration the estimated coefficient ρ moves away from one and its progress is of the same nature for all euro area countries ($\rho = \rho_i = \rho_j$). In the case of a heterogenous behaviour of countries, ρ is less than one but each country will follow an individual catching-up process ($\rho \neq \rho_i \neq \rho_j$).

[1] See their more detailed description in the appendix, Table P.A.

We will proceed in the following manner. First, we will test the stationarity of the actual *ln(ULCI)* and also of the differences between national *ln(ULCI)* and the average using panel tests to identify unit roots. The tests will also differentiate between the homogenousness and heterogenousness of possible co-integrations, helping us to decide whether to estimate models with individual effects or a common effect for either the monetary union countries or the V4 countries.

Co-integration will be tested using Pedroni's residual co-integration test[2], OLS-static co-integration test and ultimately, in the estimation of VEC-models, we will use tests of co-integration series without restrictions through the Johansen procedure[3] that verify the presence of co-integration and the number of significant co-integration equations whose number should not exceed one because of two endogenous variables used.

4 Testing and Results

4.1 Stationarity

The testing of stationarity of logarithmed unit labor cost indices for euro area and V4 countries was carried out through panel tests that identified either common unit roots (Levin, Lin, Chu; LLC) or individual unit roots (ADF- and PP-Fisher). Non-stationarity of data used, I(1), was confirmed in both cases except for the possibility of stationarity of *ln(ULCI)* in the euro area's industry sector through the ADF-Fisher statistic[4]. In our paper, therefore, we preferred to explain estimations for the manufacturing sector whose share of this tradable sector amounts to ca 86 percent.

When deciding whether we should estimate equations for each ith country separately or jointly for the euro area or the V4, we also tested real deviations from the EMU weighted average. $ln(ULCI_{i,EMU})-ln(ULCI_{EMU}*)$, $ln(ULCI_{i,V4})-ln(ULCI_{EMU})$ and from the average of V4 countries: $ln(ULCI_{i,V4})-ln(ULCI_{V4}*)$ through panel tests that identified common and individual unit roots on the basis of absolute or relative convergence. Most tests[5] reinforced the possibility of the countries' absolute convergence to the euro area's weighted average but did not help us to decide whether we should continue to work with individual effects or not.

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2 Pedroni's procedure is based on the Engle & Granger methodology and estimates Model I or II through a parametric or non-parametric approach and tests the stationarity of estimated residuals.

3 Let us consider a VAR model using *p* time delays: $y_t=A_1y_{t-1}+...+A_py_{t-p}+Bx_t+\varepsilon_t$, where y_t is the *k*-vector of non-stationary I(1) variables, x_t is the *d*-vector of deterministic variables and ε_t is the shock vector. We can transcribe VAR as: $\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1}\Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t$, where $\Pi = \sum_{i=1}^{p} A_i - I_i$, $\Gamma_i = -\sum_{j=i+1}^{p} A_j$. Granger's representation sentence postulates that if the coefficient matrix *Π* is of the rank $r<k$, then there exist $k \times r$ matrices, each with a rank *r* so that $\Pi=\alpha\beta'$ and $\beta' y_t$ is I(0). *r* is the number of co-integration relationships and each column from *β* is a co-integration vector. Elements from α are known as adapting parameters in VEC models. The Johansen method estimates the Π matrix from the VAR model without restrictions and tests whether we may reject restrictions arising from the reduced series of the Π matrix (Eviews, Co-integration Testing).

* Adjusted weighted average without any influence of the country observed, (N-i).

4 More information in Table P.B in the appendix.

5 More details in Table P.C in the appendix.

In our comparison, we further used the Pedroni's co-integration test that directly estimated the residuals of Models I and II, both parametrically and non-parametrically. In this case, the test results especially pointed out the individual co-integration process while simultaneously encouraging the possibility of a relative convergence.

We ultimately decided to test the countries individually through strategic co-integration testing as per Engle and Granger and to evaluate the speed and manner of convergence through recursive constants that should approach zero over time provided the estimated coefficient *b* converges to 1.

4.2 Static Co-integration Testing

In static co-integration testing, we simply estimated Model II (in which we included the trend component where necessary) and tested whether we accept the zero hypothesis where $b=1$ using the Wald coefficient test. We further verified the stationarity of the estimated co-integration residuals using the ADF statistic and estimated recursive constants whose chart helped us to evaluate the progress of national ULC indices' convergence to equilibrium over time.

We tried to summarise the results in two tables given in the text. Specifically in Table 2 we can see the confirmation of relative rather than absolute convergence *ln(ULCI)* of all monitored countries towards equilibrium of the euro area. 82 percent of euro area countries had no problem confirming co-integration; in fact, in five cases this was so even when presuming absolute convergence in an ex post evaluation of economic sectors as a whole (TOTAL). SR as well as other V4 countries had problems with co-integration to equilibrium of the weighted average of V4. Significant co-integration with national ULC indices was encouraged especially by the weighted average of the euro area, although only when presuming relative convergence.[6]

Tabel 2 Results of Static Co-integration Testing

Sector BUS	No Co-integr. H0: Unit root*	Absolute Conv. H0: c=0. b=1**	Relative Conv. H0: c≠0. b≠1**	CON	No Co-integr. H0: Unit root*	Absolute Conv. H0: c=0. b=1**	Relative Conv. H0: c≠0. b≠1**
EMÚi / EMÚ	2/11	3/11	6/11	EMÚi / EMÚ	2/11	3/11	6/11
V4i / V4	3/4		1(SK)/4	V4i / V4	1/4		3(SK)/4
V4i / EMÚ			4/4	V4i / EMÚ	1/4		3(SK)/4
IND				**MAN**			
EMÚi / EMÚ	1/11	3/11	7/11	EMÚi / EMÚ	3/11	3/11	5/11
V4i / V4	2/4		2(SK)/4	V4i / V4	1(SK)/4	1/4	2/4
V4i / EMÚ			4/4	V4i / EMÚ	1(SK)/4		3/4
MRS				**TOTAL**			
EMÚi / EMÚ	1/11	4/11	6/11	EMÚi / EMÚ	3/10	5/10	2/10
V4i / V4	3/4		1(SK)/4	V4i / V4	4/4		
V4i / EMÚ	1/4		3(SK)/4	V4i / EMÚ			4/4

Explanatory notes: EMÚi/EMU (or V4i/V4 or V4i/EMU) represents number of individual countries relative to the number of countries observed totally in euro area or V4; Sectors :BUS=business excl. agriculture, IND=industry, MRS=market services, CON=construction, MAN=manufacturing, TOTAL=total economy

* H0 accepted at a p-value > 10% , ADF-statistic, ** H0 accepted at a p-value > 5%

[6] For more detailed tables with results, see the appendix, Table P.D.

Source: Own calculations

Table No. 3 is based on standard deviations of estimated residuals in equation 2 and gives us a picture of the amount of their average value before and after the year 1999. The table data show that euro area countries averagely reduced their deviations from equilibrium relative to the period before the introduction of euro. On average, we are talking about a 47-percent decline within the framework of all sectors (from 0.0378 to 0.0201). We assume a similar phenomenon to happen in SR after 2009. Slovak unit labor costs generally reported a lower spread about the euro area equilibrium in the sectors of enterprise excluding agriculture, market services and economy as a whole relative to the period before 1999. Despite an increase in the variance over time in other sectors, co-integration with the euro area's weighted average was confirmed except for the manufacturing sector which we shall deal with later on.

Table 3 Average Quarterly Standard Deviations from the Equilibrium, σ_I(0), in One Period Estimated Through the Static Model for the Time Periods 90-98 and 99-07

BUS	σ_I(0) 90-98	σ_I(0) 99-07	CON	σ_I(0) 90-98	σ_I(0) 99-07
EMUi_EMU	0.0378	0.0204	EMUi_EMU	0.0774	0.0369
SK_V4	0.088	0.0915	SK_V4	0.1427	0.1323
SK_EMÚ	0.0711	0.0577	SK_EMÚ	0.1054	0.113
IND			**MAN**		
EMUi_EMU	0.0339	0.0243	EMUi_EMU	0.0445	0.0328
SK_V4	0.0425	0.0543	SK_V4	0.021	0.0611
SK_EMÚ	0.0493	0.0684	SK_EMÚ	0.0239	0.0618
MRS			**TOTAL**		
EMUi_EMU	0.0413	0.0221	EMUi_EMU	0.0378	0.0201
SK_V4	0.0986	0.1341	SK_V4	0.0632	0.0715
SK_EMÚ	0.0912	0.0565	SK_EMÚ	0.0602	0.0442

Explanatory Notes: EMUi represents individual countries and EMU (or V4) the weighted average of the euro area (or V4) adjusted for the impact of the country observed, (N-i); Sectors : Sectors :BUS=business excl. agriculture, IND=industry, MRS=market services, CON=construction, MAN=manufacturing, TOTAL=total economy
Source: Own calculations

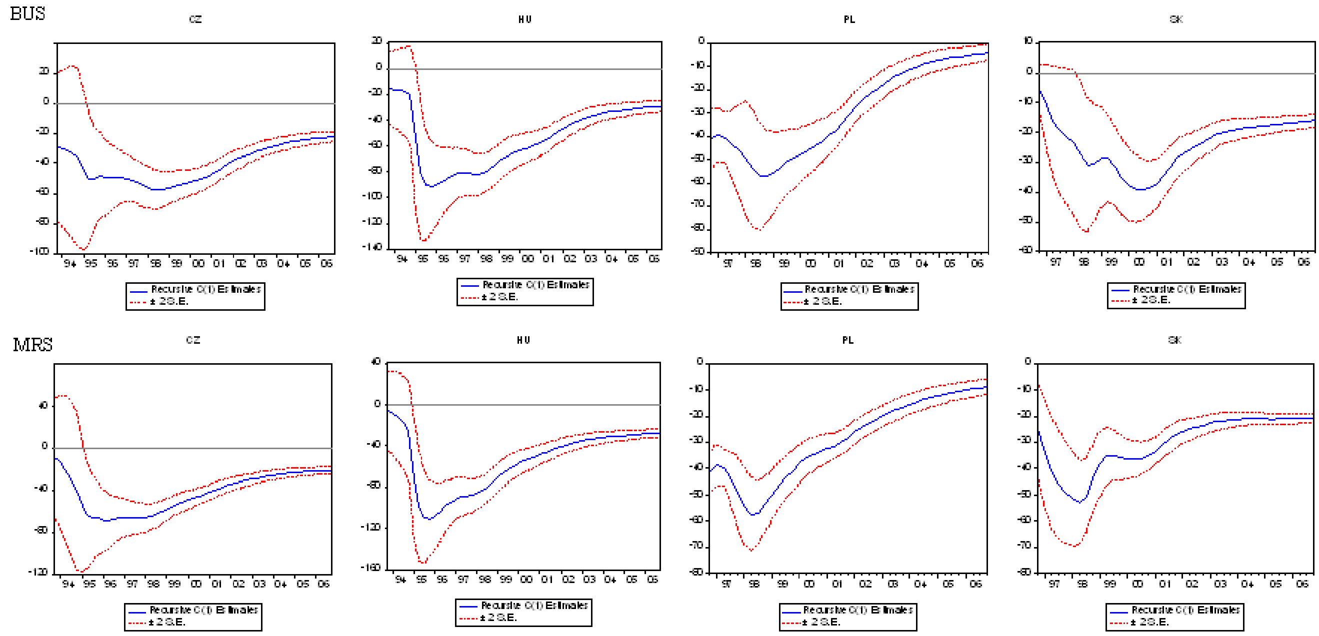
Business Sector Excluding Agriculture

When considering the individual sectors, unit labor costs of the business sector excluding agriculture within the euro area reported relative rather than absolute convergence. Italy and Ireland were two out of eleven countries that in the static test did not confirm any co-integration at all. Both countries mostly registered lower increments of unit labor costs compared to the euro area prior to the introduction of euro. The quarterly ULCI growth of the weighted average of the euro area countries was every period faster by 0.25 percent (-0.25 %) in relation to the unit labor costs growth of the above mentioned countries.[7] After 1998 the situation in this sector has deteriorated and both countries lost their favourable position of a competitive sector and their ULC started to grow faster relative to the euro area average by

[7] For a table with average roots of quadratic co-integration residuals and average speed spread ratios between individual countries and the EMU or V4 average before and after the introduction of euro for the entire economic sector, see the appendix, Table P.E.

0.28 percent (+0.28 %). We assume that this was caused by the efficient management of labor costs in Germany[8] after the introduction of euro due to its ULC, which has started do grow slower in comparison to the EMU in average by 0.59 percent (-0.59 %) per quarter, creating competitive pressure within the euro area including these two countries. If co-integration through the VEC model is not confirmed, it will pose a problem for Italy and Ireland due to their overall increasing current account deficit[9] and appreciating exchange rate through higher costs of real output produced in the given sector against their foreign partners within the euro area, further putting their position in European markets at a disadvantage.

Chart 2 Estimated Recursive Constants (*c*) for Individual Countries (CZ, HU, PL, SK); **Business Sector Excluding Agriculture and Market Services Sector**



Source: Own calculations

In the case of Slovakia and other V4 countries, the situation in the business sector excluding agriculture currently remains favourable. All of these countries try to converge to the euro area's weighted average, still distant from equilibrium but proceeding to the right values. When comparing the dynamics of the estimated recursive constants with smaller sectors of the V4 countries and the euro area average using a static model, we have found that the direction and speed of convergence are most probably indicated by ULC indices in the **market services sector**, as shown in Chart 2. That is to say, we observed the influence on the dynamics of convergence to the euro area equilibrium precisely through the above market services sector. Slovak as well as Czech and Hungarian ULC indices confirmed co-integration with the euro area's weighted average and SR even with the average of the V4 itself. The chart

[8] This country focuses its policy mainly on its favourable position in their exporting ability and in foreign demand for their domestic products. After the introduction of euro, it benefited from an above-average decline in unit labor costs in all sectors through higher productivity and profitability. They managed to decrease their wage burden by implementing a so-called “economic tax” in 1999, proceeds from which went to pensions. This subsequently enabled them to decrease pension insurance payments from 2003 onwards. (Gabrisch H., 2007)

[9] More details on current accounts are to be found in the appendix, Chart P.1 .

with recursive constants [10] suggests that Poland, although it failed to confirm co-integration in the market services sector, is trying to achieve absolute convergence together with the remaining V4 countries[11].

Hence we registered only relative convergence in the business sector excluding agriculture. A positive finding for SR is that this sector recorded the lowest estimated standard deviation from equilibrium compared to other V4 countries and that the dynamism of this deviation has a downward tendency. Furthermore, our findings suggest that the development of unit labor costs in the non-tradable sector will condition precisely the ability to converge to euro area equilibrium values. We shall deal with the market services sector later on.

Manufacturing Sector

When identifying the monitored country's competitiveness against its euro area trading partners, one of the important things is to observe the dynamism of unit labor costs in a tradable sector such as the manufacturing sector[12]. This economic unit generates increase or decrease in the current account deficit because where the production costs of a domestic product exceed foreign costs (which, of course, manifests in the price relations of an identical product), foreign demand for this product decreases and the country loses part of its exports. Actually after the introduction of euro in Slovakia, there will no longer exist any possibility to take advantage of the depreciation of domestic currency and such a above mentioned situation would contribute to an economic slowdown in this country. At the moment, SR capitalizes on effective investments just in this area and still profits in this way owing to the generally slow growth in wages relative to productivity (despite the strengthening of the domestic currency against euro during the period preceding the fixation of the conversion rate). This is the only sector where SR recorded, on average, a slower growth of national ULC in relation to the euro area's weighted average by 0.016 percent (-0.016 %) for the period of 1999-2007. It was interesting to observe that this was the only case where the static model did not confirm co-integration with the euro area equilibrium.

Out of the observed EMU countries, Spain and Italy were those that also showed problems with co-integration. It should be noted here that Spain reported above-average quarterly increments of ULC indices in all sectors regardless of whether this was before or after the introduction of euro. This means that this country had to struggle with a faster growth of the ratio of nominal wages to productivity in relation to the euro area throughout the entire period. Prior to the introduction of euro, this phenomenon was compensated by the weakening of the Spanish currency against the euro during the period from 1992 to 1994 by ca 7.6

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[10] For estimated recursive constants through the static model for the entire economic sector, see Charts P.5 in the appendix.

[11] In the charts, the absolute convergence is understood as the convergence of the recursive constant towards 0. because this is also accompanied by a decrease in the difference between the levels of national and average *ln(ULCI)* over time, which brings us to the equation $y_i = 0 + 1 * x_i$. This means that in such case there is no space for lasting growth differences and the above countries will reduce their spread from equilibrium in case of a shock. When we look for instance at the chart of recursive constants in the appendix (charts P.5) and we consider for example France or the Netherlands, both of them confirmed the possibility of an absolute convergence. Relative convergence means, that the curve of the recursive constant will not significantly converge to zero and will thus remain constantly distant from 0.

[12] Deviations in the growths of nominal ULC indices in the manufacturing sector from the weighted average in the euro area and in V4 countries are shown in Chart P.2 in the appendix.

percent per annum, hence managing to catch up with their trading partners within the euro area. However, the loss of this mechanism and inefficient direction of investments[13] caused their current account deficit to fall to an even more critical level than in 1992, a time preceding close to the consecutive EMU crisis.

Italy, too, made advantage of the flexibility of exchange rates in this period and depreciated the Italian lira against euro during 1992-1995 by as much as ca 8.5 percent per annum. Contrary to Spain, however, the growth in ULC in all sectors in this country was below average prior to the introduction of euro and they recorded balance of trade surpluses, unlike in the subsequent period characterised by a lower growth in productivity and higher growth in wages. Nevertheless, at the moment they cannot avail of the exchange rate mechanism just like other euro area countries, which means that if co-integration is not present, their situation will remain critical if they fail to adjust their wage policy. [14]

Since the static co-integration testing has generally referred to relative convergence, we wanted to know what the results of VEC estimations would be like, based on absolute convergence, whether the possibility of co-integration will be significant at all and, if so, what will be the adjustment speed to shocks in the particular sectors.

4.3 VEC Models with Two Variables

When estimating the dynamic VEC-model, we considered also the significance[15] of data used through co-integration tests that defined the number of significant co-integrations between two endogenous variables. We also took into account the significant use of time lags through a special Wald test that verified their significance in the model which, for individual countries, has the following form:

$$v_t = (y_{t-1} - bx_{t-1})\gamma + \sum_{j=1}^{k} a_j^T v_{t-j} + u_t \quad (3)$$

The following vector entry is given for further clarification:

$$v_t = \begin{pmatrix} \Delta y_t \\ \Delta x_t \end{pmatrix}, \gamma = \begin{pmatrix} -\gamma_y \\ \gamma_x \end{pmatrix}, a = \begin{pmatrix} a_x \\ a_y \end{pmatrix}, u_t = \begin{pmatrix} u_{yt} \\ u_{xt} \end{pmatrix}.$$

When presuming long-term convergence, the co-integration vector, called the β vector in many sources, should have the form of $(1,-1)^T$. As you can see in this case, our co-integration equation is therefore based on absolute convergence, i.e. without using the constant $((1)*y_{t-1}+(-1)*bx_{t-1})$ and where the presumed value of the estimated coefficient b will be oscillating around one, as long as the VEC functions correctly. This means that the difference between y_{t-1} and x_{t-1} equals to zero and in the long run $y_{t-1} = x_{t-1}$, , which represents the minimisation of growth divergences between the observed quantities. The estimated coefficients of vectors a_j

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[13] Investments were directed mainly into the construction sector. However, Spanish unemployment was bound to increase after the slump in the real estate market, both in the construction and market services sectors. (Choyleva D., 2008)

[14] According to information given in the OECD paper (2008), Italy is one of the countries that managed to decrease the tax burden of low income employees, which will gradually enable them to lower the labor costs.

[15] In all tests in the VEC model, we were more rigorous in the evaluation of significance and looked for significance level at 5 percent.

generally define the significance of changes in the growth of applied endogenous variables that, in the past, influenced present growth whereas u_t is the vector of residuals. The number of limited time lags is expressed by the value of k. For our purposes, however, the most important vector of coefficients is γ which determines the adjustment speed towards equilibrium. For instance, γ_y in the estimated model determines the adjustment speed of *ln(ULCI)* of particular countries to shocks in the weighted average of the euro area or V4. The more its absolute value is distant from zero the faster they will be able to adapt to changes in the future and converge back to equilibrium. Where necessary, we also included trend in the model.

We tried to include the above results in the evaluation of the VEC model results as well and we used the following point system for better clarity[16] :

Table 4 Point System

Sector	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Cointegration Points
	Model I ρ_i<0.98	Model II ρ_i<0.98	Model I	Model II	Model I, VEC	max 5
Country i	X	X	XX		X	**5**
	X	X		X	X	**4**
					X	**1**
		X		X		**2R**

*Granger method, **Johansen method
Source: Own calculations

For example, we only considered Pedroni's residual test significant where ρ_i<0.98 and where this was also confirmed by parametric as well as non-parametric tests. We otherwise considered the result insignificant for the probability of the estimated residuals' movement towards one and accepted the hypothesis that this is not a linear stationarity.

Moreover, if there was only one occurrence of confirmed co-integration during all tests, we only assigned low importance to the result and considered it less significant. A relative convergence (2R) was estimated only in some cases. We considered this result less significant than in the case of absolute convergence due to the significance of the estimated constant. This, however, will be dealt with in the next chapter.

4.3.1 Business Sector excluding Agriculture

This sector amalgamates most of the tradable and non-tradable sectors and provides us with information on the ability of the main section of economy to converge. According to our results, no euro area country had problems with co-integration in the business sector excluding agriculture, presuming absolute convergence.

[16] For more details see Table P.F. in the appendix.

As you can see in Table 5, the fastest-adapting national unit labor costs within the euro area were in countries such as Portugal (-0.25), Austria (-0.21), Belgium (-0.13) and Finland (-0.13). What does this mean? Let us suppose there is a one standard deviation shock in the coming quarter or year and the level of *ln(ULCI)* in the above countries diverges from the euro area's weighted average. Then it takes approximately 8 years to regain equilibrium. This estimation is especially important for Portugal which is struggling with above-average growths in unit labor costs. Spain, France, Luxemburg and the Netherlands had difficulty achieving absolute convergence in a 17-year horizon after a shock and although they were able to reduce deviations from equilibrium over time thanks to confirmed co-integration, they were not as efficient as their four neighbours mentioned above.

Table 5 Business Sector Excluding Agriculture

	Cointegration	Significance level at 5%				Cointegration	Significance level at 5%		
(y, x)	Points : max 5	γ_y	γ_x	b	(y, x)	Points : max 5	γ_y	γ_x	b
AT_€	4	-0.212076		1.02	CZ_V4	1		0.13847	0.88
BE_€	4	-0.134876		1.00	HU_V4	1		0.078602	0.85
ES_€	3		0.059231	0.95	PL_V4	2	-0.140458		1.18
FI_€	3	-0.130085	0.104676	1.02	SK_V4	3	-0.066673		1.05
FR_€	5		-0.062171	1.02	CZ_€	3	-0.102336		1.03
GE_€	3	-0.041329		1.05	HU_€	4			
IE_€	3		0.05504	0.98	PL_€	4	-0.056873		1.11
IT_€	3		0.029401	0.97	SK_€	4	-0.034537		1.04
LU_€	4	0.014946	0.008902	0.91					
NL_€	5		0.092698	0.97					
PT_€	3	-0.252095	-0.07794	0.97					

Explanatory notes: € (or V4) represents weighted average of euro area (or V4) countries adjusted for the impact of country observed
Source: Own calculations

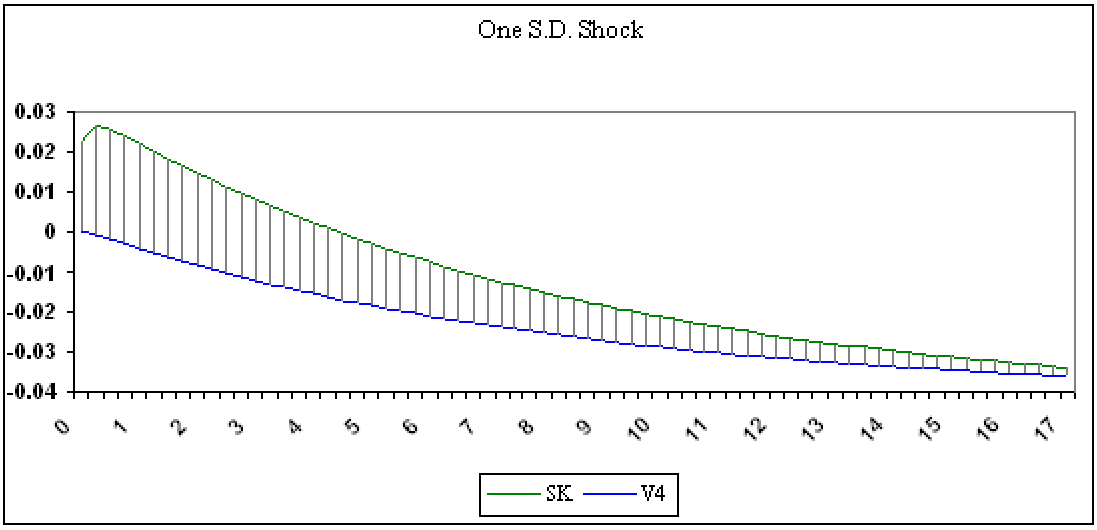
This time, unlike in the static model, the cases of Ireland and Italy confirmed the significance of co-integration through the VEC model and γ_x came out as a significant adjustment speed. This means that in order to re-establish equilibrium after a shock, an average euro area country converges to the ULCI dynamics of Italy or Ireland faster than the other way round.

The estimated co-integration coefficient *b* generally oscillated about one, confirming the possibility of absolute convergence. The greatest deviation from this value may be observed in estimations with the weighted average of V4 countries, namely in the Czech Republic, Hungary and Poland.

In estimations for SR, the co-integration of national *ln(ULCI)* with weighted average was significant in both cases. The adjustment speed was significant in our estimations both towards the weighted average of V4 (-0.0667) or the euro area (-0.0345) and not reversely. For better clarification, we have included charts that describe response of Slovak *ln(ULCI)* and the averages themselves to shocks in either one or the other variable. This shock is defined through an increase in the estimated standard deviation from equilibrium by one unit that may be caused, for instance, by an increase in the growth in ULC indices of one of the variables above their equilibrium value in the first quarter of the virtual year zero ("0:Q1"). More specifically, this defines the reaction of unit labor costs of SR and of the weighted average in V4 to a change in e.g. Slovak *ln(ULCI)* with their value increased by +0.022 in 0:Q1, at a time when the average V4 country is still unable to react to the change that caused the one standard deviation from equilibrium. Chart 3 on the other page gives us more details on this convergence.

The chart clearly shows that the dynamism of logarithmed ULCI of SR tends to converge to equilibrium over time and the spread caused is reduced. This means that the differences in growths decrease over time as well but in this case we can see it is a lengthy process.

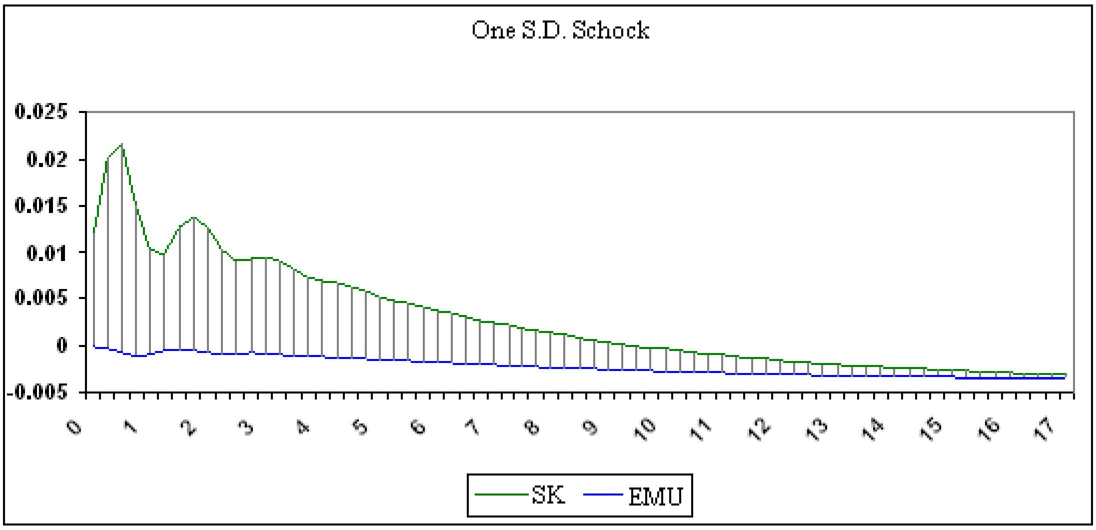
Chart 3 Responses of Variables *x (SK)* and *y (V4)* to a Shock in Slovak ULC (+0.022)



Source: Own calculations

What would happen if our ULC indices in the business sector move away from the weighted average of the euro area? In other words what happens, if e.g. wages start to grow faster than production in comparison to EMU countries? This would cause an increase in the standard deviation over time in 0:Q1 above its equilibrium value. With no convergence towards equilibrium in the long run, this would mean a fall in the given sector's competitiveness. In our case, when talking about an increase in the standard deviation from equilibrium caused by a shock through growth in Slovak *ln(ULCI)*, it means that their level increased by +0.012. The following chart shows what this looks like.

Chart 4 Responses of Variables x *(SK)* and y *(EMU)* to a Shock in Slovak ULC (+0.012)



Source: Own calculations

Here we can observe notable fluctuations during the first three years after the given shock and in this case we should pay special attention to the index increasing away from equilibrium, which may create pressures on the growth of inflation in the given periods. From the fourth year onwards there is a smooth convergence towards slightly changed *ln(ULCI)* levels in the weighted average of the euro area and we can confirm co-integration in this case as well.

4.3.2 Market Services Sector

This sector is important where it influences fluctuations from the trend in the growth in consumer prices and although it comprises only around 25 percent of the consumer basket, it constitutes the main source of divergences from the euro area average. For catching-up countries such as Slovakia this means that the increase in wages in the industrial sector caused by its higher productivity will bring about an increase in wages in the non-tradable sector as well but leaving production unchanged, effecting higher growth in the prices of provided products while simultaneously striving to prevent the outflow of qualified labor to foreign countries. As we know, the PPP concept does not apply to the market services sector and therefore we must keep check on a fast growth in ULC indices lest they create an excessive pressure on the growth in CPI, as well as to try to dispose of labor costs effectively. That is to say that the inability to converge to average levels of the euro area will cause a lasting difference in dynamics not only in the ULC but also, as we have mentioned, in the growth in consumer prices itself.

We can see in Table 6 that no euro area country had a problem confirming co-integration when presuming absolute convergence and that the deviation of the co-integration coefficient from one was minimal. When we consider the adjustment speed to the euro area's weighted average, Finland (-0.400), France (-0.264) and again Portugal (-0.257) were the fastest to adapt to shocks from among the EMU countries. When we defined a shock over time in 0:Q1, which increased the standard deviation by one unit, these countries were able to eliminate the given shock within 5 years. Other countries, on average, were able to deal with the shock after 12 years when equilibrium was re-established.

Table 6 Market Services Sector

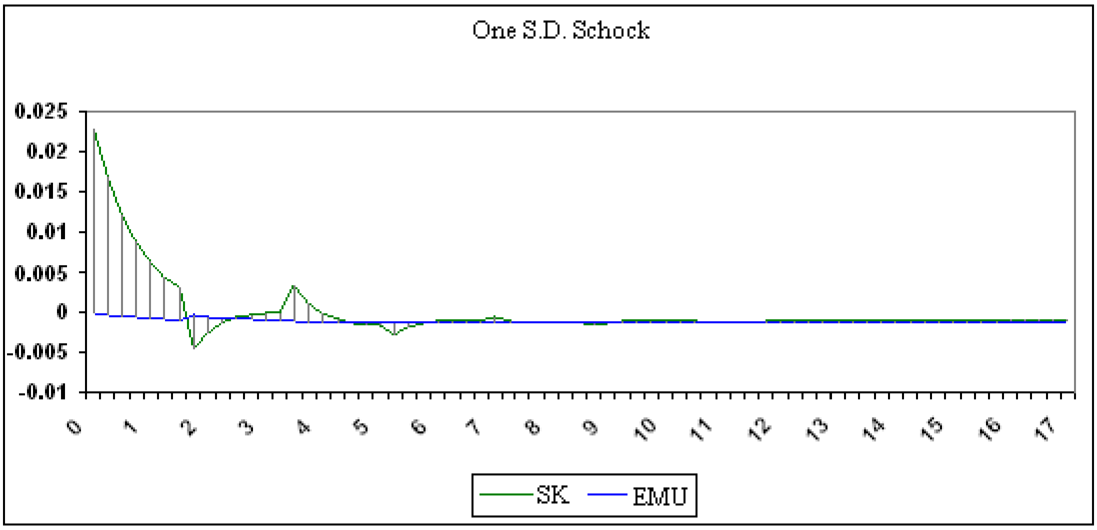
(y, x)	Cointegration Points : max 5	Significance level at 5% γ_y	γ_x	b	(y, x)	Cointegration Points : max 5	Significance level at 5% γ_y	γ_x	b
AT_€	**5**	-0.133169		1.01	**CZ_V4**	**1**	0.059059	0.112953	0.87
BE_€	**5**	-0.108992		1.00	**HU_V4**	**1**		0.080855	0.81
ES_€	**3**		0.025162	0.94	**PL_V4**	**2**	-0.097091	-0.044855	1.20
FI_€	**2**	-0.400064	0.054144	1.00	**SK_V4**	**3**		0.167444	0.81
FR_€	**5**	-0.263764		1.00	**CZ_€**	**2R**			
GE_€	**3**	-0.0741		1.04	**HU_€**	**3**			
IE_€	**3**	-0.127028		0.97	**PL_€**	**3**	-0.057265		1.17
IT_€	**4**		0.034293	0.98	**SK_€**	**3**	-0.264107	-0.012914	0.87
LU_€	**5**	-0.089768	-0.034854	1.00					
NL_€	**4**	-0.0242	-0.022104	1.02					
PT_€	**3**	-0.25753	-0.078943	0.98					

Explanatory notes: € (or V4) represents weighted average of euro area (or V4) countries adjusted for the impact of country observed

Source: Own calculations

In the case of Slovakia we were chiefly interested in the co-integration with the dynamism of euro area unit labor costs, where the adjustment speed (γ_y) of SR towards equilibrium attained the level of as much as -0.264. If co-integration were not confirmed, this would cause lasting differences of Slovak ULC from the euro area, which could influence also the diversion of growth of consumer prices in SR from the EMU average as well. As observed by Hüfner and Koske in their 2008 paper, the existing creation of inflation in Slovakia has been influenced mainly by a higher consumer demand owing to higher income together with an increased interest in better-quality services. This phenomenon, however, has become stabilized and its impact on SR inflation will be minimal. This adds to the importance of monitoring the development of ULC in this sector as it will become a significant indicator of variability in the dynamisms between the inflation in SR and in euro area countries and, because of the already declared stable demand for services offered by the domestic market, prices will be influenced precisely by the catching-up growth in wages in this sector. What will then happen in the case of some shock in the dynamism of *ln(ULCI)* away from equilibrium and Slovak wages will start to grow faster than productivity compared to euro area countries? Chart 5 gives us the answer.

Chart 5 Responses of Variables x *(SK)* and y *(EMU)* to a Shock in Slovak ULC (+0.023)



Source: Own calculations

It shows a cyclic adaptation of the Slovak unit labor costs back to equilibrium, gradually losing its value over time. Similarly as in the above three euro area countries, there is full convergence to equilibrium values after the fifth year. This sector was the only one that recorded the fastest ability to adapt to caused shocks but we still have to be aware of its excessive fluctuations in the positive values of growth differentials.

4.3.3 Manufacturing Sector

As we have mentioned, the differences in the dynamisms of ULC of the manufacturing sector from the euro area are important in view of the assessment of Slovak exporting ability as the three chief importers of Slovak products are within the EMU (Italy, Austria and Germany). Since this is a tradable sector, the development of ULC in the given sector should not have an impact on the real exchange rate through pressure on a faster growth in consumer prices than in the euro area, when presuming PPP[17].

As you can see in Table 7, the adaptation speed within the euro area did not achieve the levels attained in the previous non-tradable sector. Although Belgium and Luxemburg did not confirm co-integration through the VEC model, this precondition was fulfilled through other tests. Hence we can say that all euro area countries were successful and even in this case there is no space for a possibility of a long-term divergence. In our analysis of the response to

[17] In spite of that, Oomes N. (2004) found that real appreciation based on producer prices in the processing industry in SR and in the euro area is similar to real appreciation based on CPI. This means that the appreciation of the real exchange rate cannot be explained solely through the Balassa-Samuelson hypothesis. That is to say that despite the influence of a faster growth in prices in the non-tradable sector in SR compared to the euro area, inflation may also be influenced by minute deviations in the growth in tradable sector prices as this comprises as much as 39% of the CPI. The partial non-validity of PPP in the Slovak tradable sector could be explained by the following possible reasons: 1) it may contain significant non-tradable components that contribute to incomplete competition, 2) it includes higher prices of home-made tradable products with improved quality, reputation and marketing.

shocks we found that Finland was more effective than the fastest-adapting Portugal (after 6 years) and was able to eliminate the deviations from equilibrium after only five years following the shock in 0:Q1. Other euro area countries managed to do that on average after 9 year period. We can observe that Finland confirmed the significance of γ_x (0.037), which means that the euro area average will adapt to this country rather than the other way round. Despite a slow adjustment speed we can observe that the equilibrium may be achieved with adequate speed and efficiency.

Table 7 Manufacturing Sector

(y, x)	Cointegration Points: max 5	Significance level at 5% γ_y	γ_x	b
AT_€	3	-0.126225		1.04
BE_€	4			
ES_€	2	-0.094752	0.047001	0.95
FI_€	4		0.037298	1.04
FR_€	3	-0.040083		1.01
GE_€	3	-0.040057		1.04
IE_€	4	-0.020531		0.93
IT_€	2	-0.053312	0.026506	0.94
LU_€	3			
NL_€	5		0.127673	1.00
PT_€	4	-0.21636		0.97

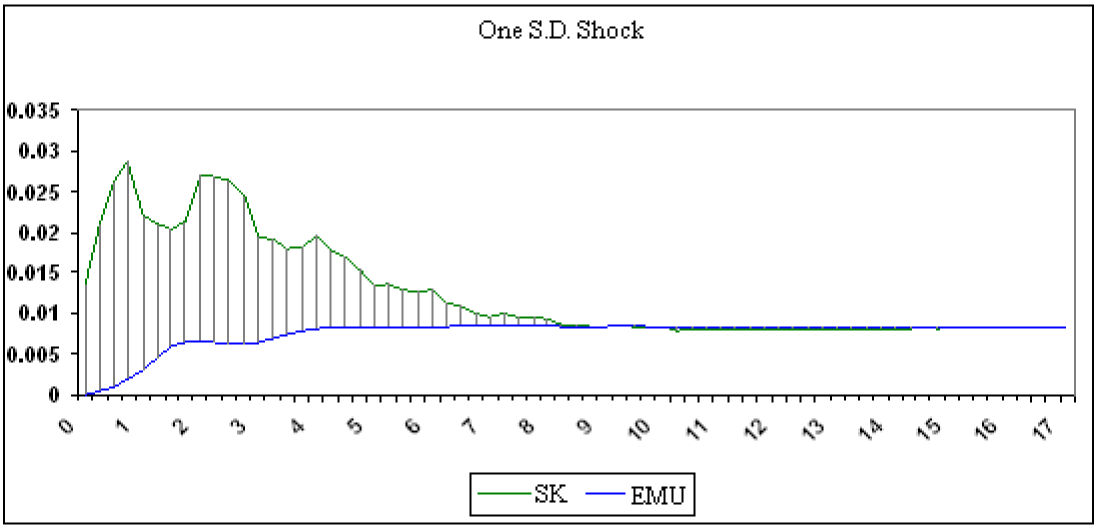
(y, x)	Cointegration Points : max 5	Significance level at 5% γ_y	γ_x	b
CZ_V4	2R			
HU_V4	4	-0.060645		1.03
PL_V4	3			
SK_V4	2			
CZ_€	4	-0.115913		0.96
HU_€	4	-0.119464		0.94
PL_€	3	-0.069224		1.09
SK_€	3		0.016655	1.00

Explanatory notes: € (or V4) represents weighted average of euro area (or V4) countries adjusted for the impact of country observed

Source: Own calculations

SR recorded a situation similar to that in Finland. Although the significance of γ_x was confirmed at a level of mere 0.017, we registered a swift reaction to shock in the co-integration with weighted average of the euro area, as you can see in Chart 6.

Chart 6 Responses of Variables x *(SK)* and y *(EMU)* to a Shock in Slovak ULC (+0.014)



Source: Own calculations

We can observe that the curve of *ln(ULCI)* in the euro area attempts to catch up with a new level of *ln(ULCI)* in SR and, after 8 years after a shock, it attained its goal. Austria and Spain from among the euro area countries achieved a similar result as SR despite a higher absolute value of the adjustment speed, regardless of whether this was towards the weighted average of the euro area or reversely.

4.3.4 Total economy

Unit labor costs of the entire economy[18] give an overview of the efficiency of a given country's economic management. A more effective economic management brings with it lower ULC. In the case of lasting differences between dynamics with the weighted average of, say, the euro area, an overall effective or ineffective economic management in the long run is one of the causes of deepening differences between countries, advantages or disadvantages on the basis of competitiveness, and encourages lasting fluctuations from equilibrium in both the ULCI and the CPI.

Table 8 Total Economy

(y, x)	Cointegration Points : max 5	Significance level at 5% γ_y	γ_x	b	(y, x)	Cointegration Points : max 5	Significance level at 5% γ_y	γ_x	b
AT_€	4		0.006927	1.02	CZ_V4	1	-0.013117		0.87
BE_€	4	-0.099474		1.00	HU_V4	3	-0.018912		0.83
ES_€	4	-0.011022		0.96	PL_V4	2	-0.036997		1.17
FI_€	1	-0.039162	0.020257	0.99	SK_V4	2	-0.017719		0.90
FR_€	5	-0.015546	0.048531	1.00	CZ_€	3	-0.019111		1.03
GE_€	2		-0.006856	1.04	HU_€	4	-0.008693		0.90
IE_€	2	0.04389		0.97	PL_€	4	-0.033691		1.08
IT_€	5		-0.004104	0.98	SK_€	2	-0.009983		1.00
LU_€	3	0.009238	0.002882	0.99					
NL_€	4	-0.004201	-0.001999	0.98					

Explanatory notes: € (or V4) represents weighted average of euro area (or V4) countries adjusted for the impact of country observed

Source: Own calculations

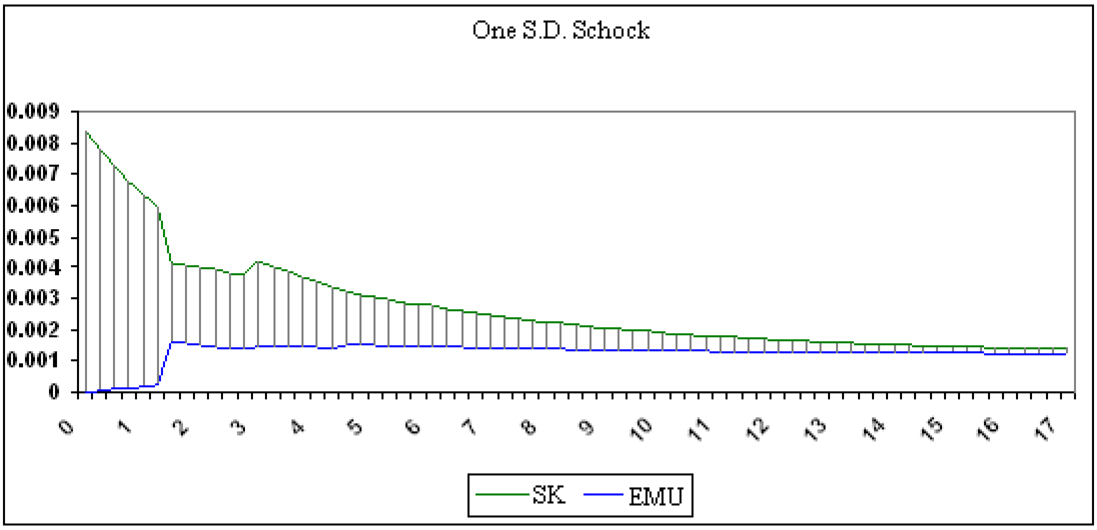
As we can see in Table 8, the adjustment speed generally decreased compared to other sectors. On average, however, *ln(ULCI)* in this sector managed to converge absolutely within 11 years after the simulated shock despite a slower adjustment speed. Co-integration coefficients again oscillated close to one.

Slovakia confirmed co-integration in both cases. We can see that the adjustment speed of all V4 countries was confirmed as proceeding towards the weighted average and not away from it. What will it mean, then, if labor costs in SR grow faster than in the euro area? Chart 7, which gave us a picture of the reaction of the level of *ln(ULCI)* in the EMU to a simulated shock in the *ln(ULCI) of SR* that increased their level by +0.008, shows that SR is trying to converge to EMU levels. As we see, however, the process is lengthy although we can also observe that by the end of the period monitored the spread from equilibrium and consequently

[18] For results of the two sectors that we have not mentioned, see the appendix, Table P.G.

also the differences in growths were minimised. Again, as in all other sectors, the possibility of co-integration with weighted average of the euro area has been confirmed.

Chart 7 Responses of Variables *x (SK)* and *y (EMU)* to a Shock in Slovak ULC (+0.008)



Source: Own calculations

5 Conclusion

Our main objective was to find if and how unit labor costs of particular euro area countries and SR converge to the weighted average of EMU countries monitored. We used various types of tests and examined absolute as well as relative convergence. An important finding was that co-integration between logarithmed ULC indices monitored was confirmed even when presuming absolute convergence. This means that if the future ULC dynamics will proceed from its ex post development and if nothing unexpected happens, we do not have to worry about lasting divergences in the long run from the viewpoint of euro area countries or SR. Our estimations also indicate that Slovak ULC indices created the lowest deviation from the euro area equilibrium for the monitored period compared to other V4 countries, in all economic sectors with the exception of the construction sector. Another positive finding was that the converging unit labor costs of euro area countries on average moderated the estimated deviation from the equilibrium, relative to the period before 1999, by 47 percent within all sectors. We estimate that a similar phenomenon could be observed in SR as well after the introduction of a common currency with the euro area.

The adoption of euro in 2009 will put SR into a new area with all the limitations implied by a single currency. Ungerman and Pick (2004) defined this "trap" of a single currency through a triple encirclement. First, such a country cannot afford to keep the wages too low because then people will leave it to find better-paid jobs in neighbouring countries. Second, in the long run its growth rate of wages may not remain higher than that of productivity because the production in such a country becomes more expensive, causing labor costs become higher than those of the competition, whereas productivity cannot be increased instantly. Third, the country is no longer able to compensate its higher costs by depreciating the domestic currency as it has lost this mechanism due to the common currency.

The maintenance of Slovak economy's competitiveness against the euro area is the most crucial criterion of its successful economic progress. At the moment, SR benefits from a faster growth of productivity owing to the effective direction of investments in the industrial sector where it can still avail of a faster growth in wages as this does not encourage inflation. The June update of the macroeconomic forecast of the Slovak Ministry of Finance for the years 2008 to 2011 even predicts that although the average wage will catch up with productivity in the future, its growth rate should not get faster.

In spite of the confirmation of the co-integration of Slovak ULC with weighted average of the euro area and a positive prediction of an effective growth of the given indicator, we have to be aware of a long- or medium-term divergence from equilibrium which we have not considered, especially in the case of higher unit labor costs in our country. We must avoid the situation where foreign investments, due to a possibly lower attractiveness of the industrial sector in the future, will be directed predominantly into the construction sector whose seven percent of GDP do not allow it to encourage overall productivity and help improve competitiveness while there is growth in wages in other sectors. A current warning example is that of Spain as the country is suffering due to structural unemployment, faces incessant pressures and struggles with an ever-appreciating real exchange rate.

Along with Spain, other three southern euro area countries (Greece, Portugal and Italy) also thought that they would converge faster towards competing countries after the introduction of euro and hoped that their productivity would increase - this, however, remained at low levels. One of these countries is Portugal which, on one hand, confirmed co-integration within *ln(ULCI)* with the euro area in the long run, but at the moment reports the lowest competitiveness since the 1980's. Our paper evaluated this country as adapting the fastest to possible shocks causing the deviation of the dynamics of *ln(ULCI)* from equilibrium. By this "fast" process of adapting to new conditions we mean a period lasting at least six years. Olivier Blanchard (2006) who examined the case of Portugal sees the solution in dismissing people which will cause a lower nominal growth in wages until there is a decrease in the overall ULC relative to the euro area average and a boost to the demand and production. However, we may expect this to be a long and difficult process. Here it should be noted that the larger the nominal or real rigidities, the more unemployed people are necessary for regaining the lost competitiveness.

Although our research did not discover any notable problems of SR that could hamper our co-integration with the weighted average of the euro area, we must not ease our efforts in this area and must maintain this position especially after the introduction of euro as even a medium-term divergence, as we could see here, brings about real economic costs such as under- or overvalued investments, slower economic growth, or increased structural unemployment.

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Appendix

Table P.A: **Industrial Classification**

International Standard Industrial Classification of All Economic Activities

Category	Sector
A:	Agriculture, hunting and related service activities
B:	Fishing
C:	Mining and quarrying
D:	Manufacturing
E:	Electricity, gas and water supply
F:	Construction
G:	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H:	Hotels and restaurants
I:	Transport, storage and communications
J:	Financial intermediation
K:	Real estate, renting and business activities
L:	Public administration and defence; compulsory social security
M:	Education
N:	Health and social work
O:	Other community, social and personal service activities
P:	Private households with employed persons
Q:	Extra-territorial organizations and bodies

Source : United Nation Publication (St/ESA/STAT/SER.M/4/Rev.3),sales No.E.90XVII.11.

	Sectors, OECD Classification
C-K	Business excluding agriculture; BUS
F	Construction; CON
C-E	Industry; IND
D	Manufacturing; MAN
G-K	Market services; MRS

Table P.B: **Panel Unit Root Tests**

ln(ULCI) Panel Unit Root Tests, *y*

Area:	Sector	Test	I(0)	I(1)	I(2)
EURO AREA	Business excl. agriculture	Levin,Lin & Chu	1,00	1.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Construction	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Industry	Levin,Lin & Chu	0.84	0.00	0.00
		ADF-Fisher Chi-square	0.02	0.00	0.00
		PP-Fisher Chi-square	0.10	0.00	0.00
	Manufacturing	Levin,Lin & Chu	0.87	0.00	0.00
		ADF-Fisher Chi-square	0.36	0.00	0.00
		PP-Fisher Chi-square	0.73	0.00	0.00
	Market services	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Total economy	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
V4	Business excl. agriculture	Levin,Lin & Chu	1,00	1.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Construction	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Industry	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Manufacturing	Levin,Lin & Chu	0.99	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.00	0.00
	Market services	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.01	0.00
	Total economy	Levin,Lin & Chu	1.00	0.00	0.00
		ADF-Fisher Chi-square	1.00	0.00	0.00
		PP-Fisher Chi-square	1.00	0.09	0.00

If p-value > 0.05 H0 accepted, H0: variable is not stationary

Source: Own calculations

Common Unit Root test:
Levin, Lin, Chu
Individual Unit Root test:
Fisher ADF, Fisher PP

Table P.C: **Panel Unit Root Tests**

Differentials ln(ULCI), Panel Unit Root Tests

		Relative convergence				Absolute convergence			
		$x_{€} - y_{€}$	$x_{V4} - y_{V4}$	$x_{V4} - y_{€}$		$x_{€} - y_{€}$	$x_{V4} - y_{V4}$	$x_{V4} - y_{€}$	
BUS	*Breitung*	0.296	0.835	0.997	*Levin,Lin,Chu*	0.002	0.737	0.000	ρ=ρi
	Im,Pesaran,Shin	0.01	0.428	0.731	*ADF-Fisher Chi-square*	0.014	0.900	0.000	ρi
					PP-Fisher Chi-square	0.000	0.960	0.000	ρi
CON	*Breitung*	0.979	1	0.728	*Levin,Lin,Chu*	0.002	0.101	0.000	ρ=ρi
	Im,Pesaran,Shin	0.299	0.565	0.1	*ADF-Fisher Chi-square*	0.042	0.025	0.004	ρi
					PP-Fisher Chi-square	0.038	0.000	0.000	ρi
IND	*Breitung*	0.532	0.113	0.932	*Levin,Lin,Chu*	0.000	0.622	0.000	ρ=ρi
	Im,Pesaran,Shin	0.021	0.346	0.651	*ADF-Fisher Chi-square*	0.000	0.282	0.000	ρi
					PP-Fisher Chi-square	0.000	0.560	0.000	ρi
MAN	*Breitung*	0.95	0.239	0.907	*Levin,Lin,Chu*	0.000	0.624	0.000	ρ=ρi
	Im,Pesaran,Shin	0.685	0.464	0.366	*ADF-Fisher Chi-square*	0.000	0.518	0.000	ρi
					PP-Fisher Chi-square	0.000	0.684	0.000	ρi
MRS	*Breitung*	0.009	0.743	0.998	*Levin,Lin,Chu*	0.000	0.382	0.000	ρ=ρi
	Im,Pesaran,Shin	0.029	0.701	0.356	*ADF-Fisher Chi-square*	0.000	0.856	0.000	ρi
					PP-Fisher Chi-square	0.000	0.974	0.000	ρi
TOTAL	*Breitung*	0.296	0.835	0.997	*Levin,Lin,Chu*	0.002	0.737	0.000	ρ=ρi
	Im,Pesaran,Shin	0.01	0.428	0.731	*ADF-Fisher Chi-square*	0.014	0.900	0.000	ρi
					PP-Fisher Chi-square	0.000	0.960	0.000	ρi

If p-value > 0.05 H0 accepted, H0: variable is not stationary
Source: Own calculations

Common Unit Root Tests
Levin, Lin, Chu: excl. individual effects, NW-BW,BK,SIC-Lag
Breitung: individual effects + individual trends, SIC-Lag
Individual Unit Root Tests
Im, Pesaran, Shin: individual effects incl. or excl. trend, SIC-Lag
Fisher ADF: excl. individual effects, SIC-Lag
Fisher PP: excl. individual effects, NW-BW,BK

NW-BW...Newey-West Bandwidth Selection, BK...Barlett Kernel Method, SIC-Lag...Schwarz Identification Criterion Lag Selection

Table P.D: **Static Co-integration Test Results**

Tab. P.D.1: Sector BUS

Static Co-integration Test Results, Engle and Granger Method (1987)

(y, x)	t-stat. (ADF)	p-value	c	H0: c = 0	b	H0: b = 1
AT_€	-1.9575	0.0487	-1.7336	0.0743	1.4005	0.0596
BE_€	-2.1355	0.0324	-0.7233	0.0041	1.1556	0.0032
ES_€	-2.7695	0.0064	-4.7739	0.0000	2.0304	0.0000
FI_€	-3.7806	0.0250	14.5779	0.0000	-2.2059	0.0000
FR_€	-2.8812	0.0046	-0.0896	0.3928	1.0217	0.3396
GE_€	-3.9547	0.0002	8.6283	0.0000	-0.9138	0.0000
IR_€	-1.5714	0.1084	-0.1703	0.6283	1.0338	0.6577
IT_€	-1.3224	0.1703	0.0679	0.9045	0.9916	0.9454
LX_€	-2.6708	0.0083	-2.1327	0.0000	1.4622	0.0000
NL_€	-2.7177	0.0074	-0.1199	0.8619	1.0117	0.9390
PT_€	-2.5933	0.0102	-7.3463	0.0000	2.5882	0.0000
CZ_V4	-0.3503	0.5535	-0.6828	0.1358	1.1723	0.0824
HU_V4	-0.7911	0.3682	-0.1349	0.8183	1.0552	0.6663
PL_V4	-1.3959	0.1493	2.1077	0.0000	0.5223	0.0000
SK_V4	-1.7049	0.0833	-1.4082	0.0020	1.3120	0.0009
CZ_€	-2.9770	0.0036	-22.2102	0.0000	5.7946	0.0000
HU_€	-1.7938	0.0694	-28.9650	0.0000	7.2604	0.0000
PL_€	-1.7506	0.0760	-3.8575	0.0345	1.8122	0.0339
SK_€	-1.8907	0.0566	-16.0767	0.0000	4.4643	0.0000

Significant if p-value < 0.10
Source: Own calculations

Tab. P.D.2: Sector MAN

Static Co-integration Test Results, Engle and Granger Method (1987)

(y, x)	t-stat. (ADF)	p-value	c	H0: c = 0	b	H0: b = 1
AT_€	-2.7974	0.0058	-2.7436	0.0054	1.6321	0.0023
BE_€	-1.9403	0.0506	0.3801	0.5901	0.9227	0.6111
ES_€	0.0295	0.6884	-0.2411	0.9184	1.0456	0.9284
FI_€	-3.0624	0.0027	10.0485	0.0000	-1.1278	0.0000
FR_€	-1.5323	0.1168	1.9981	0.0001	0.5963	0.0000
GE_€	-4.1533	0.0001	7.2565	0.0000	-0.5745	0.0000
IR_€	-1.6668	0.0900	19.7843	0.0000	-3.2712	0.0000
IT_€	-1.0812	0.2503	10.8508	0.0000	-1.3464	0.0000
LX_€	-1.6186	0.0990	1.1996	0.3282	0.7622	0.3690
NL_€	-2.2389	0.0253	-0.0968	0.8324	1.0244	0.8048
PT_€	-1.6599	0.0913	-11.6969	0.0000	3.5222	0.0000
CZ_V4	-2.1574	0.0311	2.2798	0.0000	0.4665	0.0000
HU_V4	-4.6177	0.0000	5.4420	0.0000	-0.2209	0.0000
PL_V4	-1.8100	0.0672	-0.2616	0.7995	1.1071	0.6420
SK_V4	-1.4017	0.1478	2.8545	0.0000	0.3800	0.0000
CZ_€	-3.4903	0.0007	-17.1914	0.0377	4.7076	0.0339
HU_€	-2.1369	0.0324	-20.3471	0.0639	5.3743	0.0604
PL_€	-2.3404	0.0201	19.7063	0.0006	-3.2659	0.0000
SK_€	-1.5763	0.1072	-3.8773	0.2369	1.8108	0.2476

Significant if p-value < 0.10
Source: Own calculations

Tab. P.D.3: Sector MRS

Static Co-integration Test Results, Engle and Granger Method (1987)

(y, x)	t-stat. (ADF)	p-value	c	H0: c = 0	b	H0: b = 1
AT_€	-2.4574	0.0147	-0.1948	0.334	1.0409	0.3486
BE_€	-2.5764	0.0107	1.008	0.3791	0.7583	0.343
ES_€	-2.9881	0.0034	-4.4383	0	1.9548	0
FI_€	-0.7446	0.3894	3.2658	0	0.2941	0
FR_€	-2.6872	0.0079	0.85	0.0789	0.8046	0.0666
GE_€	-2.571	0.0109	2.6923	0	0.4129	0
IR_€	-1.9892	0.0455	-2.9886	0	1.6363	0
IT_€	-1.7481	0.0764	1.1465	0.0018	0.7583	0.0017
LX_€	-2.1271	0.0331	-0.0497	0.965	0.9869	0.9588
NL_€	-2.9923	0.0034	-1.4557	0	1.3167	0
PT_€	-2.7725	0.0063	-4.3366	0	1.9378	0
CZ_V4	-0.9036	0.3197	0.081	0.7863	0.999	0.9874
HU_V4	-0.8829	0.3285	-0.2654	0.5071	1.0861	0.322
PL_V4	-1.3461	0.1629	1.3782	0	0.6835	0
SK_V4	-1.648	0.0933	-2.1333	0	1.474	0
CZ_€	-3.0133	0.0032	-21.47	0	5.6311	0
HU_€	-1.8906	0.0565	-27.5088	0	6.9484	0
PL_€	-1.5401	0.1148	-8.7343	0	2.8703	0
SK_€	-2.4844	0.0141	-20.6545	0	5.4592	0

Significant if p-value < 0.10
Source: Own calculations

Tab. P.D.4: Sector TOTAL

Static Co-integration Test Results, Engle and Granger Method (1987)

(y, x)	t-stat. (ADF)	p-value	c	H0: c = 0	b	H0: b = 1
AT_€	-4.4172	0.0000	-0.8610	0.2370	1.2064	0.1974
BE_€	-2.4996	0.0131	-1.8826	0.0000	1.4063	0.0000
ES_€	-2.3454	0.0196	1.9670	0.1547	0.5445	0.1321
FI_€	-0.9105	0.3176	10.4010	0.0000	-1.2828	0.0000
FR_€	-3.0944	0.0025	-0.0152	0.8924	1.0049	0.8404
GE_€	-1.5523	0.1124	8.0760	0.0000	-0.7887	0.0000
IR_€	-1.2189	0.2020	-3.0594	0.0000	1.6643	0.0000
IT_€	-1.6382	0.0953	0.2066	0.6938	0.9614	0.7341
LX_€	-2.8285	0.0053	-3.4680	0.0000	1.7507	0.0000
NL_€	-2.1184	0.0338	-0.5728	0.4162	1.1060	0.4946
PT_€						
CZ_V4	-0.4906	0.4983	-0.8244	0.0138	1.2010	0.0045
HU_V4	-1.5795	0.1066	-0.5901	0.1913	1.1520	0.1172
PL_V4	-1.1741	0.2162	1.4574	0.0000	0.6652	0.0000
SK_V4	-0.9848	0.2865	-0.4360	0.1288	1.1021	0.0975
CZ_€	-2.6440	0.0090	-22.5578	0.0000	5.8659	0.0000
HU_€	-1.8216	0.0655	-30.1826	0.0000	7.5166	0.0000
PL_€	-2.0127	0.0434	-7.0027	0.0000	2.4942	0.0000
SK_€	-3.1253	0.0025	-13.6896	0.0000	3.9509	0.0000

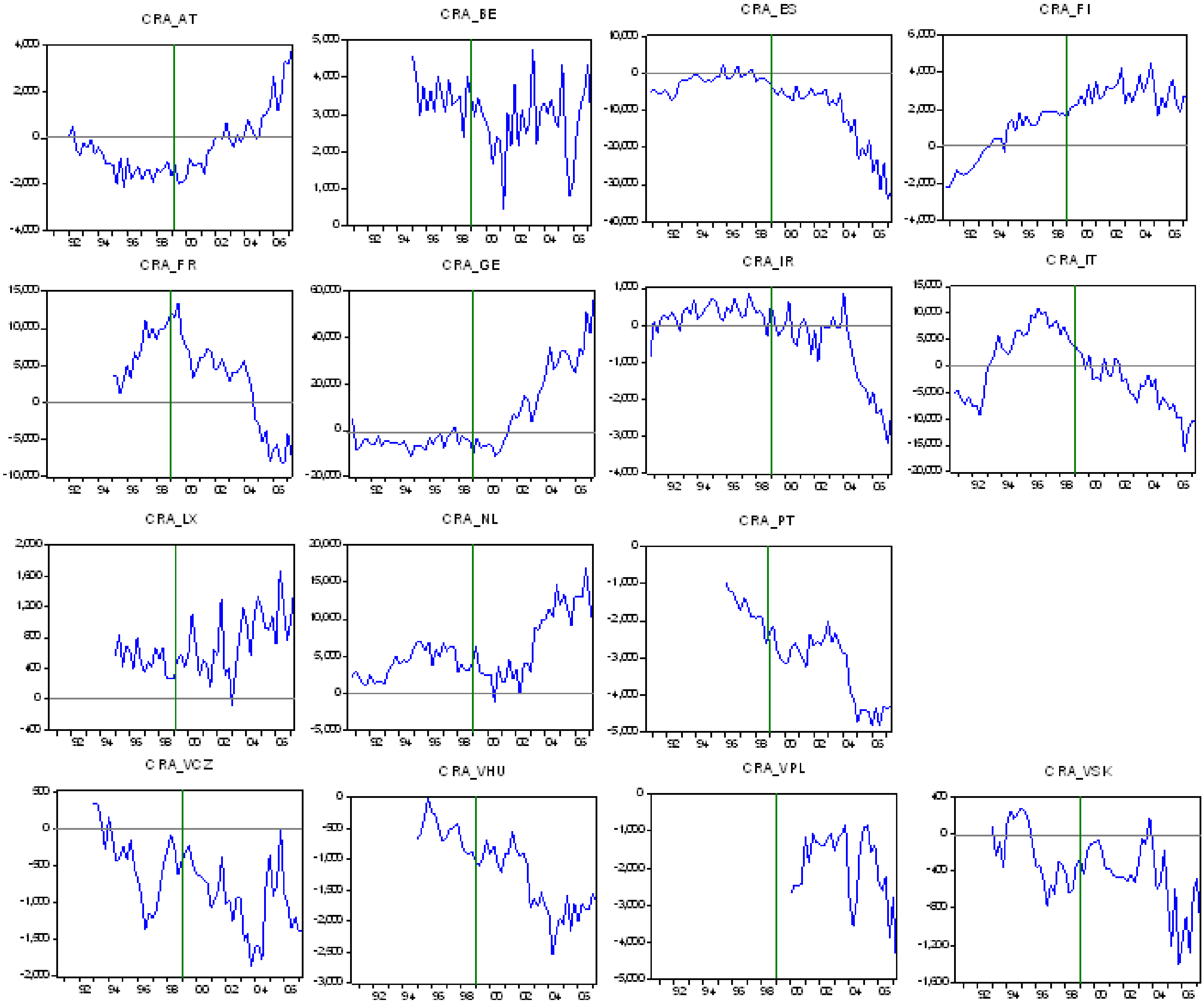
Significant if p-value < 0.10
Source: Own calculations

Table P.E: **Average Quarterly Standard Deviations from the Equilibrium, σ_I(0), in One Period Estimated Through the Static Model for the Time Periods Before and After the Year 1999,** Sector TOTAL

TOTAL	Average quarterly standard deviations 90_98		Average quarterly standard deviations 90_98	
(y, x)	σ_I(0)	μ_I (1)90_98	σ_I(0)	μ_I(1) 99_07
AT_€	0.0233	-0.0384	0.0088	-0.2118
BE_€	0.0339	0.3317	0.017	0.0447
ES_€	0.045	0.1875	0.0154	0.3856
FI_€	0.0696	-0.8155	0.0425	-0.0179
FR_€	0.0138	-0.0887	0.0083	0.0484
GE_€	0.0459	0.2203	0.0141	-0.5081
IR_€	0.0457	-0.1697	0.0318	0.4732
IT_€	0.0641	-0.2276	0.0345	0.2837
LX_€	0.0212	0.1462	0.0109	0.3034
NL_€	0.0155	0.2067	0.0181	0.2119
PT_€	x	x	x	x
CZ_V4	0.0319	0.1131	0.0878	0.6702
HU_V4	0.1219	-1.8873	0.1047	0.9520
PL_V4	0.0578	0.5083	0.0734	-0.8955
SK_V4	0.0632	-1.0333	0.0715	0.7485
CZ_€	0.1792	2.8530	0.1049	0.7687
HU_€	0.2388	3.4480	0.1098	1.3291
PL_€	0.1114	2.4040	0.081	-0.0233
SK_€	0.0602	1.2030	0.0442	0.4881

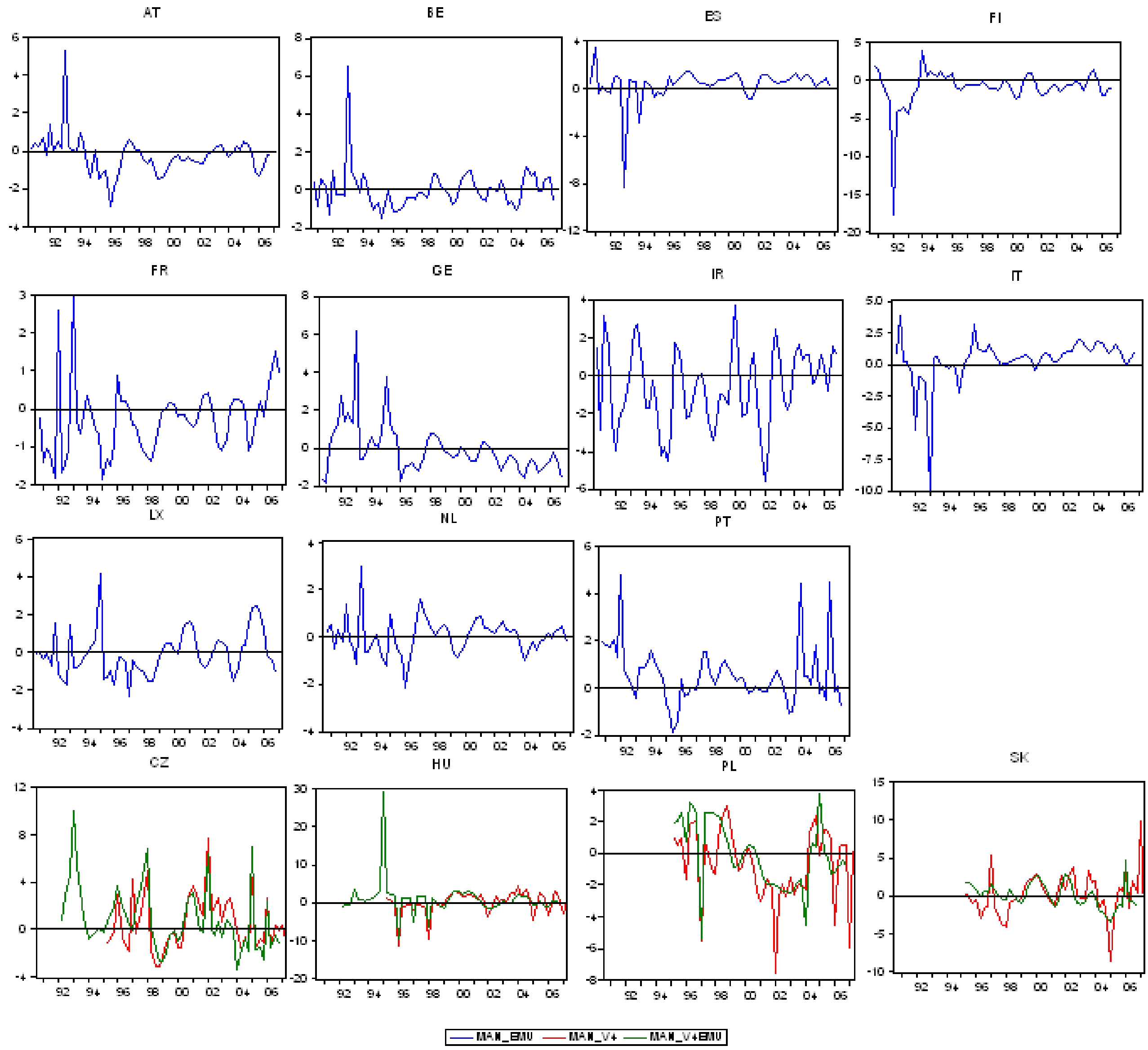
μ_I(1)….average speed spread ratios in %
Example: AT_€ (-0.04)…the euro area ULC is growing faster every period on average by 0.04% in relation to ULC of Austria => Austria more competitive
Spead spread ratio = $((ULCI_i/ULCI_i(-1))\,/\,(ULCI_{€ \text{ or } V4}/\ ULCI_{€ \text{ or } V4}(-1)))-1$
Source: Own calculations

Chart P.1: **Current accounts,** in USD



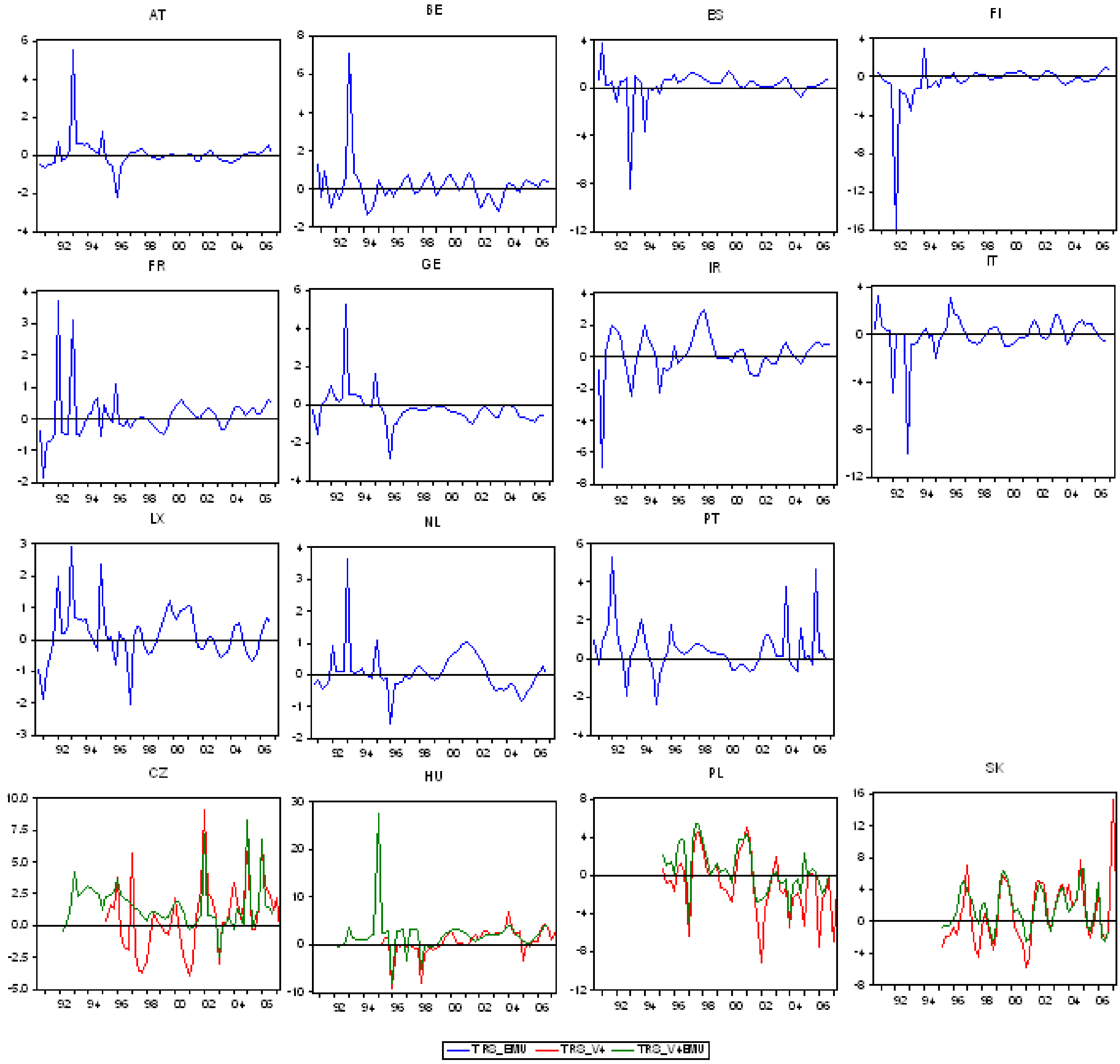
Source: OECD

Chart P.2: **Dynamics of Quarterly National ULC Indices Increments Deviations from EMU (or V4) Average,** Manufacturing Sector



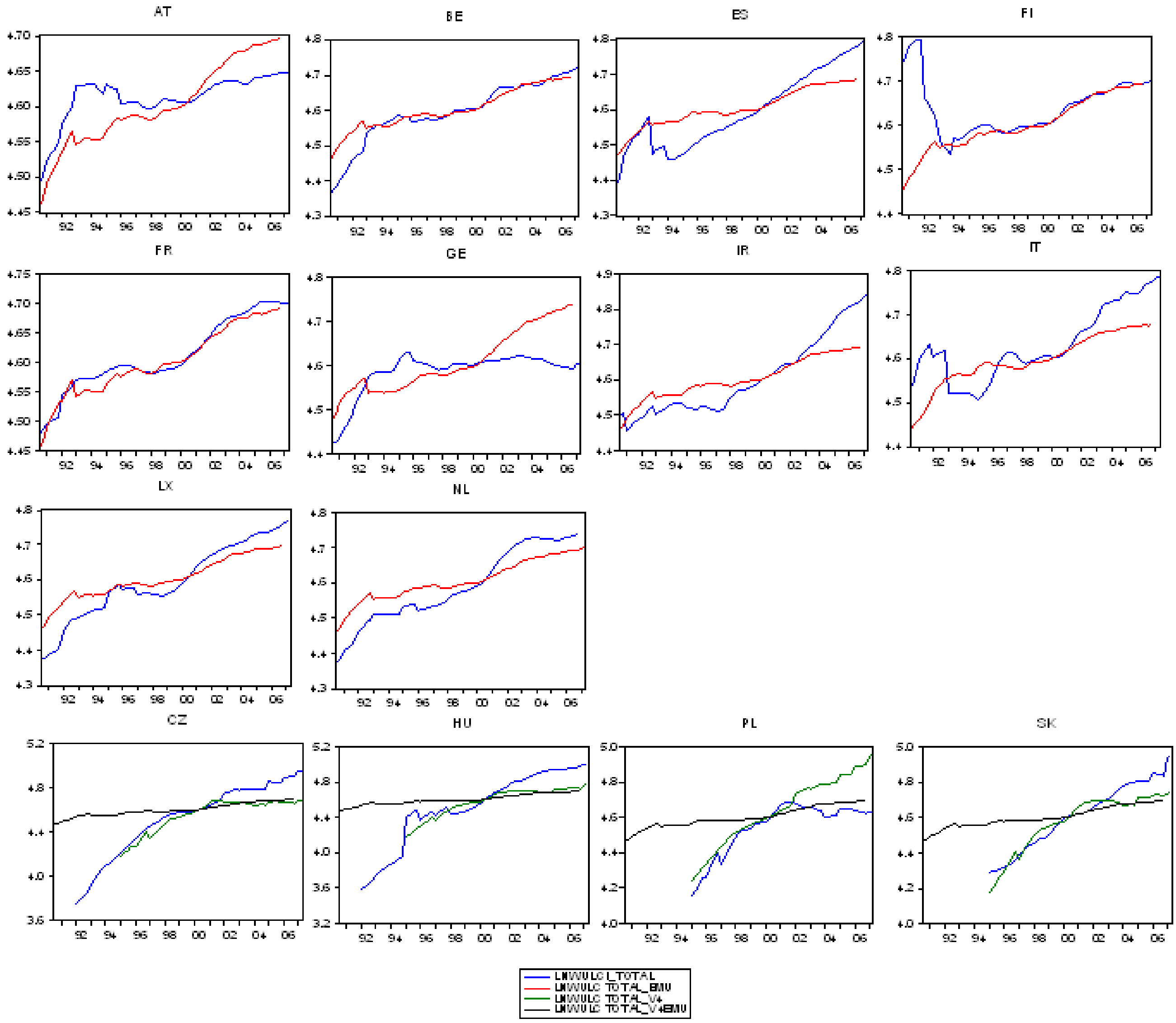
Source: Own calculations

Chart P.3: **Dynamics of Quarterly National ULC Indices Increments Deviations from EMU (or V4) Average,** Market Services Sector



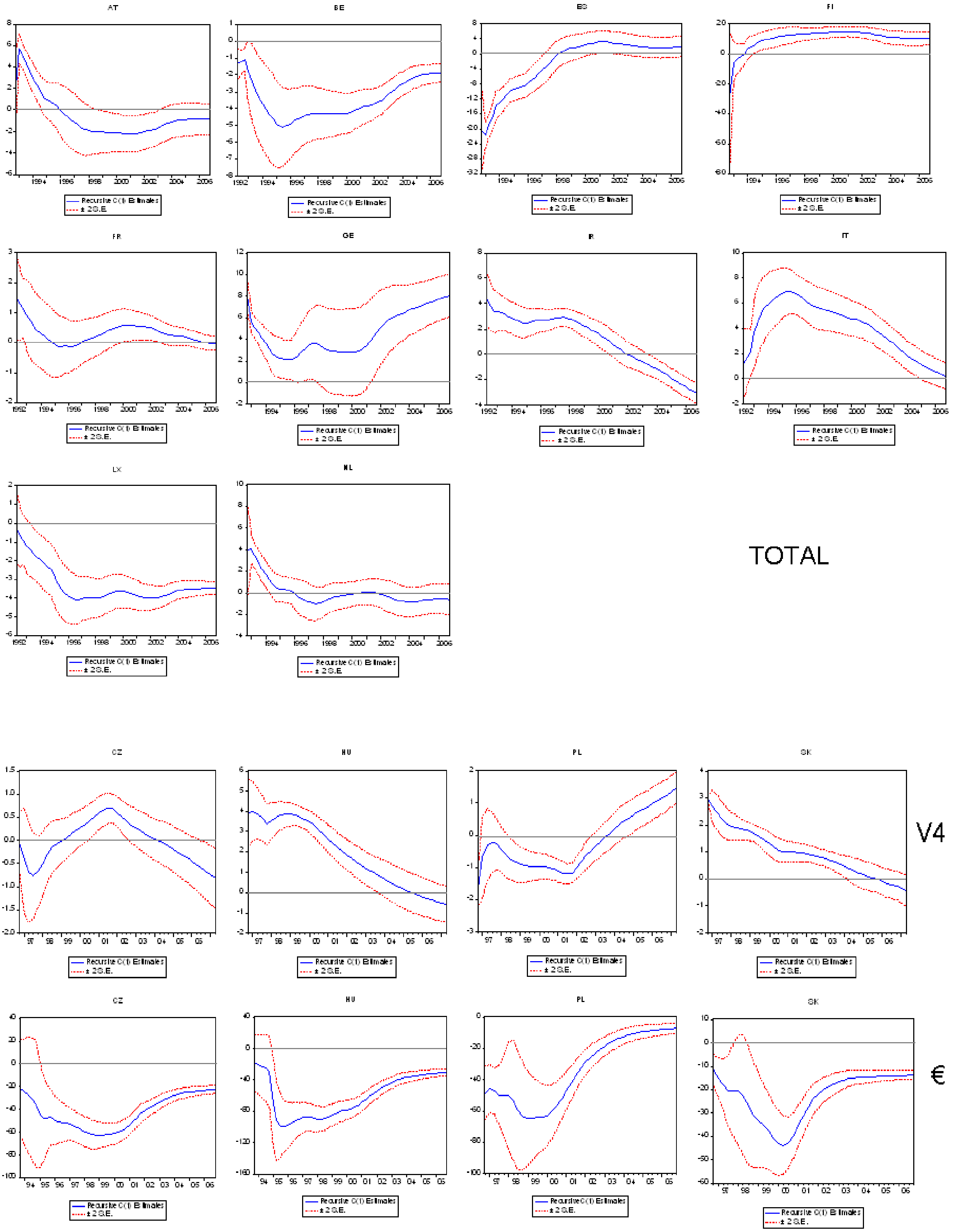
Source: Own calculations

Chart P.4: **Logarithmed ULC indices,** TOTAL



Source: OECD

Chart P.5: **Recursive Constants**, TOTAL



Source: Own calculations

Tables P.F: **Co-integration Point System,** Sectors: BUS, CON, IND, MAN, MRS and TOTAL

BUS	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
(y, x)	Model I ρ<0.98	Model II ρ<0.98	Model II	Model I	Model I, VEC	max 5
AT_€		X	XX		X	**4**
BE_€	X	X		X	X	**4**
ES_€		X		X	X	**3**
FI_€		X		X	X	**3**
FR_€	X	X	XX		X	**5**
GE_€		X		X	X	**3**
IR_€	X	X			X	**3**
IT_€	X	X			X	**3**
LX_€	X	X		X	X	**4**
NL_€	X	X	XX		X	**5**
PT_€		X		X	X	**3**
CZ_V4					X	**1**
HU_V4					X	**1**
PL_V4		X			X	**2**
SK_V4		X		X	X	**3**
CZ_€	X	X		X		**3**
HU_€	X	X		X	X	**4**
PL_€	X	X		X	X	**4**
SK_€	X	X		X	X	**4**

*Granger Method, **Johansen method
Source: Own calculations

CON	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
(y, x)	Model I ρ<0.98	Model II ρ<0.98	Model II	max 5	Model I, VEC	max 5
AT_€		X	XX		X	**4**
BE_€		X		X	X	**3**
ES_€		X		X	X	**3**
FI_€	X	X	XX		X	**5**
FR_€		X		X	X	**3**
GE_€		X			X	**2**
IR_€		X		X	X	**3**
IT_€	X	X			X	**3**
LX_€	X	X		X	X	**4**
NL_€		X		X	X	**3**
PT_€		X	XX		X	**4**
CZ_V4	X	X			X	**3**
HU_V4		X		X	X	**3**
PL_V4	X	X		X	X	**4**
SK_V4	X	X		X	X	**4**
CZ_€	X	X		X		**3**
HU_€	X	X		X	X	**4**
PL_€	X	X			X	**3**
SK_€	X	X		X	X	**4**

*Granger Method, **Johansen method
Source: Own calculations

IND (y, x)	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
	Model I ρ<0.98	Model II ρ<0.98	Model II	Model I	Model I, VEC	max 5
AT_€				X	X	**2**
BE_€	X	X	XX		X	**5**
ES_€				X	X	**2**
FI_€				X	X	**2**
FR_€			XX		X	**3**
GE_€		X		X	X	**3**
IR_€				X	X	**2**
IT_€		X		X	X	**3**
LX_€	X	X	XX			**4**
NL_€						**0**
PT_€	X			X	X	**3**
CZ_V4		X				**1**
HU_V4	X				X	**2**
PL_V4		X	XX			**3**
SK_V4	X	X	XX			**4**
CZ_€	X	X		X	X	**4**
HU_€	X	X		X	X	**4**
PL_€	X	X		X	X	**4**
SK_€	X	X		X	X	**4**

*Granger Method, **Johansen method
Source: Own calculations

MAN (y, x)	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
	Model I ρ<0.98	Model II ρ<0.98	Model II	Model I	Model I, VEC	max 5
AT_€		X		X	X	**3**
BE_€	X	X	XX			**4**
ES_€		X			X	**2**
FI_€	X	X		X	X	**4**
FR_€	X	X			X	**3**
GE_€		X		X	X	**3**
IR_€	X	X		X	X	**4**
IT_€		X			X	**2**
LX_€	X		XX			**3**
NL_€	X	X	XX		X	**5**
PT_€	X	X		X	X	**4**
CZ_V4		X		X		**2R**
HU_V4	X	X		X	X	**4**
PL_V4		X	XX			**3**
SK_V4	X	X				**2**
CZ_€	X	X		X	X	**4**
HU_€	X	X		X	X	**4**
PL_€		X		X	X	**3**
SK_€	X	X			X	**3**

*Granger Method, **Johansen method
Source: Own calculations

MRS (y, x)	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
	Model I ρ<0.98	Model II ρ<0.98	Model II	Model I	Model I, VEC	max 5
AT_€	X	X	XX		X	**5**
BE_€	X	X	XX		X	**5**
ES_€		X		X	X	**3**
FI_€	X				X	**2**
FR_€	X	X	XX		X	**5**
GE_€		X		X	X	**3**
IR_€		X		X	X	**3**
IT_€	X	X		X	X	**4**
LX_€	X	X	XX		X	**5**
NL_€	X	X		X	X	**4**
PT_€		X		X	X	**3**
CZ_V4					X	**1**
HU_V4					X	**1**
PL_V4		X			X	**2**
SK_V4		X		X	X	**3**
CZ_€		X		X		**2R**
HU_€	X	X		X		**3**
PL_€	X	X			X	**3**
SK_€		X		X	X	**3**

*Granger Method, **Johansen method
Source: Own calculations

TOTAL (y, x)	PEDRONI Panel Co-int. Residual Test*		ADF- test , Static Co-int. test*		Tests on the Number of Significant Co-int. Ranks**	Co-integration Points
	Model I ρ<0.98	Model II ρ<0.98	Model II	Model I	Model I, VEC	max 5
AT_€		X	XX		X	**4**
BE_€	X	X		X	X	**4**
ES_€		X	XX		X	**4**
FI_€					X	**1**
FR_€	X	X	XX		X	**5**
GE_€		X			X	**2**
IR_€		X			X	**2**
IT_€	X	X	XX		X	**5**
LX_€		X		X	X	**3**
NL_€		X	XX		X	**4**
CZ_V4					X	**1**
HU_V4	X	X			X	**3**
PL_V4		X			X	**2**
SK_V4		X			X	**2**
CZ_€		X		X	X	**3**
HU_€	X	X		X	X	**4**
PL_€	X	X		X	X	**4**
SK_€				X	X	**2**

*Granger Method, **Johansen method
Source: Own calculations

Tables P.G: **Significant VEC Results,** Sectors: IND and CON

IND	**Co-integration**	Significance Level at 5%		
y, x	**Points:** max 5	γ_y	γ_x	**Points:** max 5
AT_€	**2**	-0.107004		1.04
BE_€	**5**	-0.182961		1.00
ES_€	**2**		0.070738	0.97
FI_€	**2**		0.039639	1.04
FR_€	**3**	-0.160856		1.03
GE_€	**3**	-0.08086		1.04
IR_€	**2**	-0.149321		1.07
IT_€	**3**	-0.079487	0.058014	0.94
LX_€	**4**			
NL_€	**0**			
PT_€	**3**	-0.214133		0.97

	Co-integration	Significance Level at 5%		
y, x	**Points:** max 5	γ_y	γ_x	b
CZ_V4	**1**			
HU_V4	**2**	-0.091897		1.04
PL_V4	**3**			
SK_V4	**4**			
CZ_€	**4**	-0.069374		0.96
HU_€	**4**	-0.063479		1.03
PL_€	**4**	-0.071468		1.08
SK_€	**4**	-0.054386	0.014836	1.04

CON	**Co-integration**	Significance Level at 5%		
(y, x)	**Points:** max 5	γ_y	γ_x	*b*
AT_€	**4**		0.006649	0.8
BE_€	**3**	-0.053729		1.07
ES_€	**3**		0.026397	0.91
FI_€	**5**	-0.073738	-0.008966	1.06
FR_€	**3**	-0.010128	-0.012657	1.09
GE_€	**2**		-0.01389	1.12
IR_€	**3**		0.02139	0.78
IT_€	**3**		0.056999	0.97
LX_€	**4**		0.012782	0.93
NL_€	**3**	0.042127	0.069012	0.95
PT_€	**4**	-0.006462	-0.005617	1.22

	Co-integration	Significance Level at 5%		
(y, x)	**Points:** max 5	γ_y	γ_x	*b*
CZ_V4	**3**	-0.073131		1.06
HU_V4	**3**	0.020897	0.01844	0.87
PL_V4	**4**		0.06047	0.93
SK_V4	**4**		0.06904	0.72
CZ_€	**3**			
HU_€	**4**	-0.017827	-0.004349	1.29
PL_€	**3**		0.010563	0.89
SK_€	**4**	-0.214522		0.91

Source: Own calculations