The relations of real and nominal convergence in the EU with impacts on the euro area participation

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Abstract

Real convergence of economies in macroeconomic terms is accompanied by convergence of nominal variables. The paper provides an analysis of the relationship of the GDP per capita development as an indicator of the real convergence and the development of the comparable price level as a representative of the nominal convergence in relation to the EU average value in the EU economies. Using the concept of convergence, the development of variability of real and nominal convergence indicators among the EU and euro area economies is also evaluated. The Maastricht criteria are an alternative concept of the nominal convergence and their fulfilment interacts with the convergence in previous conceptions. The aim of the paper is to detect relationships between the real and nominal convergence via given indicators within the EU economies, with impacts on the euro area participation regarding the obligations to comply with the Maastricht criteria. In this sense the impacts on the new Member States are taken into account. It is clear that countries of the EU with lower levels of GDP per capita also achieve lower price levels and that simultaneous real and nominal convergence is likely to occur in these countries. The Maastricht criteria may lead to negative effects on the catching up economies joining the euro area, which experience simultaneous real and nominal convergence in the above mentioned conceptions.

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1. Introduction

The issue of convergence has been widely studied in economic literature. The term is frequently used in connection with the convergence of various economic variables at the macroeconomic as well as microeconomic level. Convergence can take place under the influence of various factors with respect to different initial levels of examined convergence indicators in different economies. In this paper, the attention is paid

to convergence at the macroeconomic level with respect to the membership of economies in a monetary union.[1]

At the macroeconomic level, the issue of the catching up with the developed economies by less devel-

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[1] Monetary union is regarded as an area with a single currency.

oped ones through monitoring of gross domestic product per capita (GDP per capita) is often analysed. This analysis is often carried out using the GDP per capita indicator and this convergence can be referred to as a real convergence in a narrow conception. Along with the real convergence, the convergence of nominal variables may occur. Nominal convergence in the narrow conception can be represented by the convergence of price levels. Structural convergence, understood in terms of criteria of the Optimum Currency Area Theory (OCA) originating in works of Mundell (1961), McKinnon (1963), and Kenen (1969), is also usually monitored. A high level of compliance with the OCA criteria by economies increases the likelihood that benefits will exceed the costs of membership in a monetary union. This theory is an essential starting point for exploring the choice of the most appropriate exchange rate regime by economies. In this paper attention is mainly paid to the real and nominal convergence and their mutual relations, while the individual convergence criteria of the OCA theory are not defined in detail. However, the indicators used in this paper are often also regarded as criteria of OCA theory.

The aim of this paper is to detect the relationship between real and nominal convergence via indicators introduced within the EU economies, with possible impacts on the participation in the euro area. Relevant aspects for convergence by the obligation to fulfil the Maastricht criteria are considered as well, as issues related to compliance with the Maastricht criteria is relevant for the new member states.

The paper is divided into six sections. The first section is the introduction. In the second section the types of convergence being analysed are explained, i.e. real and nominal convergence. In the third section the variables and methodology for measuring convergence are introduced. In the fourth section the convergence of economic and price levels and their mutual relations are analysed empirically. Using the concept of σ convergence, the fourth section is enhanced by further analysis to detect the variability of development of real and nominal convergence indicators. The fifth section describes the impact of the Maastricht criteria fulfilment of the new Member States joining the euro area, assuming the on-going real and nominal convergence in the narrow conception. The final, sixth section summarizes the results of the research. The new Member States include countries which have joined the EU since 2004. The older Member States are all the others, i.e. the EU-15 economies.

2. Definition of the real and nominal convergence for the purposes of analysis

This section contains definitions of real and nominal convergence, which are subject of the analysis in this paper.

2.1 Definition of the real convergence

For the purposes of convergence analysis within the integration group, the real convergence in macroeconomic terms is the process of catching up with developed economies by less developed ones or approaching of their real parameters and conditions (Šikulová, 2006). But for the real convergence there is no well-defined set of indicators. These are expressed mainly via GDP per capita in terms of purchasing power parity (PPP), labour productivity in PPP, and comparative price level (CPL). The comparative price level is the ratio of the exchange rate in PPP and market exchange rate. The process of convergence is thus characterized by faster growth in real GDP in the catching up countries in comparison to the ones that are caught mainly due to faster growth in labour productivity and/or appreciation of the real exchange rate (RER). Appreciation of RER takes place through inflation differentials (price channel) and/or nominal appreciation of the exchange rate (exchange rate channel) (Šikulová, 2006).

However, several authors (e.g. Žďárek, 2006) consider CPL to be an indicator of nominal convergence, and so this convergence takes place through appreciation of the real exchange rate. The definitions of nominal convergence by Žďárek (2006) is taken into account and the real GDP per capita, which expresses the quantity of goods produced per capita in a given economy without the impact of changes in price levels, is considered to be the indicator of real convergence in a narrow conception. The CPL indicator is understood as an indicator of the nominal convergence (see section 2.1).

Conceived more comprehensively, it is possible to consider three ways of definition of the real convergence (Žďárek, 2006).

1. The first way originates from the neoclassical theory of economic growth and it declares that convergence is a process of approaching GDP per capita to the steady state. It explains the hypothesis of absolute and conditional convergence. Convergence is expected in the group of countries with similar parameters that converge to the common steady state. This is the so-called conditional convergence. The more homogeneous the group of countries is, the clearer the disproportional relationship between the initial level of GDP per capita and its growth rate in the monitored group of countries occurs. Steady state is a long-term level with not changing of the income per capita or its

growing by the rate of technological progress. These characteristics are an expression of the concept of β convergence arguing that poor economies grow faster than the rich ones (Barro and Sala-i-Martin, 2004). However, this does not necessary mean that poor countries catch up with the rich ones. The reducing of GDP or income per capita dispersion over time in a group of economies is also important and it is expressed by the concept of σ convergence,

2. Definition based on the OCA theory often understands convergence as a synchronization of business cycles or compliance with the criteria of the OCA theory in general,

3. In the EU, convergence is also often understood as cohesion.

There are many other indicators used by economists to express real convergence. Economists point out that the level of real convergence can be underestimated by monitoring only the indicator of GDP per capita (see for example Spěváček and Vintrová, 2010). In this sense, the convergence of production structures or financial markets, the synchronization of business cycles, the labour mobility etc. have been observed. These indicators are also the criteria of the OCA theory and convergence factors analysed by this theory. In addition to the above mentioned indicator of the nominal convergence in the form of comparative price level, real convergence often overlaps with structural convergence in terms of the OCA theory (see section 1). Generally, the appropriateness of alternative indicators depends on the purposes of analysis. For the purpose of the analysis in this paper, the real convergence is studied using the basic indicator, i.e. GDP per capita.

2.2 Definition of the nominal convergence

Nominal convergence in a broader concept represents converging of nominal variables, such as prices, inflation rates, interest rates, nominal wages, rents, etc. In a narrow concept the convergence of prices is considered to be the nominal convergence. From a macroeconomic perspective the convergence of a comparable price level, which is expressed by CPL indicator, is usually monitored. The overall definition of the nominal convergence is through the convergence of nominal GDP per capita recalculated via the market exchange rate in euro (Žďárek, 2006). The convergence of nominal GDP in the euro among EU economies results in the reduction of the gap between the market exchange rate and the exchange rate in the PPP and thus in the nominal convergence defined by this indicator. The meaning of nominal convergence in the integration group is important as well. Kowalski (2003) understands the nominal convergence as a convergence of certain macroeconomic indicators to the levels providing macroeconomic stability in the economic integration group. In accordance with this fact the meaning nominal convergence is within the EU also associated with the Maastricht criteria, which are listed in the EU Treaty. They are the only official conditions of a country membership in the euro area and have been created in order to maintain the stability of the single currency.

Since the nominal convergence can be regarded as a convergence of absolute values of some nominal variables as well as of the growth rates of the same variables, some contradictions in achieving convergence may arise. An example is the convergence of CPL, which should proceed simultaneously with the real convergence, i.e. growth of the GDP per capita, and which is considered to be the nominal convergence in the narrow concept. It follows that in countries with lower initial level of GDP per capita and CPL, these variables should grow relatively faster in comparison to countries with a higher initial level who should therefore achieve higher inflation rates or higher exchange rate appreciation. This limits the possibilities of achieving convergence in the context of compliance with the Maastricht criteria, namely simultaneous compliance with inflation and exchange rate criterion by these economies. In general, there are many reasons for the real exchange rate appreciation and convergence of CPL. In particular the cost factors in terms of growth in unit labour costs also limit simultaneous fulfillment of Maastricht criteria.

3. Characteristics of the background, variables and methodology for the convergence analysis

In this section basic variables and methodology are defined, which are used in the analysis of convergence. Attention is also paid to the factors influencing the price convergence.

3.1 Definition of the CPL variable and factors influenced this variable

In general the CPL indicator represents the ratio of exchange rate of the economy in PPP in relation to its market exchange rate to the currency of other economy or set of economies as expressed in equation (1). This indicator represents the ratio of price levels to some other economy or some other entity (the EU, the euro area). This is the general definition of the CPL variable. The price level represented by the CPL index for the whole GDP in relation to the average level of the EU-27 has been used in the analysis of this paper:

$$CPL = \frac{ER_t^{PPP}}{ER_t}. \qquad (1)$$

It is also possible to use an indicator of exchange rate deviation (ERDI) for the expression of nominal

convergence via CPL, see equation (2). This represents the ratio of currency market exchange rate of the economy to the currency of other economy (or set of economies) and the exchange rate to the currency of this economy (or set of economies) in PPP. So, it is an inverted value of the CPL indicator (Žďárek, 2009):

$$ERDI = \frac{1}{CPL} = \frac{ER_t}{ER_t^{PPP}}. \qquad (2)$$

Finally, the process of price convergence can be expressed by equation (3):

$$cpl_t = e_t 1 + \pi_t. \qquad (3)$$

The price convergence takes place through a change of the nominal exchange rate, i.e. exchange rate channel (e_t) and/or higher growth rate of prices, i.e. price (inflationary) channel (π_t). It depends on the nature of monetary and exchange rate policy of the economy, which of the channels outweighs. Supposing the existence of fixed exchange rate regime, it is possible to use only the price channel. By the flexible exchange rate regime, both channels can be used. However, this depends on whether the central bank defines and keeps its inflation target that determines the scope of price channel. Thus some important implications for participation in economic integration result from these facts, especially in an environment with a single currency, where the autonomous monetary and exchange rate policy cannot be used by individual economies.

The development of the CPL indicator of the EU economies together with the development of GDP per capita in the PPP both in relation to the EU average can be used to examine the simultaneous nominal and real convergence. Monitoring of the nominal convergence via nominal GDP per capita, recalculated by market exchange rate of currency to the euro is also consistent with the definitions by equations (1), (2), (3). The convergence of the nominal GDP in the euro among EU economies results in the reduction of the gap between market exchange rate and exchange rate in the PPP and thus in the nominal convergence.

Differences in price levels among economies can persist due to several factors. There are also differences between the levels of GDP per capita in purchasing power standard (PPS)[2] and CPL in relation to the EU average in particular economies. Both these differences can be generally explained by several factors, including non-economic ones. The main reason for lower level of the CPL in less developed countries is the lower labour productivity, which is also lower in the non-tradable sector. Other economic

causes may be the shares of the non-tradable sector in economies, the speed or costs of the arbitrage, the impact of indirect taxes, imperfect competition and so on. Distorted price relations derived from the former regime in transforming economies may also appear. The non-economic factors of the CPL differences can for example include the consumer preferences, which reflect the local habits, consumers' effects and so on (Vintrová and Žďárek, 2007).

There are more factors of real appreciation, i.e. factors of the CPL convergence. The existence of the Balassa-Samuelson's effect (B-S effect) cannot be left unmentioned, especially in connection with the structural factors of real appreciation. The B-S effect can be simply explained as follows. In a converging economy with lower relative labour productivity (especially the new Member States), the labour productivity in the tradable sector increases faster with a differential in productivity growth in comparison to the non-tradable sector. Through wage equalizing between these two sectors the productivity growth differential reflects an inflation differential. The economy achieves higher overall inflation in comparison to an economy with higher initial labour productivity, providing a stable nominal exchange rate and similar developments of tradable goods prices. The second possibility is the nominal exchange rate appreciation providing a floating exchange rate regime. Both channels are reflected in the real exchange rate, i.e. it leads to the RER appreciation and CPL convergence.

The cost factors in terms of growth in the unit labour costs (ULC) are other factors influencing the real appreciation (Cincibuch and Vávra, 2000). Dreger et al. (2007) point out to the catching up process and the rise in competition in the Internal Market as important factors influencing the price convergence, most notably for the new Member States. Catching up has a positive and competition a negative effect on price level. However, these two groups of factors can be connected with the former ones. The catching up process in terms of the real convergence is connected with the B-S effect and costs factors play role in competitiveness of the economies. However, other factors of real appreciation cannot be neglected, either. Providing the division of real appreciation into the price and exchange rate channel, the price channel may include mainly supply and demand factors, deregulation of administratively set prices or tax arrangements. On the other hand the exchange rate channel may especially include the development of labour productivity (Vintrová and Žďárek, 2007).

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[2] For the EU countries, when aggregating GDP, purchasing power standards (PPS) derived from the average prices of the EU or euro area have been used.

3.2 The background of methodology for the convergence analysis

Economies with a lower initial level of GDP per capita within the EU are likely to grow faster than economies at a higher level assuming the validity of the concept of conditional β convergence (Barro and Sala-i-Martin, 2004). Instead of the definition of a steady state it is possible to follow the development and convergence/divergence of GDP per capita (and CPL) in relation to the average values of a group, i.e. the EU and the euro area (see Slavík, 2007). This was applied in this paper where it was appropriate. It was also assumed that the analysed groups of the EU countries are sufficiently homogeneous, because the countries of the EU are developed and post-transitive economies. In particular, new member states can be considered as catching up economies.

The concept of β convergence is largely used to examine the convergence in the EU countries. Economies with a lower initial level of the GDP per capita in the EU grow on average faster than the ones with a higher level. For example, Vintrová and Žďárek (2007) show the changes of GDP per capita in PPS in relation to its initial level in 1995 for the new Member States of the EU and demonstrate the existence of β convergence. However, the aim of this paper is to detect if simultaneous real and nominal convergence has been occurring. In terms of methodology, graphical analysis, correlation analysis and panel regression have been used to verify the simultaneous real and nominal convergence. Using the model of panel regression, the following equation (4) has been used to verify the mutual relationship of the GDP per capita in PPS and CPL for the GDP in the EU countries:

$$\ln CPL = \alpha_1 + \alpha_2 \cdot \ln GDPpc(PPS) + \mu_{ij}. \quad (4)$$

In the equation (4) the symbols of *CPL* and *GDPpc(PPS)* express the analysed variables, and α_1 and α_2 are coefficients. If the coefficient α_2 is positive, a proportional relationship exists between the developments of the GDP per capita in PPS and the CPL in the analysed sample of countries.

The concept of σ convergence is also based on neoclassical growth theory and was originally used to analyse the convergence of the real income. This concept examines the development of variability in time. If there has been a reduction in the variability of values, the σ convergence has occurred. A logarithm has been used by explaining the σ convergence to avoid the effect of different levels of variables existing at various points in time. For expressing the σ convergence, the following formula (5) can be used:

$$\sigma_{i,t}^2 \geq \sigma_{i,T}^2. \quad (5)$$

It is true that the time $t < T$. Symbol $\sigma_{i,t}^2$ expresses the variance (dispersion) of the analysed variable at

a time t in a particular entity i (group of countries) and $\sigma_{i,t}^2$ is the dispersion of the monitored variable at the time T. A reduction of the variability in time needs to be verified by statistical tests. According to Lichtenberg (1994) it is possible to verify the convergence hypothesis via the test statistic based on the *F-test*. The F statistic (F_1) can be adjusted to the form expressed by the equation (6) together with test conditions for the case of convergence:

$$F_1 = \frac{\hat{\sigma}_{i,t}^2}{\hat{\sigma}_{i,T}^2}, F_1 \geq F_\alpha. \quad (6)$$

Also, the $t < T$, degrees of freedom depend on the number of countries (N) included in the analysis. This test statistic in the form used by Lichtenberg (1994) has been criticised by Carre and Klomp (1997) because the values of the variance in the initial and final period are dependent on each other. Carre and Klomp (1997) propose two alternative test statistics of the hypothesis that the variances in the first and last periods are equal. However, some insights into the issue can be provided using the methodology given by the formula (6) and this was used for the analysis in this paper. This was based on the two-sample *F-test* for variances. The degrees of freedom are: numerator sample size − 1 and denominator sample size − 1. The null hypothesis of the equal variances is rejected if the F observed is larger than the F critical. Thus σ convergence has taken place if the computed statistics of the *F-test* is larger or equal to critical value of the *F*-distribution at 5% significance level.

4. Empirical analysis of real and nominal convergence in the EU

In this section, convergence in the EU is analysed using the introduced methodology and also some factors influencing the simultaneous real and nominal convergence in the EU are derived from the analysis.

4.1 Analysis of differences and convergence in economic and price level in the EU

The convergence analysis in this section is based on examining the development of relationships between CPL for GDP and GDP per capita in relation to the EU average in order to subsequently detect the mutual relations in their development. The presumption is the existence of the β convergence of GDP per capita in the EU and the euro area. The first analysed field of the relationships between the real and nominal convergence is therefore restricted to their narrow conceptions. For the introductory comparison of older and new Member States, the yearly data of GDP per capita in PPS and CPL for the GDP extracted from Eurostat were used. The same data for the longer time period, approximately since the middle nineties, were further

also used for majority of the analyses carried out in this paper.

In 2010, the GDP per capita in PPS reached an average value of 67.583% (62.577%) in 12 new Member States in relation to the EU-27 (euro area-17) average value. The process of catching up in individual catching up countries has proceeded with varying intensity. The average purchasing power of the 12 new Member States in the year 2010 in relation to the EU-27 (euro area-17) average value, expressed by the CPL indicator, is about 66.267% (63.171%) of the purchasing power in the domestic market. Goods, which are purchased by residents from the new Member States per unit of domestic currency on the domestic market, are on the EU-27 (euro area-17) average market bought for about 1.51 (1.58) of the national currency unit, see the calculation according to equation (2). Euro's purchasing power is therefore on the markets of the new Member States on average 1.51 (1.58) times higher than on that of the EU-27 (euro area-17). The new EU Member States achieve a lower CPL in relation to the average level of the EU-27. Their CPL is in relation to the EU-27 or euro area-17 average roughly similar to their economic level. However, there are significant differences in some countries.

By catching up with the average of the GDP per capita of the EU, the CPL is increasing and ERDI is decreasing (see equation (1), (2), (3)). CPL convergence towards the EU-27 and the euro area average means a growth of the purchasing power of converging economies' currencies, especially of the new Member States with lower initial economic and price level. Using data for GDP per capita in 2010 and CPL for total GDP in the year 2010, positive correlation between these two variables can be observed (see Figure 1). Both indicators are in relation to the EU and not to the euro area average. However, the situation is similar. The reason for focusing on the EU is that the EU is the analysed integration group as a whole. Economic and Monetary Union (EMU) is the highest stage of integration in the EU. Not all economies have yet used the single currency, but they are obliged to introduce it, with the exception of two EU economies, such as Denmark and UK. These two economies are not excluded from the analysis. The economic integration group as a whole should achieve a convergence of economic variables and all economies should proceed to deepen the integration process. Overall, it is arguable which group of the EU or euro area should be used as a benchmark economy, or whether it should not be just one particular economy (Germany is often used). It all depends on the purpose of the analysis. The EU-27 was chosen for analysing the development of mutual relations between GDP per capita in PPS and CPL. More groups of the EU and euro area countries were used for the analysis of the σ convergence.

In reference to the analysis of the relationship between the real and nominal convergence among the EU economies in the narrow conception, it is possible to start from Figure 1. Economies with the highest economic levels have been also achieving high price levels (Denmark, Sweden, Finland, Luxembourg, etc.) and conversely, economies with the lowest economic levels have been achieving the lowest price levels (Bulgaria, Romania, Lithuania, Latvia, etc.). On the one hand, with the highest on both levels, there are primarily the Nordic economies, Benelux countries, France, Austria, Germany, etc. On the other hand, the lowest on both levels are apparent for the catching up economies of the new Member States, mainly Bulgaria and Romania and the Baltic economies (see Figure 1). Luxembourg represents the outlier in this analysis.

Some economies have been achieving throughout the whole observed period of 1995–2010, for which the data for the GDP per capita in PPS and the CPL for the whole GDP in Eurostat were available, positive differences between given variables, i.e. higher economic than price level (see Figure 2 and 3). The most significant differences have been apparent in Luxembourg, which has the highest value of GDP per capita in the EU. Values for this economy are outliers to the values of other economies and were thus excluded from the Figure 2. Positive differences over the whole monitored period have been achieved by the Czech Republic, Malta, Germany, Austria, Netherlands, Slovakia, Slovenia, Ireland, Spain, Belgium, Cyprus, Greece (with the exception of the years 2009 and 2010), Italy (with the exception of the year 2010), the United Kingdom (with the exception of the years 2000 and 2007) etc. For most of the monitored period, Denmark, Finland, Portugal, Estonia, Latvia, Romania, Poland and some others have been achieving higher price than the economic levels. In 2010, apart from Luxembourg, the Netherlands achieved the highest positive difference (25.3 p.p.) and Denmark the highest negative difference (–14.6 p.p.) between the economic and price level. It is clear that even among individual economies there can be differences in factors or sets of factors affecting the development.

To complete this analysis, it is necessary to compare the differences (differentials) between the two analysed variables in individual years for the EU economies graphically. The differences were computed as *the GDP per capita in PPS – CPL for GDP* in relation to the EU average for each country and each year of the monitored period. The results are shown in Figure 2 for the older Member States and in Figure 3 for the new Member States.

In the new Member States a higher variability in the development of analysed differences in comparison with the older Member States (see Figure 2 and
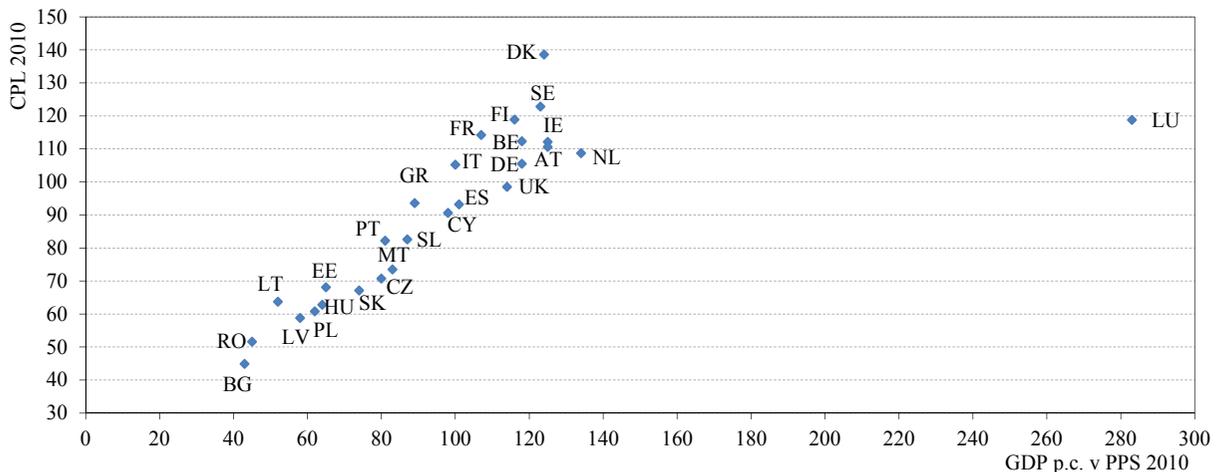
Figure 1 Relationship between GDP per capita in the PPS and CPL of GDP in countries of the EU (EU-27 = 100), 2010
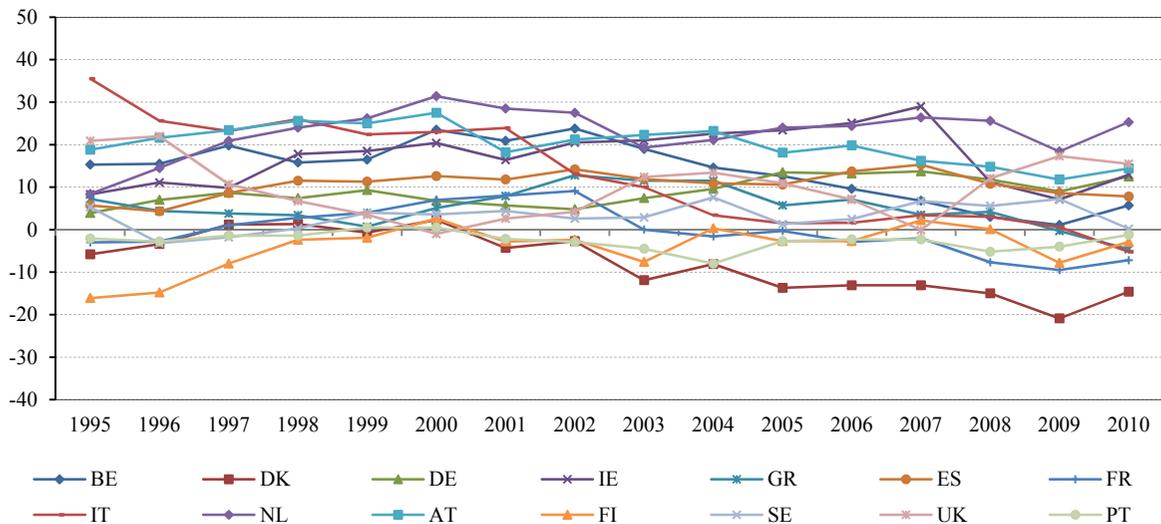Source: Eurostat (2011)

Figure 2 Development of the differences in the GDP per capita in PPS and CPL in the older EU Member States (EU-27 = 100 for both indicators), 1995–2010
Source: Eurostat (2011)
Note: Luxembourg is not depicted due to outliers.

Figure 3) is generally obvious. More visible is the reduction of differences between GDP per capita and CPL in the new Member States, which also results from a comparison of Figures 2 and 3. The highest change of differences in values in the negative direction was recorded in Italy, the Czech Republic, Malta, Romania and Greece in terms of reduction or elimination of the positive excess of GDP per capita in PPS above the CPL from 1995 to 2010. Overall, the correlation of changes with the initial difference was high and negative in the economies of the new Member States. So, there is not only the parallel development of GDP per capita and the CPL, i.e. real

and nominal convergence.[3] In the new Member States, which achieved high positive excess of GDP per capita over the CPL in relation to EU at the beginning of the monitored period, a greater reduction of these differentials has been experienced.

This change is characteristic mainly for the Czech Republic, Lithuania, Bulgaria, Malta, Hungary, Slovakia, and Romania. However, in some of these countries the positive differentials changed into the negative ones (for example Lithuania, Bulgaria, and Romania). Conversely, in the economies of Latvia and

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[3] It means the correlation between the initial difference in the year 1995 and the annual changes of differences in variables in the monitored period 1995–2010.
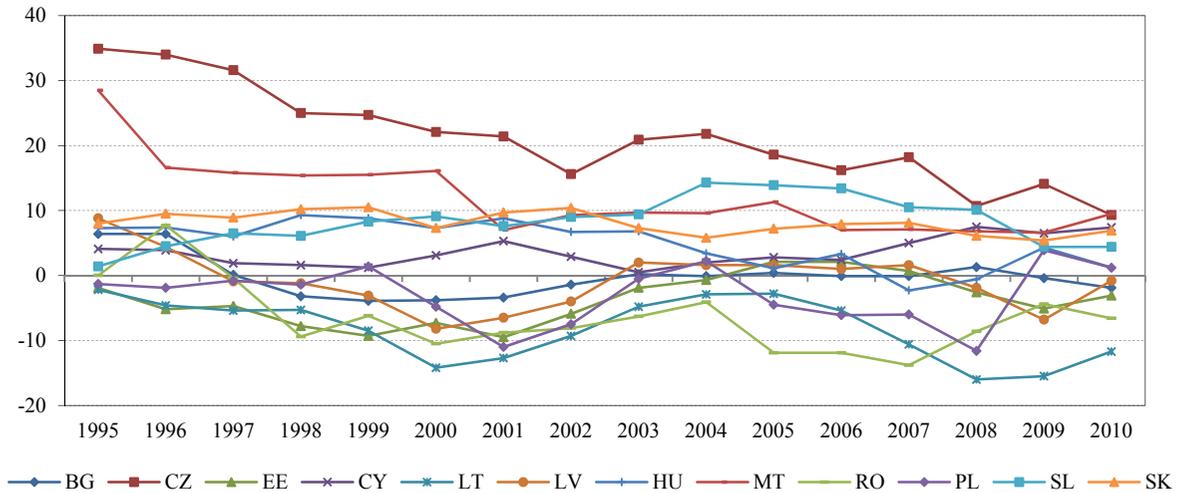
Figure 3 Development of the differences in the GDP per capita in PPS and CPL in the new EU Member States (EU-27 = 100 for both indicators), 1995–2010
Source: Eurostat (2011)

Estonia to a lesser extent, the negative differences between the GDP per capita in PPS and the CPL have deepened. The opposite trend is typical of Poland where the negative differences between GDP per capita and CPL were transformed into the positive ones in the last two monitored years 2009 and 2010, i.e. the excess of GDP per capita in PPS above the CPL. Slovenia and Cyprus have had a positive excess of GDP per capita in PPS throughout the whole monitored period, which also has been increasing. The overall development of variables during the whole period is various and variable in the particular EU economies.

For almost all new Member States, the high correlation of the GDP per capita in PPS and CPL is visible and thus simultaneous nominal and real convergence in terms of *β* convergence can be confirmed. As to particular economies, Malta is an exception with its negative correlation coefficient (–0.333) between two levels in the period 1995–2010.[4] In the whole EU, the highest positive correlation was achieved by Slovakia (0.992), followed by Estonia (0.954), Hungary (0.940) Latvia (0.927), Ireland (0.904) and Lithuania (0.898). These facts are relevant to consider in terms of the integration process of the EU, especially with regard to making decisions by the new Member States on the participation in the monetary union.

To verify the relationship between comparable price level, measured by the CPL for GDP (EU-27 =

100) as an explained variable and GDP per capita in PPS (EU-27 = 100) as an explanatory variable, a panel regression model has been also used for completion. A similar analysis using a cross-section of economies has been used by Čihák and Holub (2002) and Žďárek (2006), and dynamic panel regression model also including alternative explanatory variables besides the GDP by Vintrová and Žďárek (2007). Other authors, who set up the models analysing the price convergence, were Žďárek (2009), Dreger et al. (2007) and Nestić (2005), also using the cross section analysis of the EU member or candidate countries. Data from Eurostat for the EU-27 economies for the period 1996–2010 were included and the method of least squares for panel data was used. The simplest pooled model assumes that the individual effect is the only unit vector, i.e. a single parameter α_1 is a common constant, see equation (4). The relationship shown in equation (7) represents a direct proportional development of the analysed variables:

$$\ln CPL = 0.9817 + 0.7615 \cdot \ln GDP \, pc(PPS). \quad (7)$$
$$N = 405, T = 15, CS = 27, R^2 = 0.8465,$$
$$adjR^2 = 0.8461, S.E. = 0.155, DW = 0.106$$

However, the panel unit roots tests indicate the existence of the unit root. Using the model expressed by the equation (7) also indicates low *Durbin-Watson* statistics *(DW)*. The model was modified by using the generalised method of least squares (GLS) and GLS weights, i.e. variance structure referred to as Period SUR, which can mitigate this problem. The assumption of the common constant α_1 (see equation (4)) was also abandoned and model with fixed effects for periods was created. The symbols *"PER = F"* indicate the fixed effects for each period (see the equation (8)).Using this alternative model and method the slope

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[4] Correlation coefficients between the CPL for the GDP and GDP per capita in PPS, both in relation to the EU-27 average, were computed for all EU members in the period 1995–2010.

of function was only slightly reduced and the direct proportional relationship between the analysed variables is still visible:

$$\ln CPL = 1.63 + 0.6158 \cdot \ln GDPpc(PPS) + \\ + [PER = F]. \qquad (8)$$
$$N = 405, T = 15, CS = 27, R^2 = 0.6175,$$
$$adjR^2 = 0.6028, S.E. = 0.9915, DW = 1.972$$

However, the relationship between these variables is complex and influenced by many factors, including non-economic ones. The differences between the levels of CPL and GDP per capita relative to the EU average exist in particular countries and in addition, these differences vary among countries. It is likely that the positive relation between the labour productivity and the CPL variable is more significant than the above mentioned relationship between the CPL and GDP per capita in PPS (as expressed in equation (7) and (8)). This problem is together with some other factors of convergence discussed further in section 4.3 with application to the EU countries.

The results of this section can be summarized as follows. The economies of the EU with lower economic level also achieve a lower price level. If β convergence has been occurring in terms of real convergence, then it is possible to presume the faster growth of the CPL in the catching up countries. It means higher inflation rates or appreciation of the exchange rate depending on importance of particular channels of the real appreciation. But it is not enough to demonstrate that economies with lower economic and price level should achieve higher growth of these variables. To complete the analysis of the simultaneous real and nominal convergence, the examination of the σ convergence has been used in the next section to detect if the variability in the convergence indicators has been decreasing in the EU and euro area countries.

4.2 Using the concept of σ convergence to verify the real and nominal convergence within the EU

If we adopt the assumption that economies with lower initial levels of GDP per capita grow faster and together with GDP per capita the CPL is growing, we may continue to examine whether a reduction in variability of the analysed variables within the groups

of the EU and euro area economies has been occurring. This analysis is essential to find out whether the values of convergence indicators have been really converging and whether its variability has been reducing in the analysed groups of countries. In all σ convergence analyses are used annual data from Eurostat for the years 1996 and 2010.

Before using the *F-test* it is necessary to verify the normal distribution of samples. Based on the *Jarque-Bera test* we do not reject the null hypothesis of normal distribution at a 5% significance level in all further analysed samples with the exception of the one sample, i.e. GDP per capita in PPS in euro area-17 for the year 2010. In this case the null hypothesis of normal distribution of the sample is rejected at the 5% significance level. Since it is only one group, it is supposed that the analysis has sufficiently high explanatory power and nonparametric tests are not implemented in the same way as Slavík (2007) does. In all analyses of the real and nominal σ convergence in this section, the mean of the samples for each group of countries is increasing and the variance is decreasing between years 1996 and 2010. However, the σ convergence needs to be verified by the *F-test*.

It is appropriate to start the analysis with the real convergence. The real GDP per capita in euros is calculated in prices of the previous period, which is considered to be the basic period. Table 1 shows the results of the σ convergence analysis for the real GDP per capita across the EU and euro area for the period 1996–2010 with the exception of Bulgaria and Malta, for which data for the year 1996 were not available. However, the exclusion of these countries did not affect the results of the analysis in a large extent. It means that exclusion of these two countries do not influence the acceptation or rejection of the hypotheses, because these countries are not outliers in the analysis of the real σ convergence.

The analysis starts with the EU-25 and euro area-16 (without Bulgaria in the group of the EU and Malta in both groups). Besides Malta and Bulgaria, the EU-24 and the euro area-15 do not include Luxembourg and, moreover, the EU-23 and euro area-14 are without Luxembourg and Ireland. These two economies are considered to be the outliers in this analysis.

Table 1 σ convergence of real GDP per capita in EUR in the euro area and EU, 1996–2010

grouping	euro area-14	euro area-15	euro area-16	EU-23	EU-24	EU-25
F computed	1.634	1.557	1.378	1.437	1.408	1.348
F critical	2.577	2.484	2.403	2.025	2.014	1.984
p-value	0.194	0.209	0.271	0.197	0.209	0.235

Source: Eurostat (2011), own calculations
Note: The EU-25 sample does not include Bulgaria and Malta due to missing data; the euro area-16 does not include Malta again due to missing data; In addition, the EU-24 and euro area-15 do not include Luxembourg due to outliers and the EU-23 and euro area-14 do not include Luxembourg and Ireland due to outliers.

In the EU and euro area the real σ convergence cannot be confirmed. The reduction of the real GDP per capita variance also cannot be confirmed in either of the group of economies being monitored (Table 1). F statistics represent the ratio of sample variance in the initial period (1996) and in the current period (2010). It is near 1 in each group of economies and thus we cannot reject the null hypothesis of equal variances. The null hypothesis of equal variances (H_0) cannot be rejected against the alternative one of its decreasing although there is lower variance in each group in year 2010 than in year 1996. Further analysis is focused on the detection of nominal σ convergence or divergence (results are summarized in Table 2). The overall definition of the nominal convergence is via convergence of the nominal GDP per capita (at current prices). In this case, data were not available for Bulgaria. However, the results were not again influenced by exclusion of this country from the analysis.

In Table 2 the F statistics are higher than their critical values for all EU and euro area groups except the group of the euro area-17. In all analysed groups of the EU and euro area, except for the euro area-17, reduction of the variance of nominal GDP per capita in the EU and euro can be statistically confirmed.

In this group H_0 of equal variances is accepted against the alternative one of its decrease. The reduction of the variability of nominal GDP per capita and nominal convergence in this sense have occurred in the EU and the euro area. However, in the euro area it is visible after removal of outliers for the economy of Luxembourg.

The previous Tables 1 and 2 include the results of σ convergence analysis using the real and nominal GDP per capita, from which it is possible to draw conclusions about the real and nominal σ convergence. The analysis may be completed by additional indicators, which were used for the analysis of relations between the real and nominal convergence in their narrow conception, i.e. the GDP per capita in the PPS and the CPL for GDP in relation to the EU-27 average. The data were available for the years 1996 and 2010 in all EU economies. So, it was examined whether the σ convergence has been occurring in the EU and euro area.

In Table 3 the result of analysis only for three groups: the EU-27, the euro area-17 and the euro area-15 (the euro area without Luxembourg and Ireland) are summarized. Table 3 confirms the findings of Tables 1 and 2. The nominal σ convergence can be confirmed, but not the real σ convergence in the EU-27 and euro area-17 groups despite the reduction in the variances of all the groups for both indicators. By the indicator of GDP per capita in PPS for the EU-27 and euro area-17 the H_0-hypothesis about identical variances of the samples in 1996 and 2010 against the convergence hypothesis, i.e. reduction of the variability, cannot be rejected. Real convergence measured by the GDP per capita in PPS can be confirmed for the groups of the EU and euro area after removal of outliers for Luxembourg (see the group of the euro area-15 in the Table 3). As it was said, regarding the nominal convergence expressed by the CPL indicator, the alternative hypothesis of convergence is accepted against the null hypothesis of identical sample's variances between 1996 and 2010 in all groups of the EU and euro area. Luxembourg and Ireland are not outliers in the analysis of the CPL convergence.

Table 2 σ convergence of nominal GDP per capita in EUR in the euro area and EU, 1996–2010

grouping	euro area-15	euro area-16	euro area-17	EU-24	EU-25	EU-26
F computed	3.203	3.001	2.147	2.838	2.759	2.414
F critical	2.484	2.404	2.333	2.014	1.984	1.955
p-value	0.019	0.021	0.069	0.008	0.008	0.016

Source: Eurostat (2011), own calculations
Note: The EU-26 sample does not include Bulgaria due to missing data; Luxembourg is excluded from the EU-24 and euro area-16 due to outliers; Luxembourg and Ireland are excluded from the EU-24 and euro area-15 samples due to outliers.

Table 3 σ convergence of GDP per capita in PPS and CPL in the euro area and EU (EU-27 = 100), 1996–2010

grouping	GDP per capita in PPS, EU-27 = 100			CPL, EU-27 = 100		
	euro area-15	euro area-17	EU-27	euro area-15	euro area-17	EU-27
F computed	2.947	1.565	1.864	3.355	3.073	3.227
F critical	2.484	2.333	1.929	2.484	2.333	1.929
p-value	0.026	0.190	0.059	0.015	0.015	0.002

Source: Eurostat (2011), own calculations
Note: Luxembourg and Ireland are excluded from the sample of the euro area-15.

4.3 Factors of simultaneous real and nominal convergence in the EU

As mentioned above, the primary factor of the lower CPL in less developed countries is the lower labour productivity, which is also lower in the non-tradable sector. So, the CPL differences among countries can be mainly explained by the labour productivity. For example, the Czech Republic and Slovakia achieve almost similar values of the CPL indicator (70.7% and 67.1% of the EU-27 average respectively in 2010) but different values of GDP per capita (80% and 74% of the EU-27 average respectively in 2010). However, the labour productivity of Slovak economy is higher than that of Czech economy. In 2010, the indicator of labour productivity, percentage of EU-27, achieved 82.2% in Slovakia in comparison to the Czech Republic, which achieved 73.4% in the same year.[6]

Resulting from the definition of the real convergence (Šikulová, 2006) the labour productivity is an indicator of real convergence as well and it is also positive correlated with the development of price level. In this term, the labour productivity can be regarded as a better indicator of real convergence. However, it is an important factor of the GDP per capita growth and thus there are mutual relations among all three indicators. The labour productivity is thereby especially the factor of the CPL convergence through the exchange rate channel of the real appreciation (Vintrová and Žďárek, 2007). However, it does not exclude the real appreciation through the second possible channel. As has been explained, this depends on the conditions of particular economies.

Explaining the CPL by labour productivity is not especially unambiguous. Some economies may have a high proportion of high-tech industries and thus high productivity at a relatively low price level. The examples in the EU are the United Kingdom and Ireland. Other economies achieve high productivity at a high price level, for example Denmark and the Netherlands. Regarding the other economic factors of the CPL differences among countries, the important ones are also the proportion of non-tradable sector and the size of indirect taxes in the economies.

To sum up, many factors influence the appreciation of RER. This appreciation consists of two channels of the CPL convergence. The B-S effect or generally the catching up process in terms of the real convergence are possible factors. The cost factors in terms of growth in the unit labour costs are other ones influencing the real appreciation in the new Member

States (Cincibuch and Vávra, 2000). This aspect of real appreciation is connected with the loss of competitiveness because rise in competitiveness in general exerts a downward pressure on prices (Dreger et al., 2007). Regarding the costs factors, i.e. growth in the ULC, we can say that these costs have been growing in all new Member States, with some of them achieving especially strong appreciation of the real effective exchange rate (REER) based on the ULC[7], mainly Slovakia, the Czech Republic, Romania and Bulgaria. On the other hand, Poland and Malta have achieved minor real appreciation as a result of the ULC growth, which is comparable with France and Finland. Generally, the older Member States have been achieving weak real appreciation or the depreciation (Germany, United Kingdom, Sweden, and Austria in year 2010) whereas the new Member States a typically strong real appreciation of the indicator. The result is a faster growth of the CPL by the new Member States and in this case, opposite to working of B-S effect, the loss of competitiveness.

4.4 Summary of the results

The economies with lower initial levels of GDP per capita in the EU grow faster and it is associated with a simultaneous increase in the CPL. In relation to the EU average values, the variability in the price level of the EU economies has been reducing and the overall variability of the nominal GDP per capita in the EU and the euro area (in the euro area after removal of the outliers for the economy of Luxembourg) has been also decreasing. The real σ convergence is less visible or we cannot claim it has been occurring in a significant extent within the EU and the euro area. It is not evident by the usage of the real GDP per capita indicator in the EU and euro area. When using the GDP per capita in the PPS, the hypothesis of its existence in the EU and euro area can be accepted after the removal of outliers for Luxembourg.

Tables 2 and 3, which reflect differences in the development of GDP per capita in PPS and CPL in relation to the EU average, can be completed with additional knowledge. Reducing differences between these variables, which is especially noticeable in the new Member States, is associated with reduction of the variability in the CPL variable while this trend is less clear by the GDP per capita in PPS (both in relation to the EU-27 average). Though the σ convergence of the GDP per capita in PPS takes place after removing the outliers, using the real GDP per capita

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[6] Data for labour productivity, expressed by GDP per person employed (EU-27=100), were obtained from Eurostat, 2011.

[7] The data of the real effective exchange rate (deflator: unit labour costs in the total economy – 27 trading partners, i.e. EU-27) indicator, extracted from Eurostat, were compared for the year 2010.

for analysis does not indicate it in the EU and euro area. Not reducing the differences in standards of living between more and less developed countries can have negative impacts and so appropriate measures in catching up countries are required to prevent high costs of participation of these countries in euro area. These can include the support of new technologies, the openness of economies and trade with other countries of integration group. These issues require a deeper analysis of factors of economic growth, structural convergence and characteristics of the integration process, which is beyond the extent of this article.

5. Fulfilment of the Maastricht criteria and its relations to the real convergence

The previous results of the analysis should be completed with some aspects of compliance with the Maastricht criteria, which are also the criteria of nominal convergence from an alternative point of view. They are the only official conditions of the entry into the euro area for the EU countries. Some important consequences of the compliance with these criteria in the preparation and integration of economies into the euro area arise in association with the on-going real and nominal convergence in its narrow conception. This is relevant to the catching up economies with lower economic and price levels.

5.1 Characteristics of the Maastricht criteria

The purpose of the Maastricht criteria is to ensure monetary or macroeconomic stability in the euro area, which should create a favourable environment for the long-term economic growth. However, the criteria themselves are not capable of ensuring long-term economic growth, high standards of living and the convergence of economic structures of the economies, i.e. real and structural convergence. They consist of three monetary and two fiscal criteria. Monetary criteria include the criterion of inflation similarity and exchange rate stability, which should manifest the country's ability to exist without its own monetary policy in a low inflation environment. Participation in the exchange rate mechanism (ERM II), which is associated with the exchange rate criterion, is necessary to help ensure that Member States outside the euro area are able to direct their policies to stability and to promote convergence in order to participate in the single currency area.

The third monetary criterion is concerned with the similarity of long-term interest rates, measured by the indicator of the rates of the ten-year government bonds. There are mutual relations among the three monetary criteria: price in/stability affects the exchange rate and it reversely affects the price stability. Convergence of interest rates is emphasised as a factor

of monetary stability in the euro area. It should lead to roughly similar credit conditions. The existence of interest rate differentials may lead to speculative capital movements and to pressures on appreciation or depreciation of currencies. A relationship exists between the development of inflation and interest rates and the development of interest and exchange rates as well. The fiscal criteria are concerned with the delimitation of the maximum share of the government deficit and debt relative to the GDP.[8] However, the critique of compliance with the Maastricht criteria is associated mainly with the lack of evidence of long-term sustainable readiness of economies for the participation in the euro area where no possibility of an autonomous monetary policy exists.

5.2 Some impacts of complying with the Maastricht criteria on the new Member States

In relation to the analysed problem it can be claimed that the simultaneous fulfilment of the price and exchange rate criterion is in general in contradiction with the price level convergence of economies with the lower initial economic and price level, i.e. with the catching up process. The previous analysis indicates a significant convergence of the CPL indicator and its approaching to the EU average or to the values of more developed economies while factors of this development can be the catching up process in terms of the real convergence (connected with B-S effect) and costs factors as well. It is possible to use the price or exchange rate channel of real appreciation. However, the fulfilment of these two Maastricht criteria can exclude both these channels simultaneously. In addition, there are other factors which affect the real exchange rate appreciation. As a result of the above mentioned factors of the CPL differences and its growth and convergence (described in the Section 3.1 and 4.3), the real appreciation in almost all new Member States is significant. This is an impact of combined effects of these factors (see Figure 4). In the monitored period 1995–2010, the most significant real appreciation has been achieving by Slovakia, Bulgaria, the Czech Republic, Romania and also other new Member States except Slovenia, Malta and Cyprus.

In order to satisfy the price and exchange rate criterion, both channels of the RER appreciation can be limited. The aggregate expenses of economies need to be reduced for this purpose and the real convergence in terms of catching up with the living standards of more developed economies can be slowed down.

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[8] There are many other interconnections of the criteria. The connections between the fiscal criteria and economic growth are especially significant. With respect to the scale of the topic no other aspects are analysed in this paper.
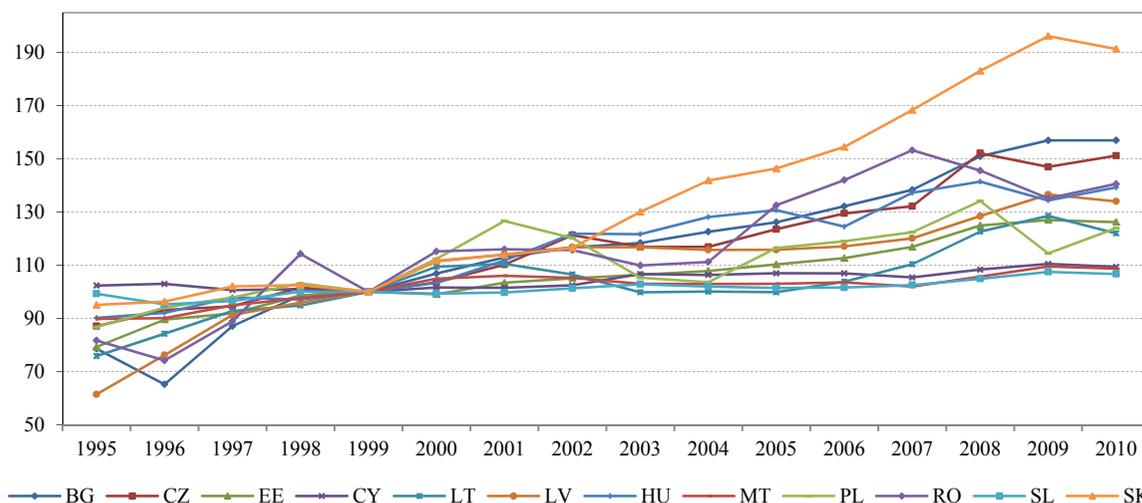
Figure 4 Real Effective Exchange Rate (deflator: consumer price indices – 27 trading partners) in the EU countries, (Index, 1999=100), 1995–2010,
Source: Eurostat (2011)

Moreover, after joining the monetary union, the exchange rate channel of catching up with the CPL is completely excluded and the price channel is limited by the monetary policy of the European Central Bank (ECB). Thus, the new Member States should also take into account the extent to which the exchange rate and price channel have played a role and can further play a role in their real appreciation. In section 3.1, it was generally pointed out that the price channel may include mainly supply and demand factors, deregulation of administratively set prices or tax arrangements and the exchange rate channel includes in particular the development of labour productivity (Vintrová and Žďárek, 2007). However, there are also differences in significance of these channels among economies of the new Member States. In almost all new Member States the price channel of the real appreciation has been significant roughly since the second half of the nineties till recently.[9] The exceptions may be considered to be two economies, i.e. Malta or Cyprus. For example, the exchange rate channel has been most significant in the Czech and Slovak economy for the period 1994–2010 and especially in the more recent period after the year 2000. In both economies the price channel was also particularly significant after the year 2000, though more so in the Slovak economy. The price channel has been dominant, especially in all Baltic economies and together with this the exchange

rate channel has played an important role in Lithuania. Latvia and Lithuania are the ERM II members in which the exchange rate channel is limited. Slovakia and Estonia are already members of the euro area, where this channel of real appreciation is completely excluded.

Bulgaria, Romania and Hungary are other three economies of the new Member States with particularly strong price channel of the real appreciation by simultaneous depreciation of the nominal exchange rate (NEER). Regarding the Polish economy, the appreciation of the REER in comparison to other Member States is overall low and has been so since 2000. In the second half of the nineties the price channel of the real appreciation in this economy has been especially strong by nominal depreciation on the average for the whole period 1994–2010. To sum up, all the non-members of the euro area may have a problem with the performance of either the price or exchange rate criterion, depending on which channel of real appreciation is dominant in their price convergence. Complying with both criteria simultaneously can subsequently limit parallel real and nominal convergence in terms of their narrow conceptions.

Moreover, there are some other aspects, i.e. asymmetric transmission channels, which can function in the euro area. The single monetary policy can have procyclical as well as countercyclical impacts on the new Member States as a result of these transmission channels. Namely, in case of fixed exchange rate in monetary union the exchange rate channel of the real appreciation is excluded and catching up countries achieve higher inflation rates because of the above mentioned reasons. This is especially typical of the new Member States which have achieved the CPL

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[9] These conclusions were derived from the Eurostat data of nominal (NEER) and real effective exchange rate indices (REER) for the period 1994–2010 extracted in the year 2011. REER indices are deflated either by the CPI or ULC. All effective exchange rates are computed in relation to the EU-27 economies.

convergence. Since in a monetary union, nominal interest rates are harmonised across countries, higher inflation rates of particular countries will lead to lower real interest rates. The new Member States are growing faster and achieving real convergence can be supported by ECB in terms of the overheating of the domestic economy. This may be at first glance seemed to be the opposite of the limitation of the real and nominal convergence, because the further growth of the price level is supported due to overheating of the economy. However, the opposite is true. The procyclical effect may be mitigated by the countercyclical effect arising from the rigidity of the nominal exchange rate. Because of the growth of labour costs following the overheating of the economy, the country is losing its competitiveness. The ECB is not able to cope with this asymmetry and can support economic divergence in the euro area (Mongelli, 2008).

Thus, it is questionable whether the performance of macroeconomic stability achieved through fulfilment of the Maastricht criteria and participation in the euro area can support economic growth of economies more significantly compared to the potential adverse effects of its fulfilment. Besides the reduction of the convergence due to decrease in aggregate expenses and slowing down the economic growth, the potential asymmetric transmission mechanisms working in the monetary union could also lead to divergence. Moreover, it is not possible to omit the fact that external shocks are able to influence the whole convergence process in significant way and in case of the existence of monetary union with combination of lack of competitiveness of countries may the negative impacts be particularly significant.

6. Conclusion

Regarding the aim of the paper, a relationship between the real and nominal convergence was detected. The countries of the EU with lower level of GDP per capita also achieve lower price levels and simultaneous real and nominal convergence occurs in these countries. The Maastricht criteria may lead to negative effects on the catching up economies joining the euro area, which experience simultaneous real and nominal convergence.

Economies with lower initial levels of GDP per capita grow faster and this development is connected with the simultaneous growth of the CPL. A positive relation between the development of the economic and price level variables, i.e. the GDP per capita in PPS and CPL, can be confirmed. However, some economies have been achieving higher GDP per capita in PPS over a longer period in comparison with the CPL (e.g. Netherlands, Germany, Austria, the Czech Republic and Slovakia) whereas both variables are in

the relation to the average value of the EU-27. On the contrary, other EU economies have been achieving higher values of the CPL in a longer term (e.g. Denmark, Estonia, and Latvia). The CPL differences between countries can be primarily explained by differences in labour productivity.

An important factor influencing these relationships and leading to the RER appreciation, especially in the new Member States, is the catching up process also connected with working of the B-S effect. The other significant factors of the CPL development are the changes in the unit labour costs as well. Regarding these cost factors, we can say that labour costs have been growing in all new Member States, with some of them achieving especially strong appreciation of the real effective exchange rate based on the unit labour costs. This has been typical, especially in Slovakia, the Czech Republic, Romania and Bulgaria. The result is faster growth of the CPL by the new Member States and in this case, opposite to the working of structural factors, the loss of competitiveness.

It is likely that the real convergence in the narrow conception in the EU and the euro area occurs in terms of β convergence, i.e. economies with lower initial levels grow faster. This cannot be certainly confirmed by using the concept of σ convergence, i.e. reducing the variability of the GDP per capita. The real σ convergence hypothesis, measured by reducing the variability of the real GDP per capita in the EU and euro area, was rejected at the 5% significance level. When using the indicator GDP per capita in PPS relative to EU-27, σ convergence cannot be confirmed in the sample of EU-27 economies and the euro area-17. However, the *F-test* confirms the reduction of indicator variance in the EU and euro area (1996–2010) after removal of the outliers for Luxembourg. On the contrary, the nominal convergence in terms of reduction in the variability in price levels among the EU and euro area economies occurs in relation to the EU-27 average. Similar conclusions can be demonstrated using the comprehensive indicator of nominal convergence, i.e. nominal GDP per capita, where again the existence of nominal σ convergence in the analysed groups of the EU and euro area (in the euro area after removal of the outliers for Luxembourg) is confirmed. Variability in price levels among the EU economies in relation to the EU average was reduced and the reduction of the overall variability of nominal GDP per capita in the EU and the euro area (after removal of the outliers) also occurred.

A reduction in the differences between GDP per capita in PPS and the CPL in time, which is especially visible in more new Member States, is associated with reduction in the variability of the CPL indicator in the EU and euro area. So, when the economies with

a lower initial level of GDP per capita in the EU grow faster, it is associated with a simultaneous increase in the CPL. The variability of the CPL in the EU and the euro area was reduced and the nominal σ convergence has occurred. A trend of decrease in variability of GDP per capita in the PPS during this development is visible after removing the outliers for Luxembourg.

The Maastricht criteria are formal conditions of joining the euro area, and the nominal convergence criteria from an alternative point of view. These criteria have been established in order to ensure macroeconomic stability in the euro area. However, they are not by themselves able to provide the long-term economic growth or real and structural convergence of economies. Moreover, the Maastricht criteria may lead to negative effects on the catching up economies joining the euro area, which experience simultaneous real and nominal convergence in their narrow conceptions. The limiting factor for the economies of the new Member States entering into the euro area can therefore be a parallel fulfilment of these official criteria of nominal convergence with the nominal and real convergence in their narrow conception by limiting the both channels of real appreciation. Moreover, after joining the monetary union, the exchange rate channel of catching up with the CPL is totally excluded and the price (inflationary) channel is limited by the common monetary policy of the ECB. It is relevant to consider these aspects by the new Member States integrating into the euro area. The importance of external shocks, such as the latest economic crisis, cannot be underestimated also. These shocks can significantly influence or reverse all the convergence process.

In terms of macroeconomic convergence it is desirable to analyse the additional areas more in depth. Besides the impacts of convergence and the euro area participation on the economic growth should the further research be focused more on its impacts on the employment and unemployment. Low unemployment and high employment rates should be the overall goal and the result of economic growth. Otherwise, economic growth fails to have its desired positive significance and social inequality can deepen, with further adverse impacts on living standard of economies. Moreover, the structural convergence in terms of the Optimum Currency Area theory should be extended to new quantitative methods and indicators for an assessment of the structural similarity and convergence of economies. This structural similarity increases the likelihood that the benefits of the euro area membership exceed the costs associated with it. The other important area which should be taken into account is the convergence in all mentioned meanings among regions across the EU. It is not possible to omit this area in the integration group such as the EU where national borders have been becoming less important.

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