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Petar Sopek

Real Convergence of EU-27 and Croatia in the Period 1995-2017

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REAL CONVERGENCE OF EU-27 AND CROATIA IN THE PERIOD 1995-2017[1]

Petar Sopek[2]

Abstract

One of the main economic objectives of the European Union is diminishing differences in the level of development among EU Member States, i.e. real convergence process. The main aim of this paper is to analyse disparity and historical movements of real convergence of all 27 current EU Member States and Croatia in the period from 1995 to 2011, but also to provide an insight into possible directions of real convergence in the future period up to 2017. Final results show that in the three observed periods (1995-2004, 2004-2011 and 2011-2017) there are significant differences evident in the level of economic development as measured by GDP per capita among the observed EU Member States and Croatia. However, in all three observed periods the disparity between new Member States and Croatia and old EU Member States is diminished, i.e. the existence of real convergence is confirmed. The impact of still ongoing global economic crisis led to deceleration of real convergence, primarily due to slow recovery of less developed Member States. It is shown that the Croatian real convergence has followed the EU-12 real convergence trend relatively well, especially in the period from the beginning of the century and before their formal membership in the EU. After the accession of these 12 countries into the EU (after 2004) there is evident a bit slower trend of the real convergence of Croatia compared to EU-12, and this trend is expected to be continued also in the forthcoming period, regardless of the Croatian membership in the EU.

Keywords: real convergence, GDP per capita, European Union, New Member States, Croatia

[1] This version is just the first draft of the paper and is still unrevised. The paper is currently in the process of independent peer review for the Financial Theory and Practice magazine.

[2] The author is employed in Privredna banka Zagreb (PBZ) in the Risk Management Division. However, the views expressed in this paper are exclusively those of the author and do not necessarily represent those of PBZ. Therefore, this paper should not be construed as representing the views of Privredna banka Zagreb.

1. Introduction

Each country is a specific unit which differs from others with respect to geographical characteristics and natural resources, inherited conditions, mentality of its citizens, way of execution of different social and economic policies, received grants and similar. All of these factors impact countries' ways and level of development, as well as the level of their general wealth. Economic integrations are intended to achieve long-term diminishment of differences in the level of development and unified economic growth and prosperity, i.e. gradual real convergence of integrated countries.

The existence and measurement of real convergence of old and new EU Member States is very often the topic of modern professional and scientific literature which deals with economic integrations (see for instance Kutan and Yigit, 2005; European Commission, 2009; Morgese Borys, Polgár and Zlate, 2008; Žďárek and Šindel, 2009 etc.). European Commission (2009:33) estimated the relationship between growth and the level of GDP per capita for the 27 EU countries for the five years before and after enlargement in 2004. Results show that β-convergence took place, supporting the notion that countries with a lower income level (the new Member States) were growing at a faster pace. Furthermore, while the speed of convergence in the pre-accession period was 2.3%, it increased further to 3.4% following enlargement. With regard to σ-convergence in the enlarged EU, the European Commission (2009:33-34) found that income dispersion remained largely the same during the 10 years examined. However, if Luxembourg were excluded, the dispersion after enlargement would have decreased. However, this increase in income equality was due to diminishing disparities among the new Member States, as there was no further convergence among the old EU Member States. Final conclusion was that the new Member States with low GDP per capita were not only catching up with their wealthier peers in relative terms, but they were doing so at a fast enough pace for absolute income inequalities to diminish over time (European Commission, 2009:33-34).

In the context of Croatia's forthcoming EU accession it is interesting to investigate whether this enlargement of the EU will increase total disparity of the level of development between the Member States and what would be the trends expected in the following period. Therefore, the main objective of this paper is to analyse historical movements of real convergence of all

27 current EU Member States and Croatia in the period from 1995 to 2011, but also to provide an insight into possible directions of real convergence in the medium-term period up to 2017. Since the majority of existing literature dealing with this topic is dedicated to ex-post estimations of real convergence movements, this paper tends to provide additional contribution to scientific and professional literature in the context of future directions of real convergence development. For the analysis of real convergence trends different statistical and econometric analyses were used, from basic descriptive statistics of per capita GDP movements and labour productivity to more advanced σ-convergence and β-convergence.

Final results show that in the three observed periods (1995-2004, 2004-2011 and 2011-2017) there are significant differences evident in the level of economic development as measured by GDP per capita (PPS) among the observed EU Member States and Croatia. However, in all three observed periods the disparity between new Member States and Croatia and old EU Member States is diminished, i.e. the existence of real convergence is confirmed. The impact of still ongoing global economic crisis led to deceleration of real convergence primarily due to slow recovery of less developed Member States. It is shown that the Croatian real convergence has followed the EU-12 real convergence trend relatively well, especially in the period from the beginning of the century and before their formal membership in the EU. After the accession of 12 new Member States to the EU (after 2004) there is evident a bit slower trend of real convergence of Croatia compared to EU-12, and this trend is expected to be continued also in the forthcoming period, regardless of the Croatian membership in the EU.

The paper is structured as follows: After the introduction follows the section which defines and discusses real convergence together with its broader causes and implications like interdependence with nominal convergence, impact of common EU policies and similar. Third section deals with descriptive analysis of disparity in the level of development of the EU Member States and Croatia, as well as historical movements of GDP per capita and labour productivity. In fourth section are defined, calculated and discussed various measures for analysing existence and development of real convergence. After that follows a paper conclusion and recommendations for further research.

2. Real Convergence

Convergence means a process of gradual reduction in differences among observed participants (countries, regions, etc.) in certain time period and it connotes time dynamics and conditions that determine direction and speed of its development (Kandžija and Cvečić, 2011:1055). Economic convergence means a process of approaching the values of economic variables among countries in a way that less developed countries develop faster and catch up with more developed ones (Bilas, 2005:221). Real convergence connotes diminishing differences in the level of development (e.g. similarities in GDP per capita, level of nominal wages and prices and other) and the crucial factor of convergence and sustainable growth is human factor (Kandžija and Cvečić, 2011:1055). However, it is very often the case that real convergence is defined as the process of approaching the level of GDP per capita and comparative price level of the given country to levels that correspond to the long-term steady state (Kulhánek, 2012:2). Opposed to real convergence, there is also a nominal convergence which represents a multilateral process, defined by the gradual harmonisation, at a relatively high rate, of the national institutions and policies of the member countries with the EU ones, in the monetary and financial field (Iancu, 2009:1). The Maastricht Treaty defines precise criteria of nominal convergence, i.e. minimum requirements that should be fulfilled in order to access the Economic and Monetary Union (EMU). These conditions mean price and exchange rate stability, sustainable fiscal status (deficit and public debt) and long-term diminishment of interest rates.

According to Veiga (1999:1), real convergence occurs if (1) poorer countries or regions are growing faster than rich ones, (2) if the dispersion of GDP per capita is decreasing over time, (3) if country or regional rankings of GDP per capita are not persistent, or (4) if the regional distribution of GDP per capita is evolving towards an increased concentration at the centre (at the EU average).

Iancu (2006:2) claims that considering the way the determinants and trends of real convergence are approached, the studies and models may be divided into three categories:

- The first one views real convergence as a natural process, based exclusively on the market forces, in accordance with which the convergence process is surer and faster as the market is larger, more functional, less distorted.

- The second one denies that, in the present competitive market, there is an actual real convergence between the poor and the rich countries, but accepts the existence of the tendency of polarisation or deepening of the divergences and inequalities between the centre and the periphery.
- The third one considers that real convergence is necessary and possible in a competitive market, provided that economic policies are implemented to compensate for the negative effects of the inequalities or divergences, until the economic systems reach maturity or the so-called critical mass to support the self-sufficiency of the real convergence process.

Real convergence is not a spontaneous process; in many senses it depends on capability of a country to follow technological spill-overs, especially through foreign direct investments. Macroeconomic stability, efficient competitiveness on goods, services and production factor markets, as well as quality human capital are needed for it (Bilas, 2005:223). According to Mihaljek (2003:59), the purpose of the whole process of convergence is to achieve a gradual approximation of the level of per capita income of the countries in the region to the average of the less developed members of the EU. Real convergence can be attained only with high rates of growth sustained in the long term, i.e. if they are accompanied by macroeconomic stability and institutional effectiveness. In other words, meeting the criteria for joining the EU and the EMU is a necessary, but not sufficient condition for successful long-term economic development.

There are numerous findings in the literature that confirm interdependence of real and nominal convergence. According to Lein-Rupprecht, León-Ledesma and Nerlich (2007:9), a catching up economy with high rates of productivity growth is assumed to experience more rapid convergence of productivity levels in the tradable goods sector than in the non-tradable goods sector. Stronger productivity growth in the tradable goods pushes up wages in this sector. Under the assumption of perfect labour mobility across sectors, wages rise in the whole economy. As productivity growth in the non-tradable sector is assumed to lag behind that of the tradable sector, higher wages in this sector translate into higher prices of non-tradable goods and hence an increase in the overall price level. This is often referred to as the internal version of the Balassa-Samuelson effect (Lein-Rupprecht, León-Ledesma and Nerlich, 2007:9).

Nestić (2004:21) considers the factors that may influence the process of price level convergence, especially in transition countries, and concludes that three factors come to the

foreground. One is the initial price level, the other is productivity growth, i.e. income level, and the third potential factor of convergence is the initial deviation from the expected price level where expectations are based on the income level. By these findings it is confirmed that price level convergence can appear without real convergence. In case of transition countries this is certainly the result of historical inheritance, i.e. certain structural factors, with the price level in most of these countries being set „too low" relative to the income level in the early stages of transition (Nestić, 2004:21).

Achievements in the area of real convergence of less developed EU Member States should not be considered without the contribution of EU regional policies. The main aim of regional policies is to enhance long-term growth of less developed EU areas, i.e. diminishing differences in the level of development among countries and regions. According to Kandžija and Cvečić (2011:1055-1056) decrease of regional disparities constitutes the pre-condition of the Economic and Monetary Union realization and internal European market functioning. Furthermore, inequalities among EU Member States cause differentiated effects of application of common policies. Thus, it is necessary to act in the direction of their decrease, i.e. convergence, which will in the end result in the increased effectiveness of applied policies.

In the EU Member States and potential candidate countries special importance in development strategies have regional EU policies, i.e. structural funds, Cohesion Fund, as well as other aids and grants (see for instance Kandžija and Cvečić, 2011; European Commission, 2011; Cuculić, Faulend and Šošić, 2004; Sopek, 2013). Structural Funds have three main objectives: promotion of the development and structural adjustment of regions whose development is lagging behind, economic and social assistance to areas with structural difficulties, and assistance to adaptation and modernization of policies and systems for education, training and employment. The Structural Funds cover exclusively regions whose GDP per capita is below 75% of the EU average. Countries eligible for cohesion funding are those EU Member States with a gross national income lower than 90% of the EU average. The Cohesion Fund finances action on the trans-European transport networks, priority projects of special interest, as well as some other transport and environmental activities. Direct support schemes for farmers come from the Agricultural Fund, or more precisely from the part of it for guarantees, and they constitute an important part of the transfers from the EU budget. These mean direct aids (the largest share), refunds for the export of agricultural products to third countries, intervention measures for regulating the agricultural markets (for wine, fruit and vegetables, milk, sugar etc.) and others. Transfers by means of internal policies

include a variety of the EU programs aimed at increasing the co-operation between the Member States in the conduct of common policies, and these are for instance programs for investment in citizenship, freedom, security, justice, education, environmental protection, research, energy efficiency and so on. The main reason for the existence of these programs is that the EU considers that it is much better to implement common policies through various organizations, associations and legal entities, rather than by public authorities only (Sopek, 2013:35-36).

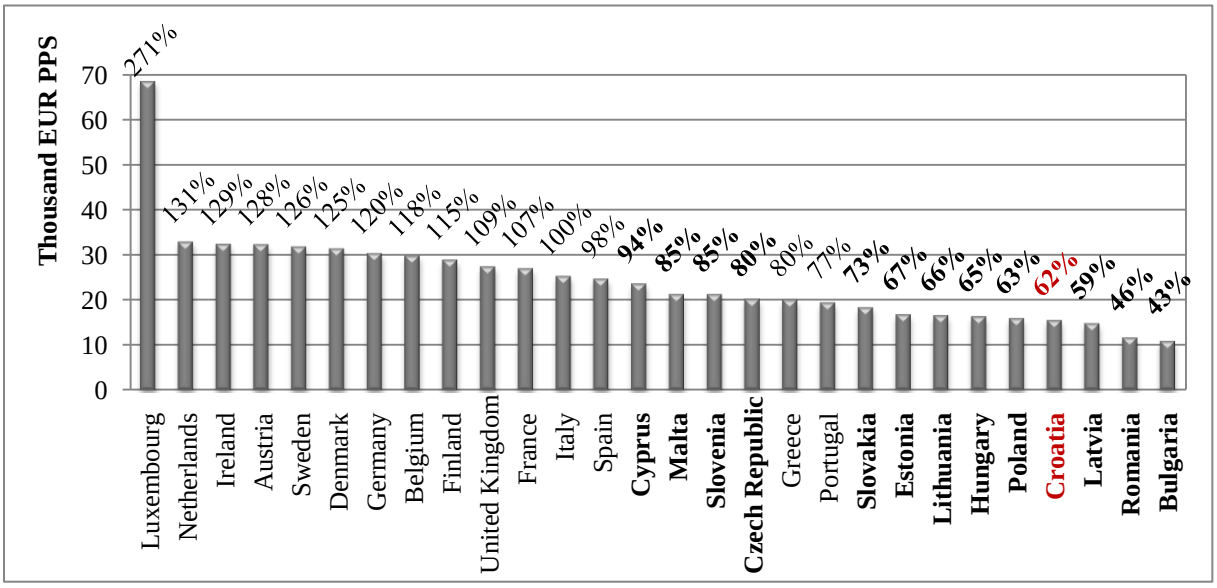
Although it is not questionable that these measures have a positive effect on the economy development, yet there are some necessary preconditions for their effective use, and they mainly relate to building adequate absorption capacities. Bilas (2005:223-224) states that no matter of the benefits arisen from the integration with the EU and liberalization of the trade, possibilities of a certain country to utilize these benefits depend on their policies, especially in the area of macroeconomic stabilizations, development of human capital and openness to foreign investments. Reiner (2003:16-17) stresses that EU regional policies can only exert a positive impact on real convergence if the supported countries are characterised by a stable macroeconomic environment and institutional and microeconomic structures that are conducive to growth. The former includes a low level of inflation and sound budgetary policies. The economic policy framework of the EU in combination with a monetary policy focused on maintaining price stability helps to ensure a growth-enhancing macroeconomic environment. The latter includes inter alia a regulatory framework that facilitates the setting-up and growth of endogenous companies as well as foreign direct investments, a business-friendly tax system, sound financial markets, efficient transport and communication infrastructures and a high level of human capital endowment in the workforce (Reiner, 2003:16-17).

3. Old and New EU Member States and Croatia

The issue of the real convergence in the EU can be seen from various viewpoints. For example, one can analyse real convergence from the standpoint of the current EU (or EMU) members, from the standpoint of the EU members in a particular period or from the standpoint of future EU members. In this paper will be analysed the historical development of

real convergence of the EU members and Croatia in the period from 1995 to 2011, as well as future expected real convergence up to 2017. In the context of the historical trend of real convergence particularly interested is the year 2004, because on 1 May 2004 there was the biggest historical enlargement of the EU with inclusion of 10 new Member States: Cyprus, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Slovakia and Slovenia. In that moment total number of the EU population increased for approximately 74 million or 19% (Eurostat, 2012a), while total GDP in the EU increased by only EUR 569 billion or 5% (Eurostat, 2012b). The main reason was that all new Member States were on a relatively lower level of economic development in comparison with previous 15 Member States. Although in the whole previous period from 1995 to 2011 all EU-27 Member States are taken into account, this period due to the obvious structural changes will be divided into two parts, the first one from 1995 to 2004, and the second one from 2004 to 2011. Figure 1 shows GDP per capita of all EU Member States and Croatia and as a percentage of EU-27 average in 2011.

Figure 1. GDP per capita of all EU Member States and Croatia (in thousand EUR PPS) and as a percentage of EU-27 average (EU-27 index 100%), year 2011



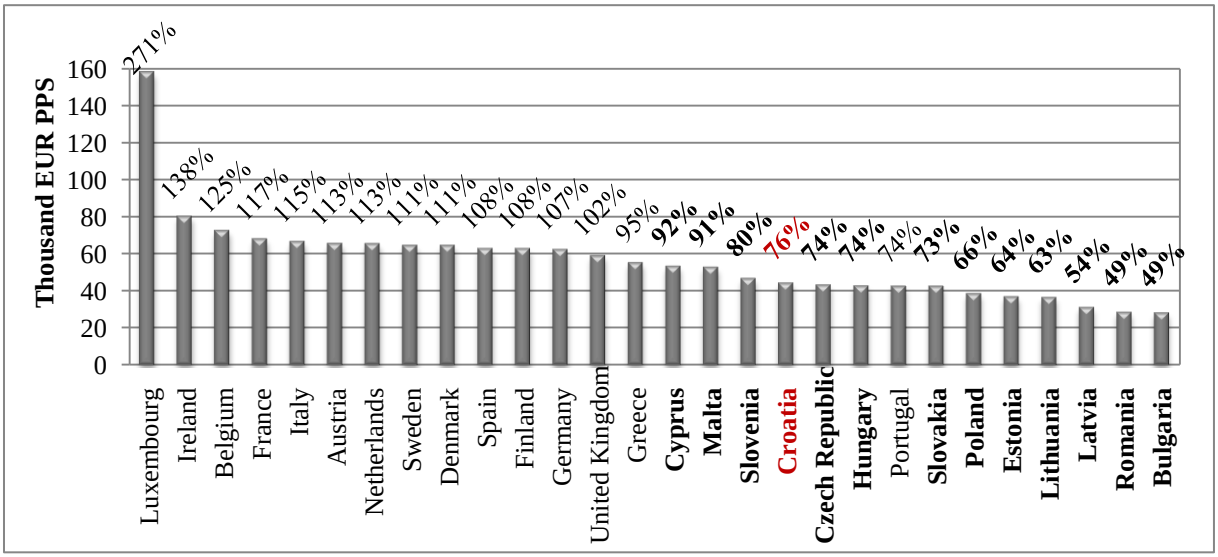
Source: Eurostat (2012b), author's calculation and adjustment

The GDP per capita measured by the purchasing power standard (PPS) is a very good indicator of the standard and level of development of a particular country[3]. From the

[3] The purchasing power standard (PPS) is an artificial currency unit that can be used as an equivalent of EUR regarding the purchasing power or as EUR in real terms. Theoretically, one PPS can buy the same amount of

presented figure it is obvious that in 2011 new Member States were still below EU-27 average. Next to these 12 countries, below the EU-27 average were also Greece, Portugal and Spain, while Italy was marginal at 100%, i.e. all PIGS countries[4]. Croatia, as a future 28th EU Member State, is also significantly below EU-27 average per capita GDP and with its 62% of the EU-27 average it ranks 25th. All of these countries have to put a significant effort to move their living standard closer to those of more developed Member States. Figure 2 shows labour productivity measure in the EU Member States and Croatia in thousand EUR PPS and as a percentage of EU-27.

Figure 2. Labour productivity in EU Member States and Croatia (in thousand EUR PPS) and a percentage of EU-27 average (EU-27 index 100%), year 2011



Source: Eurostat (2012b, 2012d), author's calculation and adjustment

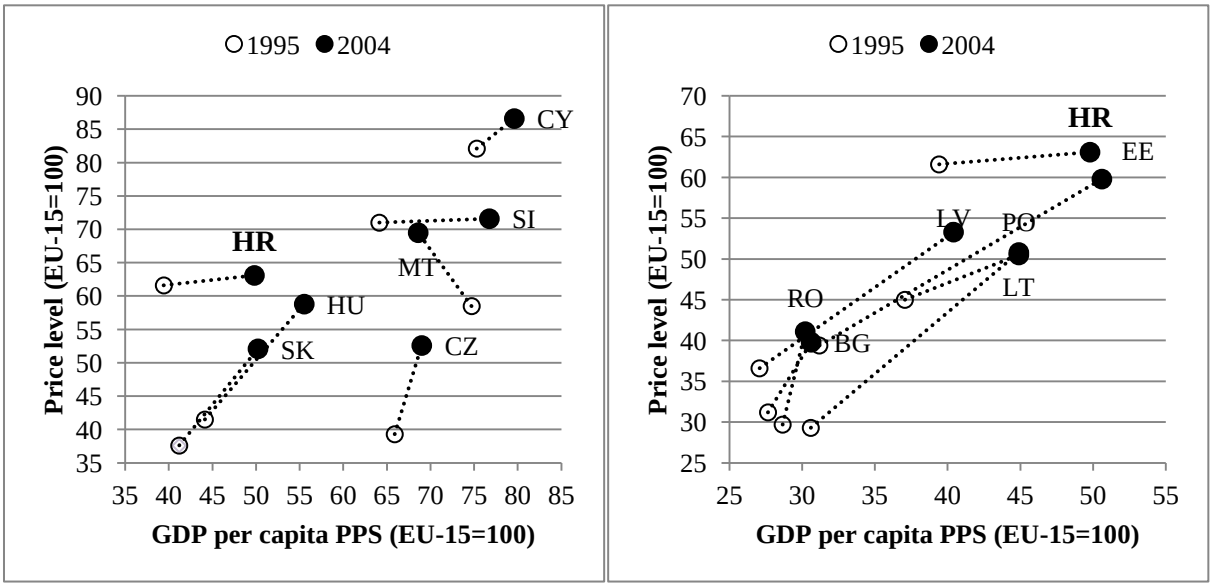
The measure of labour productivity is calculated as a ratio of GDP expressed in EUR PPS and average number of employed persons according to the Labour Force Survey by the methodology of the International Labour Organisation (ILO). As in the case of GDP per capita, all new Member States and Croatia are below EU-27 average. However, in comparison with the data shown on Figure 1, some changes are obvious in the rankings of countries. It is an interesting fact that according to the labour productivity Croatia holds relatively high 18th place with the labour productivity of 76% of EU-27 average.

goods and services in each country. For this reason PPS is used for comparison of monetary indices in various countries.

[4] PIGS is an abbreviation for Portugal, Italy, Greece and Spain that are taken together in the same context due to similar economic circumstances. Since 2008 the mentioned abbreviation has been extended by Ireland, so PIIGS is a term used for the group of European countries hit the hardest by the financial crisis.

It is quite obvious that new Member States and Croatia are below EU-27 average according to both the index of economic development and the index of labour productivity, but the crucial question is whether the mentioned disparity increases or decreases over time. As an answer to this question, the following figures can be useful.

Figure 3. Convergence of GDP per capita and the price level of new Member States and Croatia in the period from 1995 to 2004

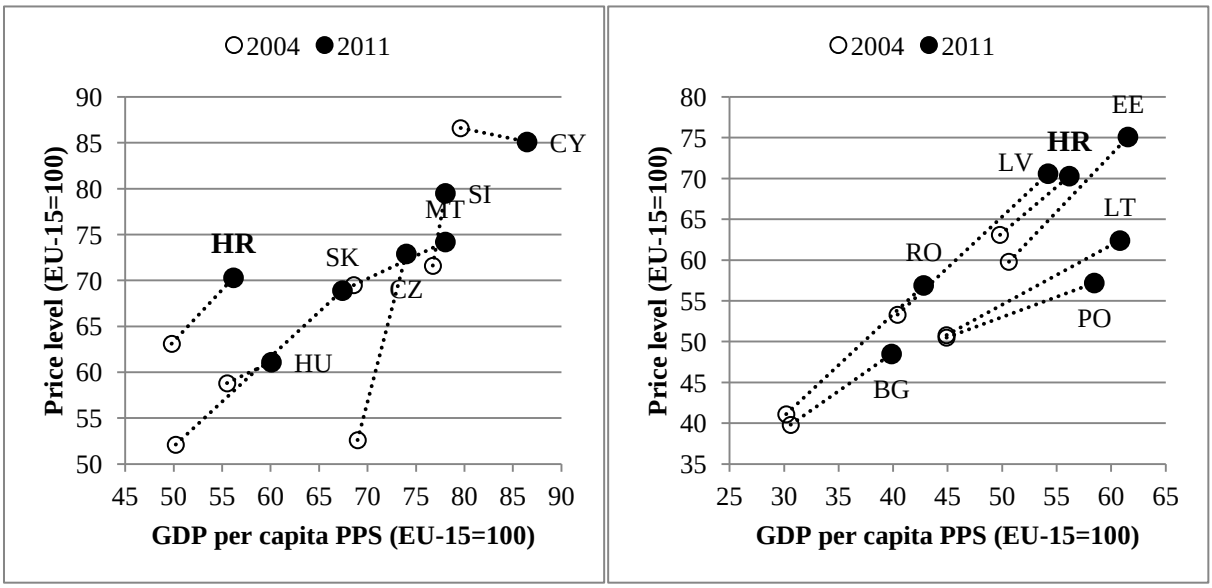


* In Eurostat database data for price level for Croatia have been available only since 2003. Real line on the upper graph probably should be significantly steeper.

Source: Eurostat (2012b, 2012c), author's calculation and adjustment

Figure 3 clearly shows real (and nominal) convergence of new EU Member States in the period after accession because almost all countries recorded a diagonal shift to the direction of the upper-right corner. This actually means that the less developed countries managed to grow faster even before the accession to the EU compared to the more developed ones. Positive trends of diminishing differences in terms of GDP per capita of the old EU Member States are also visible in Croatia, which with less than 40% of the EU-15 average in 1995 grew to 50% of old Member States average in 2004. Only Malta from the observed countries above recorded the fall of GDP per capita in the observed period.

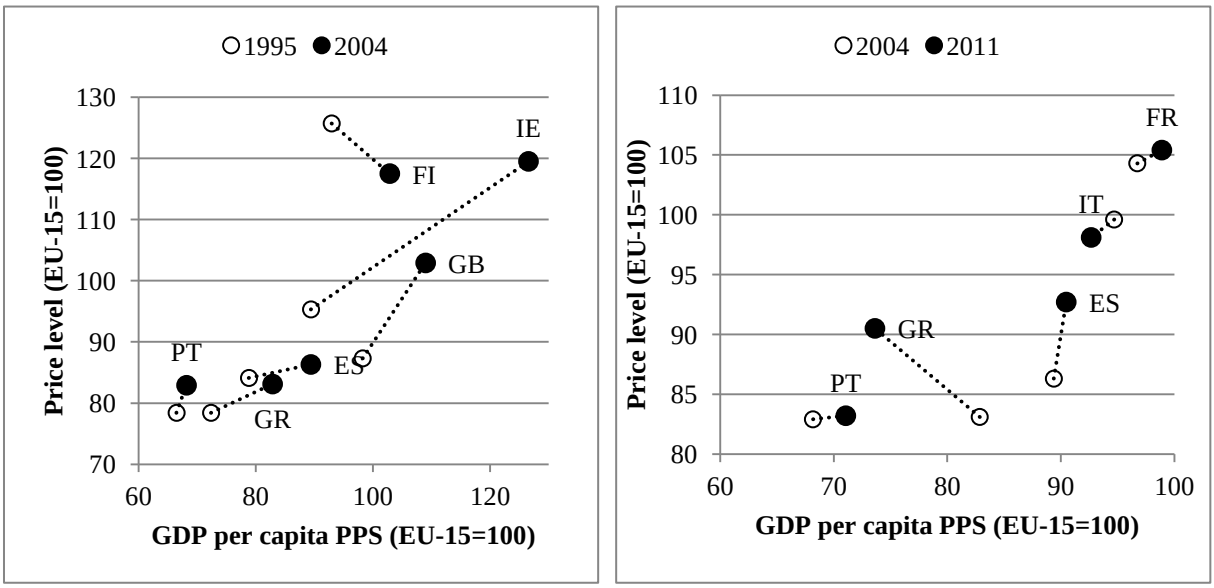
Figure 4. Convergence of GDP per capita and the price level of new Member States and Croatia in the period from 2004 to 2011



Source: Eurostat (2012b, 2012c), author's calculation and adjustment

After accession, the new Member States still continued to record positive trends in GDP per capita and the price level compared to the EU-15 average. Thus, in the period 2004-2011 in almost all countries there has been clearly visible diagonal shift in the direction to the upper-right corner. An identical trend is discernible in the case of Croatia.

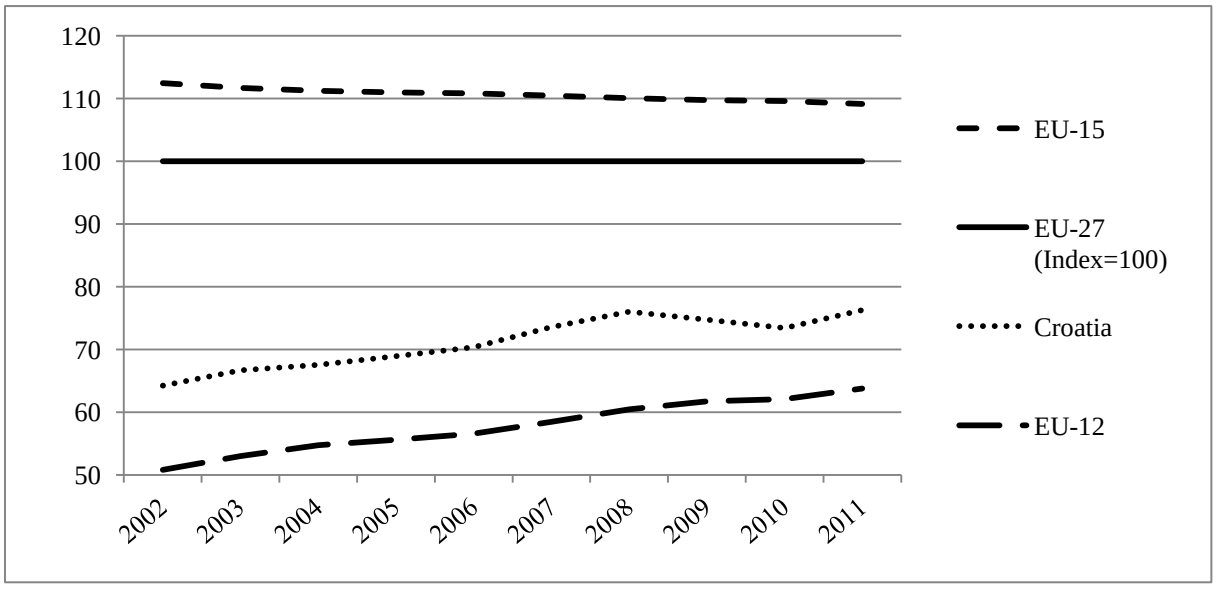
Figure 5. Convergence of GDP per capita and the price level of certain old EU Member States in periods 1995-2004 and 2004-2011



Source: Eurostat (2012b, 2012c), author's calculation and adjustment

Figure 5 contains only those EU-15 Member States that were below EU-15 average regarding GDP per capita (index lower than 100) in the observed years. In the period 1995-2004 all six observed countries from Figure 5 (Finland, Greece, Ireland, Portugal, Spain and Great Britain) recorded positive trends of GDP per capita in comparison with the EU-15 average, while all countries except Finland recorded also the growth in the price level compared to the EU-15 average. Without any doubt, the most interesting of all selected countries is Ireland whose GDP per capita increased from 89.4% of EU-15 average in 1995 to 126.5% of EU-15 average in 2004. In the period 2004-2010 Figure contains five countries with GDP per capita below the average of EU-15, and those are France, Greece, Italy, Portugal and Spain. Portugal, Spain and France recorded the growth of GDP per capita in comparison with EU-15 average, while only Italy recorded a decrease in both indicators in relation to the EU-15 average.

Figure 6. Trend of labour productivity in comparison with EU Member States average (EU-27 index=100) in the period 2002-2011



Source: Eurostat (2012b, 2012d), author's calculation and adjustment

The trend of labour productivity comprises the period from 2002 to 2011, since for the earlier period there are no available data for the number of employed persons for most of new Member States. Similarly as in case of GDP, labour productivity in new Member States and Croatia recorded upward trend throughout the period of 2002-2011. In the old Member States, this trend has been slightly downward, which affects the reduction of disparities in labour productivity between old and new Member States. Particularly important is that labour

productivity in Croatia has been above the average of all new Member States for 13.5 percentage points (or in average 23.5% above).

4. Measurement of real convergence of EU-27 and Croatia

Figures from the previous section clearly show upward trends of per capita GDP and labour productivity of new Member States and Croatia compared to the EU-15 and EU-27 averages. This evidently decreases the disparity in the level of development among all EU Member States, which is almost certainly the indicator of the existence of real convergence in the EU. However, in order to prove this analytically, it is necessary to specify models for real convergence measurement and then apply these models to real data. For that purpose this paper identifies four different models, i.e. four different measures of real convergence, and these are catch-up rate, β-convergence (cross-section and panel) and σ-convergence. The focus of this analysis is put on the convergence of all EU-27 Member States and Croatia.

The estimation of the existence of real convergence will be considered separately for each of three defined periods. First period includes data from 1995 to 2004, i.e. from the earliest available data in the Eurostat database to the largest enlargement of the EU. The second period comprise historical data from 2004 to 2011. Data used in the analysis of these two periods, that is from 1995 to 2011, are available in Eurostat database (2012b). The third period is oriented to future medium-term perspective up to 2017, whereby actual projections available in the moment of writing this paper will be used. In other words, actual Croatian GDP growth estimates for the years 2012 and 2013 are available from public press release of the Institute of Economics, Zagreb (2012) in which it is estimated that the Croatian real GDP growth rate was -1.3% in 2012 and will be 0.8% in 2013. For further projections, as well as for projections of average GDP growth rates of EU countries, IMF forecasts were used (IMF 2012a; 2012b)[5]. For the sake of simplification of calculation of GDP per capita, it is assumed that the number of inhabitants in Croatia and the EU will not change significantly[6].

[5] Since the IMF forecasts cover only 2012, 2013 and 2017, for the period between 2013 and 2017 (i.e. for years 2014-2016) linear growth of real GDP was assumed. In other words, growth estimations for the period 2014-2016 were extracted as the linear interpolation of the real growth estimates in 2013 and 2017.

[6] This is a key assumption which enables to identify GDP per capita PPS growth with real GDP growth.

2.1. Catch-up rate

The catch-up rate is an indicator which measures the pace of catching-up more developed countries. Halmai and Vásáry (2010:233) argue that the pace of catching-up and convergence are not identical concepts. Both concepts may be interpreted in a negative light. However, their dynamics are not identical: catching-up is the distance to be travelled, while convergence expresses the measure of progress. Consequently, in the context of growth, the extent of the catch-up will be greater in the case of a narrower residual difference, while the measure of convergence shall accordingly be lower. According to Halmai and Vásáry (2010:234), the catch-up rate can be defined by the following expression:

$$CR = 100 \cdot \frac{\Delta\left(y_{i,t} - y_t^*\right)}{\left(y_{i,t-1} - y_{t-1}^*\right)} \qquad (1)$$

where $y_{i,t}$ denotes GDP per capita measured by the purchasing power standard of a country i in time period t, y_t^* is an average of EU-15 Member States, and Δ denotes the difference between time periods $t-1$ and t. The catch-up rate is generally calculated by means of the historical actual growth rate and serves as a framework for ex post analysis of catch-up dynamics. In case of negative catch-up rates disparity between countries concerned and the EU-15 average is decreased and vice versa. This paper also extends catch-up consideration by calculating catch-up rates in the forthcoming period up to 2017.

As it is shown on Table 1, the disparity between all PIGS countries and EU-15 increases in the whole period, which is primarily the consequence of positive catch up-rates of Italy. The situation is completely different when EU-12 and Croatia are considered. In the period up to 2004 all EU-12 Member States, just like Croatia, recorded positive catch-up rates, i.e. the disparity between them and the EU-15 average increased. In the period from 2004 to 2011 the catch-up rate turns to negative, meaning that both EU-12 average and Croatia managed to decrease the disparity between themselves and EU-15 Member States. In the future period the situation could also move in favour of new Member States, while it may be slightly unfavourable for Croatia.

Table 1. Average annual catch-up rates of selected EU countries (PIGS, new Member States) and Croatia in various periods

	1996-2004	2004-2011	2011-2017
Portugal	3.6	1.7	4.0
Italy	2.3	22.9	10.7
Greece	-1.0	8.8	9.4
Spain	-3.4	2.1	8.7
PIGS Average	**0.4**	**8.9**	**8.2**
Bulgaria	3.7	0.1	0.4
Czech Rep.	3.3	-0.4	-2.9
Estonia	0.4	-1.7	-3.6
Cyprus	2.1	-2.8	0.2
Latvia	1.9	-1.8	-2.1
Lithuania	1.6	-2.4	-4.3
Hungary	1.6	0.7	0.2
Malta	7.3	-1.1	-3.1
Poland	2.6	-1.8	-2.3
Romania	3.9	-0.9	-0.2
Slovenia	-0.6	0.2	0.4
Slovakia	2.3	-3.4	-3.3
EU-12 Average	**2.5**	**-1.3**	**-1.7**
Croatia	**2.0**	**-0.2**	**0.4**

Source: Author's calculation

Figure 7. Annual catch-up rates of EU-12 Member States and Croatia in the period from 1996-2017

Source: Author's calculation

Figure 7 implicates one very interesting observation not visible from Table 1. The catch-up rate of new Member States was negative already three years before the formal EU membership. One of the reason for negative catch-up rate in that pre-accession period may be the preparation of these countries for the EU membership, that is the utilization of various pre-accession aids and arrangements up to 2004. Moreover, it can be noticed that annual catch-up rate of Croatia followed EU-12 catch-up rate relatively well, especially in the period from the beginning of the 21st century, and before the formal membership of EU-12. After the accession of new Member States it is evident a bit slower trend of catching-up of Croatia compared to EU-12, and influenced by the economic crisis it continues in the next period regardless of the soon expected Croatian membership in the EU.

Still, it has to be noted that catch-up rate observes absolute disparity, which may not be the best measure in this context. Namely, due to the usage of absolute amounts in formula (1) it may happen that calculated catch-up rate has a positive sign, meaning by the definition that the disparity between the observed countries and the EU average increases, although the difference of GDP per capita with regard to the EU average actually decreases. This may happen due to the fact that the same increment measured by absolute amounts has higher relative effect in case of lower starting state. In order to prove it, the best solution would be to observe the difference of per capita GDP in two subsequent years, defined by the following expression:

$$\Delta GDP_{i,t}^{pc} = \frac{y_{i,t}}{y_t^*} - \frac{y_{i,t-1}}{y_{t-1}^*} \qquad (2)$$

where $y_{i,t}$ denotes per capita GDP measured by purchasing power standard of a country i in year t, and y_t^* is the average of EU-15 Member States in year t. Opposite to catch-up rate, the disparity between the observed countries and the EU-15 average is diminished in case of positive difference of per capita GDP.

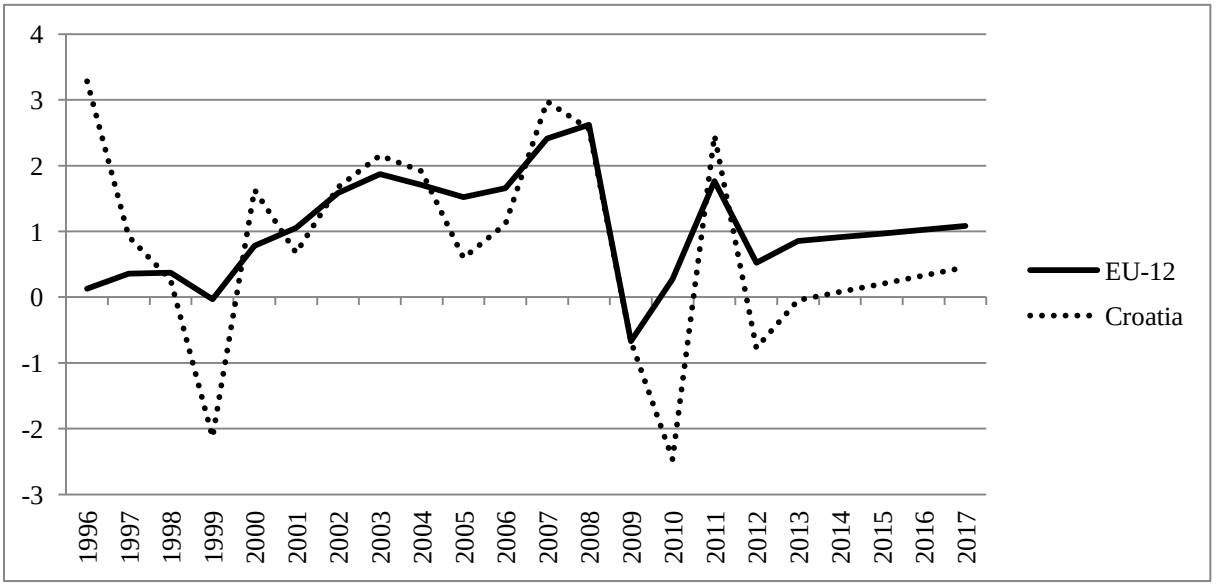
As shown on Table 2, average annual changes of GDP per capita PPS of new Member States and Croatia show the decrease of disparity in relative amounts with regard to the EU-15 average in all three observed periods. In case of PIGS countries the decrease of disparity can be observed in period until 2004, while after 2004 the trend is the opposite. These results indicate that the real convergence of new Member States and Croatia is present in all observed periods, that is in both the pre-accession period and in the years of formal membership, and that per capita GDP differences between old and new Member States may completely disappear in the long-run if these trends manage to continue.

Table 2. Average annual changes of GDP per capita PPS of selected EU countries (PIGS, new Member States) and Croatia compared to the EU-15 average in various periods

	1996-2004	2004-2011	2011-2017
Portugal	0.2	0.1	-0.8
Italy	-1.1	-0.7	-1.0
Greece	1.2	-1.0	-1.6
Spain	1.2	0.2	-0.8
PIGS Average	**0.4**	**-0.4**	**-1.1**
Bulgaria	0.3	1.2	0.5
Czech Rep.	0.3	0.8	1.0
Estonia	2.2	1.7	1.7
Cyprus	0.5	1.1	0.2
Latvia	1.5	2.0	1.5
Lithuania	1.6	2.1	2.3
Hungary	1.3	0.6	0.4
Malta	-0.7	0.9	1.0
Poland	0.9	1.9	1.3
Romania	0.2	1.9	0.8
Slovenia	1.4	0.5	0.2
Slovakia	1.0	2.3	1.3
EU-12 Average	**0.9**	**1.4**	**1.0**
Croatia	**1.2**	**1.1**	**0.4**

Source: Author's calculation

Figure 8. Annual changes of GDP per capita PPS of EU-12 and Croatia compared to the EU-15 average in the period 1996-2017



Source: Author's calculation

Figure 8 shows decreasing trends of differences of per capita GDP compared to the EU-15 average. The impact of crisis on GDP per capita difference can also be noted, which in that case changed sign and turned into negative. This is observable in 2009 for new Member States average and in case of Croatia in 1999 impacted by the post war recession, as well as in the recent years in 2009, 2010 and 2012 under the influence of still ongoing economic crisis. The same as it was shown by the catch-up rate, Croatia recovers slowly under the influence of economic crisis compared to new Member States. Nevertheless, it is interesting to notice that four years before the EU-12 accession (2001-2004) the average annual change of GDP per capita of EU-12 members was lower than the average in the period 2004-2008. It can be concluded that formal membership of new Member States has had certain positive impact on the increase of living standard, i.e. on the decrease of disparity between EU-12 and EU-15.

2.2. β-convergence

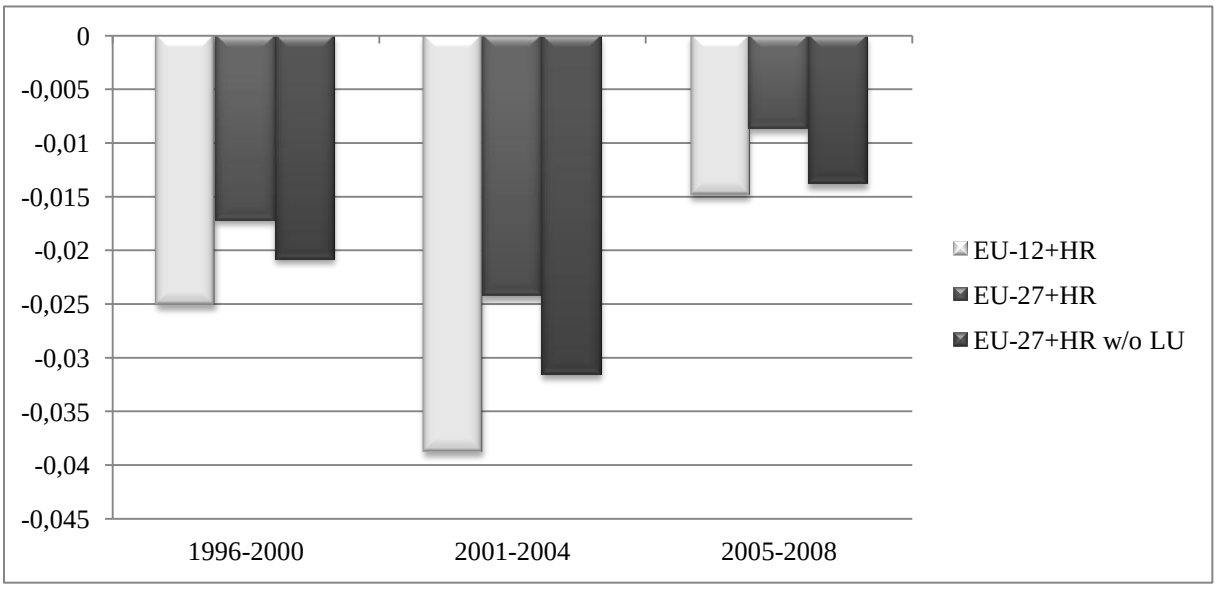
β-convergence occurs in case when less developed countries grow faster than the more developed ones meaning that there is a negative relationship between initial income level and the growth rate. Generally, in analysing β-convergence regression analysis is used. The difference in model specification occurs whether the analysis is based on cross-section or panel data. In both cases convergence occurs when β coefficients are negative, indicating that higher initial income level negatively affects the consequent growth rate (Vojinović and Oplotnik, 2008:30-31).

According to Vojinović and Oplotnik (2008:30-31), in case of cross-section analysis β-convergence is calculated using ordinary least squares regression based on average annual GDP growth rates versus GDP levels from the beginning of the period. This can be specified by the following equation:

$$\frac{1}{T} log \frac{y_{i,T}}{y_{i,0}} = \alpha_{cs} + \beta_{cs} \cdot logy_{i,0} + \varepsilon_i \quad (3)$$

where $logy_{i,t}$ is a natural logarithm of GDP per capita of i-th country in year t, whereby 0 denotes the first year of the observed period, and T the last one, i.e. T denotes the length of the observed period. α_{cs} and β_{cs} denote coefficients estimated from linear regression model, and ε is an error term.

Figure 9. β-convergence of GDP per capita of selected EU Member States in various time periods



Source: Author's calculation

For the purpose of this analysis cross-section model was run for different groups of countries in different time periods and all results are presented in Table A1 in the Appendix. Cross-section analysis from Figure 9 shows that in all three observed periods from 1995 to 2017 β-convergence was realized in all of observed groups of countries. Higher negative values of β coefficients from linear regression in pre-crisis period, especially in years 2004-2008, indicate that the highest real convergence was realized exactly in these years. β-convergence results for EU-12 and Croatia are higher than β-convergence results for EU-27 and Croatia meaning that the disparity between new Member States and Croatia decreased at a faster pace than the one at the level of the whole EU. However, this is primarily the consequence of lower mutual differences in the level of development among new Member States.

Panel analysis or extended β-convergence approach tries to exploit the full time-series information of the panel and, in a certain sense, implies that each country may converge to its own steady-state (Marelli and Signorelli, 2009:23). The difference between panel analysis and regular regression time series models or cross-section regression models is that variables used in panel analysis have double index, meaning that they comprise both components, i.e. time and individual (e.g. identification of a country). According to Vojinović and Oplotnik (2008:30-31), in case of panel analysis regression is made on annual GDP growth rates with regard to GDP levels from the preceding year, which can be specified by the following equation:

$$logy_{i,t} - logy_{i,t-1} = \alpha_p + \beta_p \cdot logy_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

where $logy_{i,t}$ is a natural logarithm of per capita GDP of i-th country in year t. The same as before, α_p and β_p are coefficients estimated from the linear regression model, and ε denotes error component.

Generally, panel models could be specified as *one-way* or *two-way*, and each of them could be with fixed effects (*fixed effects model*) or with stochastic effects (*random effects model*). The difference between these four models is only in the specification of an error component. Definitions hereafter are based on Baltagi (2005:11-52).

In one-way model error component is defined as:

$$\varepsilon_{i,t} = \mu_i + \nu_{i,t} \quad (5)$$

where μ_i denotes the unobservable individual-specific (country) effect and $\nu_{i,t}$ denotes the remainder disturbance. In case of fixed effects model, the μ_i are assumed to be fixed parameters to be estimated and the remainder disturbances stochastic with $\nu_{i,t}$ independent and identically distributed $IID(0, \sigma_\nu^2)$. However, there are too many parameters in the fixed effects model and the loss of degrees of freedom can be avoided if the μ_i can be assumed random (random effects model). In this case $\mu_i \sim IID(0, \sigma_\mu^2)$, $\nu_{i,t} \sim IID(0, \sigma_\nu^2)$ and the μ_i are independent of the $\nu_{i,t}$.

In two-way model error component is defined as:

$$\varepsilon_{i,t} = \mu_i + \lambda_t + \nu_{i,t} \quad (6)$$

where μ_i denotes the unobservable individual-specific (country) effect, λ_t denotes the unobservable time effect and $\nu_{i,t}$ denotes the remainder disturbance. In case of a two-way fixed effects error component model μ_i and λ_t are assumed to be fixed parameters to be estimated and the remainder disturbances stochastic with $\nu_{i,t} \sim IID(0, \sigma_\nu^2)$. In case of a two-way random effects error component model all three error components are assumed to be random, i.e. $\mu_i \sim IID(0, \sigma_\mu^2)$, $\lambda_t \sim IID(0, \sigma_\lambda^2)$, $\nu_{i,t} \sim IID(0, \sigma_\nu^2)$ and independent of each other.

According to Baltagi (2005:11-52), the fixed effects model is an appropriate specification if the analysis focus is on a specific set of N countries (in one-way model), i.e. on a specific set of N countries in a specific time period (in two-way model). In this case inference is restricted

to the behavior of these sets of countries (in a specific time period), i.e. inference in this case is conditional on the particular N countries over the specific time periods observed.

The random effects model is an appropriate specification if N countries were drawn randomly from a large population (and T randomly chosen time components). In this case, N is usually large and a fixed effects model would lead to an enormous loss of degrees of freedom. The individual (and time) effects are characterized as random and inference in this case pertains to the large population from which this sample was randomly drawn.

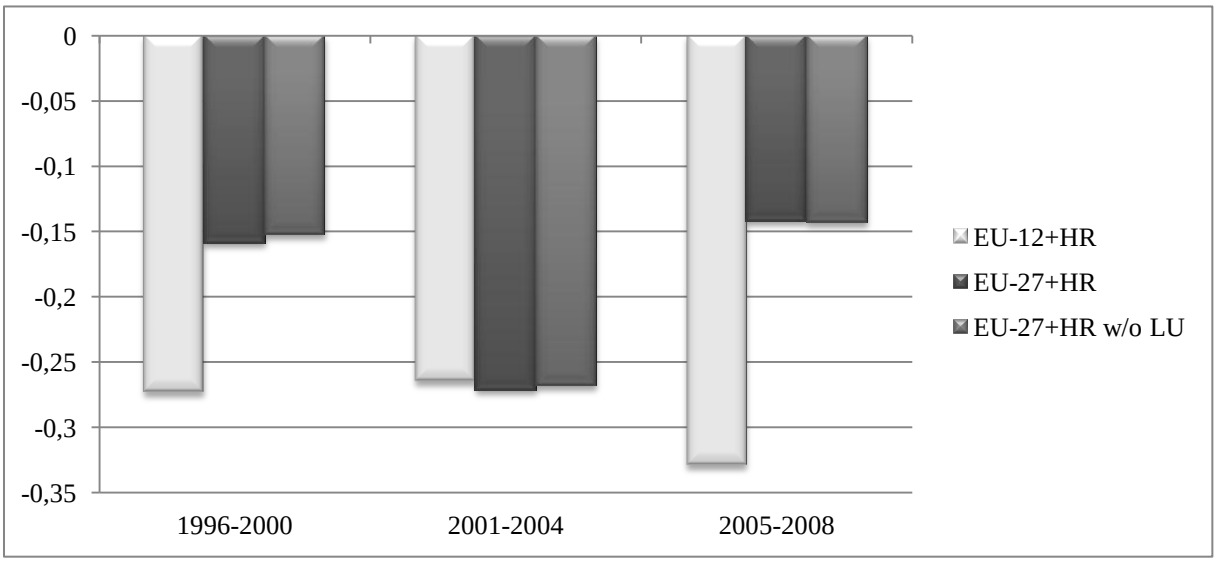
For the purpose of this analysis all four models were extracted in different time periods and the results are shown in Tables A2-A6 in the Appendix[7]. From the explanation of all four panel models presented above and especially having in mind data to be analysed, two-way model with fixed effects is intuitively imposed as the one that fits the best for measuring β-convergence of GDP per capita of observed EU Member States in different time periods. This hypothesis is also verified by statistical results according to which two-way model with fixed effects shows the best model fit measured by coefficient of determination (R^2), as well as the highest significance of estimated parameters. Moreover, generally very low p-values of Hausman and F-test also confirm the decision in favour of fixed effects model[8].

Panel analysis results presented on Figure 10 bring to similar conclusions as the results of cross-section analysis, that is in all three observed periods from 1995 to 2017 β-convergence was realized. Considering all EU Member States and Croatia the highest real convergence was realized in the period 2004-2011 and in that period β-convergence was roughly the same for all three observed groups of countries. Results of extended β-convergence for EU-12 and Croatia were significantly higher in the period from 1996 to 2004, i.e. before new Member States' formal accession, but also in the future period 2011-2017 meaning that in these periods disparity between new Member States and Croatia decreases at a faster pace than those at the level of the whole EU. However, unlike cross-section analysis, exclusion of Luxembourg does not impact β regression coefficients significantly.

[7] For display simplification, in tables A2-A6 coefficients of estimated fixed effects were not shown.

[8] In tables A2-A6 p-value of FE models denotes p-value of F-test, while in case of RE models p-value denotes Hausman test p-value. Hausman test compares fixed and random effects under the null-hypothesis that individual effects are uncorrelated with other regressors in the model (Hausman, 1978). In case of a proven correlation (i.e. when the null-hypothesis is rejected), random effects model brings to biased estimators meaning that one of Gauss-Markov assumptions is not satisfied. In that case fixed effects model is preferred (Park, 2009). In F-test, null-hypothesis is that all dummy parameters are equal to zero, except one (i.e. in case of a one-way model $H_0: \mu_1 = \mu_2 = \cdots = \mu_{N-1} = 0$). Rejecting the null-hypothesis means preferring fixed effects model.

Figure 10. Extended β-convergence of GDP per capita of selected EU Member States in various time periods



Source: Author's calculation

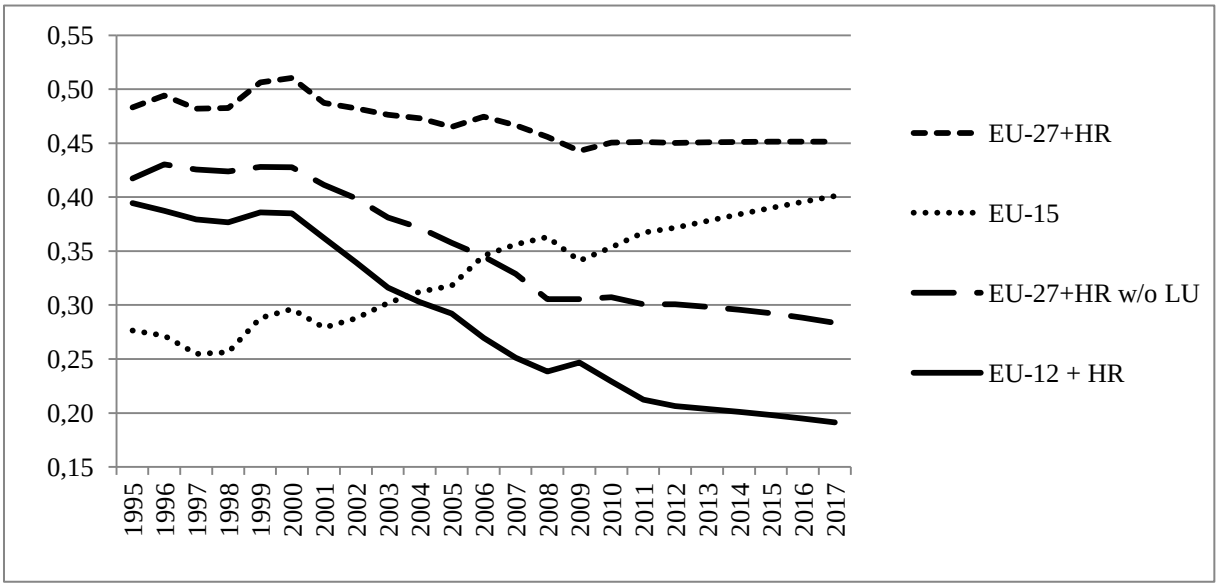
2.3. σ-convergence

σ-convergence takes place when the dispersion of real per capita income declines over time. The dispersion of income levels can be measured by standard deviation, variation or the coefficient of variation of GDP per capita levels between economies. All these indices yield similar results because the direction of change matters when analysing σ-convergence, not the absolute value of the indices (Vojinović and Oplotnik, 2008:28). Coefficient of variation is defined according to the following formula:

$$CV = \frac{\sigma}{\mu} \tag{7}$$

where σ denotes standard deviation, and μ mathematical expectation, i.e. mean value of a certain measure. Vojinović and Oplotnik (2008:28-29) use coefficient of variation of GDP per capita measured by the purchasing power parity, while Kulhanek (2012:2) uses natural logarithm of GDP per capita measured by the purchasing power standard.

Figure 11. σ-convergence of GDP per capita of selected EU Member States in period from 1995 to 2017



Source: Author's calculation

If one observes old Member States (EU-15) separately from new Member States and Croatia together it can be concluded that the dispersion of GDP per capita in case of EU-12 and Croatia mainly decreases, while in case of EU-15 the dispersion records an increasing trend. On the other hand, dispersion of GDP per capita of all EU Member States and Croatia (EU-27+HR) records slight decreasing trend in the period from 1995 to 2010, i.e. slight σ-convergence was present among Member States from 1995 to 2010, while it should remain unchanged in the following period up to 2017. However, if Luxembourg, as the wealthiest peer, was excluded from EU-27, results would have been significantly different showing a considerable decrease of dispersion of GDP per capita in the remaining 26 EU Member States and Croatia.

5. Conclusion

One of the fundamental goals for the realisation of economic integration of united countries is the pursuit for common progress through the widening of the common internal market, increasing competitiveness on goods, services and production factors market, long-term harmonious economic growth and general prosperity. Exactly these efforts lead to a gradual

reduction of disparities in the level of economic development within observed economic integration and guide to the development of real convergence. For any discussion on realisation of successful long-term economic development and real convergence, there is a need to satisfy the necessary conditions for achievement and maintaining of monetary, fiscal and institutional stability. Real convergence is evident in the reduction of disparity of GDP per capita and the level of labour productivity in the group of observed countries.

The main goal of this paper was to analyse historical trends of real convergence in all EU-27 Member States and Croatia (as its future member) in the period from 1995 to 2011, and to provide forecasts of possible trends of the real convergence in the following mid-term period up to 2017. The inclusion of Croatia into the analysis of real convergence of EU Member States and provision of projection of real convergence development in mid-term period up to 2017 is without any doubt an additional contribution to existing scientific and professional literature that deals with the study of this subject.

The results show that all new Member States (EU-12) in 2011 were below the EU-27 average according to labour productivity and GDP per capita measured by purchasing power standard. Croatia, as the future 28th EU Member State, was in 2011 also significantly below the average of all EU Members with only 62% of EU-27 average and takes a relatively low 25th position among 28 countries. New Member States and Croatia have been investing and should continue to invest significant efforts to move up the living standard and the labour productivity closer to more developed EU Member States. However, in the period from 1995 to 2011 the level of GDP per capita in the new Member States and Croatia recorded an upward trend compared to the average of old Member States, and the same trend is evident in the case of labour productivity in the period 2002-2011. Furthermore, it was shown that in the period 2002-2011 the labour productivity in Croatia was constantly above the average of all new Member States for approximately 13.5 percentage points (or on average 23.5% higher).

Just a glance at simple indicators and their trends may suggest the existence of real convergence within the EU. This paper confirms this hypothesis by using several standard measures such as the catch-up rate, σ-convergence and β-convergence. Final results show that in all three observed periods (1995-2004, 2004-2011 and 2011-2017) there has been really a lessening in the difference in the level of economic development among the new Member States and Croatia on one side and the old Member States on the other, confirming the existence of the real convergence. Particularly important is the impact of still ongoing global economic crisis which led to deceleration of real convergence, primarily due to slow recovery

of less developed Member States. The Croatian real convergence has followed the EU-12 real convergence trend relatively well, especially in the period from the beginning of the century and before their formal membership in the EU. After the accession of these 12 countries into the EU (after 2004) there is evident a bit slower trend of the real convergence of Croatia compared to EU-12, and this trend is expected to be continued also in the forthcoming period, regardless of the Croatian membership in the EU.

Although the impact of Croatian accession to the EU is still unknown, it should be noted that from July 2013 there will be many possibilities for Croatia to utilize significant resources from a number of funds for cohesion, employment and economic growth. For the absorption of these funds it is necessary to plan, develop and continuously improve the macroeconomic, financial and administrative absorption capacity, as well as institutional capabilities, and design and prepare adequate and timely project activities. Furthermore, the financial benefits of EU membership could be manifested also in the opening of the European market for Croatian producers, developing competitiveness, improving the efficiency of public administration and the like. It can be concluded that the following period provides an interesting perspective for Croatia, but opens also a number of issues that have not been tackled in this paper.

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Appendix

Table A1. Cross-section regression model statistics for EU countries and Croatia by selected time periods

		EU-12	EU-12 + HR	EU-12 + PIGS + HR	EU-27 + HR	EU-27 + HR w/o LUX
1996-2000	Intercept[a]	0.04897 (0.33)	0.04882 (0.34)	0.06136 (0.64)	0.03401 (0.60)	0.05268 (0.86)
	Beta[a]	-0.0001823 (-0.01)	-0.00018837 (-0.01)	-0.00158 (-0.15)	0.00151 (0.25)	-0.0005358 (-0.08)
	R-square	0.0000	0.0000	0.0015	0.0024	0.0003
	F-test p-value	0.9916	0.9909	0.8827	0.8028	0.935
2001-2004	Intercept[a]	0.43585 (5.05)***	0.4357 (5.29)***	0.46058 (6.66)***	0.3086 (6.07)***	0.36827 (7.82)***
	Beta[a]	-0.04185 (-4.48)***	-0.04184 (-4.69)***	-0.04457 (-6.05)***	-0.02817 (-5.38)***	-0.03449 (-7.07)***
	R-square	0.6672	0.6671	0.7091	0.5265	0.6667
	F-test p-value	0.0012	0.0007	<0.0001	<0.0001	<0.0001
2005-2008	Intercept[a]	0.58064 (5.00)***	0.57896 (5.21)***	0.57453 (7.00)***	0.37573 (5.82)***	0.4961 (9.35)***
	Beta[a]	-0.0554 (-4.53)***	-0.05526 (-4.72)***	-0.05484 (-6.42)***	-0.03411 (-5.22)***	-0.04653 (-8.63)***
	R-square	0.6726	0.6698	0.7331	0.5118	0.7488
	F-test p-value	0.0011	0.0006	<0.0001	<0.0001	<0.0001
1996-2004	Intercept[a]	0.28023 (3.24)***	0.28006 (3.39)***	0.28248 (4.85)***	0.20897 (5.21)***	0.24234 (6.04)***
	Beta[a]	-0.02515 (-2.60)**	-0.02515 (-2.72)**	-0.0254 (-3.96)**	-0.01717 (-4.03)***	-0.02082 (-4.86)***
	R-square	0.4031	0.4021	0.5113	0.3842	0.4861
	F-test p-value	0.0265	0.0199	0.0013	0.0004	<0.0001
2004-2011	Intercept[a]	0.40356 (6.75)***	0.40168 (6.68)***	0.43092 (9.04)***	0.26342 (6.38)***	0.33348 (9.50)***
	Beta[a]	-0.03891 (-6.14)***	-0.03877 (-6.09)***	-0.04196 (-8.41)***	-0.02427 (-5.79)***	-0.03155 (-8.80)***
	R-square	0.7903	0.771	0.825	0.5628	0.7561
	F-test p-value	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2011-2017	Intercept[a]	0.18202 (2.47)**	0.16599 (1.97)*	0.309 (3.69)***	0.10195 (2.51)**	0.15288 (3.28)***
	Beta[a]	-0.0165 (-2.18)*	-0.01496 (-1.72)	-0.02993 (-3.50)***	-0.00868 (-2.15)**	-0.01382 (-2.96)***
	R-square	0.3219	0.2125	0.4499	0.1506	0.2596
	F-test p-value	0.0544	0.1129	0.0032	0.0413	0.0066

[a] Significance levels: 1% ***, 5% ** and 10% *

Source: Author's calculation

Table A2. Panel model statistics for EU-12 by selected time periods

		One-way FE	Two-way FE	One-way RE	Two-way RE
1996-2000	Intercept[a]	0.773742 (-1.54)	3.919465 (5.88)***	0.088337 (0.49)	0.438908 (1.66)
	Beta[a]	-0.07479 (-1.41)	-0.4015 (-5.75)***	-0.0035 (-0.17)	-0.0425 (-1.45)
	R-square	0.3977	0.6912	0.0005	0.0348
	Test p-value[b]	0.0067	<0.0001	0.1469	<0.0001
2001-2004	Intercept[a]	0.431021 (0.98)	2.506551 (2.70)**	0.579397 (4.76)***	0.624044 (4.58)***
	Beta[a]	-0.03913 (-0.87)	-0.24987 (-2.64)**	-0.05541 (-4.22)***	-0.06022 (-4.10)***
	R-square	0.6096	0.7208	0.2791	0.2678
	Test p-value[b]	0.0776	0.008	0.7061	0.0428
2005-2008	Intercept[a]	1.1057 (2.36)**	1.878731 (1.69)*	0.733467 (4.86)***	0.71968 (4.52)***
	Beta[a]	-0.10675 (-2.26)**	-0.18538 (-1.68)	-0.06937 (-4.39)***	-0.06792 (-4.09)***
	R-square	0.486	0.7185	0.2949	0.2664
	Test p-value[b]	0.3858	0.0023	0.4008	0.2819
1996-2004	Intercept[a]	0.040396 (0.20)	2.63401 (4.90)***	0.167857 (1.55)	0.351961 (2.28)**
	Beta[a]	0.002111 (0.10)	-0.26119 (-4.76)***	-0.01174 (-0.99)	-0.03194 (-1.89)*
	R-square	0.2211	0.4507	0.0091	0.0326
	Test p-value[b]	0.021	<0.0001	0.4318	<0.0001
2004-2011	Intercept[a]	3.466953 (6.30)***	3.163624 (3.95)***	1.364263 (4.45)***	0.648731 (4.00)***
	Beta[a]	-0.34729 (-6.27)***	-0.31429 (-3.93)***	-0.1377 (-4.32)***	-0.0632 (-3.77)***
	R-square	0.3945	0.794	0.1851	0.1474
	Test p-value[b]	0.0122	<0.0001	<0.0001	0.0013
2011-2017	Intercept[a]	-1.28456 (-7.00)***	1.407379 (4.25)***	-0.30681 (-2.35)**	0.253615 (2.46)**
	Beta[a]	0.130089 (7.07)***	-0.13818 (-4.19)***	0.033955 (2.54)**	-0.02337 (-2.22)**
	R-square	0.7002	0.9186	0.0843	0.0659
	Test p-value[b]	<0.0001	<0.0001	<0.0001	0.0002

[a] Significance levels: 1% ***, 5% ** and 10% *

[b] p-value in FE model denotes p-value of F-test, while in case of RE model it denotes p-value of Hausman test

Source: Author's calculation

Table A3. Panel model statistics for EU-12 and Croatia by selected time periods

		One-way FE	Two-way FE	One-way RE	Two-way RE
1996-2000	Intercept[a]	0.958233 (1.97)*	4.127279 (6.26)***	0.11851 (0.66)	0.469435 (1.78)*
	Beta[a]	-0.09434 (-1.83)*	-0.42328 (-6.12)***	-0.00675 (-0.34)	-0.04579 (-1.57)
	R-square	0.3868	0.687	0.0018	0.0375
	Test p-value[b]	0.0072	<0.0001	0.0654	<0.0001
2001-2004	Intercept[a]	0.3559 (0.86)	2.530917 (2.85)***	0.571748 (4.88)***	0.623881 (4.75)***
	Beta[a]	-0.03139 (-0.74)	-0.25232 (-2.78)***	-0.05462 (-4.33)***	-0.06025 (-4.26)***
	R-square	0.6027	0.7213	0.2723	0.2663
	Test p-value[b]	0.075	0.0043	0.5684	0.0322
2005-2008	Intercept[a]	1.065773 (2.36)**	1.952091 (1.84)*	0.725131 (4.98)***	0.716764 (4.62)***
	Beta[a]	-0.10272 (-2.25)**	-0.19265 (-1.82)*	-0.06857 (-4.50)***	-0.06769 (-4.18)***
	R-square	0.4687	0.7246	0.2883	0.2593
	Test p-value[b]	0.4314	0.0008	0.4268	0.2322
1996-2004	Intercept[a]	0.09062 (0.46)	2.750724 (5.23)***	0.184242 (1.78)*	0.376195 (2.47)**
	Beta[a]	-0.00315 (-0.15)	-0.27315 (-5.09)***	-0.01349 (-1.19)	-0.03456 (-2.07)**
	R-square	0.2098	0.4509	0.0122	0.0359
	Test p-value[b]	0.0306	<0.0001	0.5429	<0.0001
2004-2011	Intercept[a]	3.490244 (6.56)***	3.225981 (4.17)***	1.391578 (4.64)***	0.651165 (4.03)***
	Beta[a]	-0.34963 (-6.54)***	-0.32038 (-4.15)***	-0.14066 (-4.50)***	-0.06354 (-3.80)***
	R-square	0.3933	0.7996	0.1854	0.1397
	Test p-value[b]	0.0098	<0.0001	<0.0001	0.0006
2011-2017	Intercept[a]	-1.32671 (-6.77)***	1.504002 (5.29)***	-0.33056 (-2.47)**	0.30325 (2.62)**
	Beta[a]	0.134317 (6.83)***	-0.1478 (-5.22)***	0.03631 (2.65)***	-0.02858 (-2.41)**
	R-square	0.6888	0.9315	0.0845	0.0712
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001

[a] Significance levels: 1% ***, 5% ** and 10% *

[b] p-value in FE model denotes p-value of F-test, while in case of RE model it denotes p-value of Hausman test

Source: Author's calculation

Table A4. Panel model statistics for EU-12, PIGS and Croatia by selected time periods

EU-12 + PIGS + HR		One-way FE	Two-way FE	One-way RE	Two-way RE
1996-2000	Intercept[a]	0.70446 (1.74)*	4.157257 (7.07)***	0.093173 (0.78)	0.32101 (1.76)*
	Beta[a]	-0.06649 (-1.58)	-0.41867 (-6.93)***	-0.0039 (-0.30)	-0.02884 (-1.45)
	R-square	0.3686	0.6824	0.0011	0.0246
	Test p-value[b]	0.0057	<0.0001	0.1169	<0.0001
2001-2004	Intercept[a]	0.505145 (1.32)	1.444442 (1.94)*	0.586072 (6.20)***	0.603464 (6.16)***
	Beta[a]	-0.04679 (-1.21)	-0.13989 (-1.87)*	-0.05618 (-5.59)***	-0.05803 (-5.58)***
	R-square	0.6736	0.7437	0.3215	0.3207
	Test p-value[b]	0.0184	0.0017	0.801	0.2686
2005-2008	Intercept[a]	1.247339 (2.96)**	1.56654 (1.77)*	0.753979 (6.89)***	0.73402 (6.67)***
	Beta[a]	-0.11957 (-2.86)**	-0.15253 (-1.75)*	-0.07167 (-6.33)***	-0.0696 (-6.14)***
	R-square	0.527	0.7432	0.3774	0.3638
	Test p-value[b]	0.4838	0.0002	0.2339	0.3361
1996-2004	Intercept[a]	0.19461 (1.16)	2.024044 (4.18)***	0.244402 (3.23)***	0.309061 (3.23)***
	Beta[a]	-0.01437 (-0.84)	-0.19678 (-4.06)***	-0.02018 (-2.47)**	-0.02716 (-2.63)**
	R-square	0.2389	0.395	0.0388	0.0439
	Test p-value[b]	0.0226	<0.0001	0.7002	0.0003
2004-2011	Intercept[a]	3.674349 (7.63)***	2.856035 (4.37)***	1.245132 (5.26)***	0.645473 (5.64)***
	Beta[a]	-0.36204 (-7.60)***	-0.27957 (-4.34)***	-0.12484 (-5.11)***	-0.06299 (-5.39)***
	R-square	0.4205	0.7819	0.1826	0.1991
	Test p-value[b]	0.0022	<0.0001	<0.0001	0.0006
2011-2017	Intercept[a]	-1.14335 (-3.77)***	1.691555 (7.46)***	0.089735 (0.68)	0.634174 (5.25)***
	Beta[a]	0.113332 (3.78)***	-0.16518 (-7.40)***	-0.00724 (-0.54)	-0.06267 (-5.10)***
	R-square	0.6072	0.9301	0.0029	0.2064
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001

[a] Significance levels: 1% ***, 5% ** and 10% *

[b] p-value in FE model denotes p-value of F-test, while in case of RE model it denotes p-value of Hausman test

Source: Author's calculation

Table A5. Panel model statistics for EU-27 and Croatia by selected time periods

		One-way FE	Two-way FE	One-way RE	Two-way RE
1996-2000	Intercept[a]	0.175841 (0.60)	3.776871 (7.72)***	0.038244 (0.56)	0.145238 (1.48)
	Beta[a]	-0.01171 (-0.40)	-0.37134 (-7.56)***	0.002144 (0.30)	-0.00917 (-0.89)
	R-square	0.3665	0.6534	0.0006	0.0057
	Test p-value[b]	0.0009	<0.0001	0.6289	<0.0001
2001-2004	Intercept[a]	0.473362 (1.22)	1.982485 (3.46)***	0.438722 (7.13)***	0.457407 (6.89)***
	Beta[a]	-0.04281 (-1.12)	-0.19011 (-3.37)***	-0.04036 (-6.37)***	-0.04228 (-6.24)***
	R-square	0.618	0.7559	0.2696	0.2615
	Test p-value[b]	0.0094	<0.0001	0.9484	0.0084
2005-2008	Intercept[a]	1.011439 (2.64)***	1.507769 (2.00)**	0.438796 (3.98)***	0.504438 (3.34)***
	Beta[a]	-0.0961 (-2.57)**	-0.14643 (-2.01)**	-0.03866 (-3.47)**	-0.04559 (-3.00)***
	R-square	0.5111	0.7407	0.1083	0.0835
	Test p-value[b]	0.0436	<0.0001	0.1072	0.1566
1996-2004	Intercept[a]	0.413096 (3.18)***	1.670439 (4.60)***	0.232215 (4.66)***	0.2404 (4.12)***
	Beta[a]	-0.03627 (-2.79)***	-0.1588 (-4.44)***	-0.01869 (-3.60)***	-0.01955 (-3.22)***
	R-square	0.2683	0.4262	0.0492	0.0398
	Test p-value[b]	0.0009	<0.0001	0.14	<0.0001
2004-2011	Intercept[a]	3.983998 (9.47)***	2.793477 (5.97)***	0.727898 (4.70)***	0.382419 (4.78)***
	Beta[a]	-0.38923 (-9.47)***	-0.27142 (-5.97)***	-0.07031 (-4.52)***	-0.03558 (-4.52)***
	R-square	0.4079	0.7997	0.0955	0.0952
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001
2011-2017	Intercept[a]	-1.2749 (-5.78)***	1.48 (6.70)***	0.020687 (0.36)	0.17009 (3.10)***
	Beta[a]	0.12616 (5.87)***	-0.14198 (-6.59)***	-0.00032 (-0.06)	-0.01518 (-2.79)***
	R-square	0.6113	0.8947	0	0.0447
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001

[a] Significance levels: 1% ***, 5% ** and 10% *

[b] p-value in FE model denotes p-value of F-test, while in case of RE model it denotes p-value of Hausman test

Source: Author's calculation

Table A6. Panel model statistics for EU-27 (excluding Luxembourg) and Croatia by selected time periods

		One-way FE	Two-way FE	One-way RE	Two-way RE
1996-2000	Intercept[a]	0.294959 (1.02)	3.778505 (8.08)***	0.060716 (0.82)	0.192238 (1.78)*
	Beta[a]	-0.02381 (-0.81)	-0.37159 (-7.91)***	-0.00028 (-0.04)	-0.01425 (-1.25)
	R-square	0.3861	0.685	0	0.0116
	Test p-value[b]	0.0003	<0.0001	0.4059	<0.0001
2001-2004	Intercept[a]	0.540255 (1.41)	1.839669 (3.24)***	0.504092 (8.30)***	0.519929 (8.01)***
	Beta[a]	-0.04944 (-1.30)	-0.17607 (-3.14)***	-0.04726 (-7.53)***	-0.0489 (-7.34)***
	R-square	0.6351	0.7658	0.3486	0.3372
	Test p-value[b]	0.0405	<0.0001	0.9536	0.0222
2005-2008	Intercept[a]	1.047202 (2.73)***	1.433157 (1.90)*	0.560721 (6.06)***	0.615781 (5.54)***
	Beta[a]	-0.0996 (-2.66)***	-0.13925 (-1.91)*	-0.05127 (-5.46)***	-0.05711 (-5.10)***
	R-square	0.5195	0.7451	0.2371	0.2132
	Test p-value[b]	0.3521	<0.0001	0.1826	0.2532
1996-2004	Intercept[a]	0.417327 (3.19)***	1.601411 (4.43)***	0.262032 (5.04)***	0.273329 (4.48)***
	Beta[a]	-0.03669 (-2.80)***	-0.15202 (-4.27)***	-0.02191 (-4.02)***	-0.0231 (-3.62)***
	R-square	0.2803	0.4362	0.0629	0.0517
	Test p-value[b]	0.0016	<0.0001	0.2145	0.0002
2004-2011	Intercept[a]	3.942496 (9.25)***	2.756801 (5.83)***	0.868817 (5.35)***	0.490245 (6.30)***
	Beta[a]	-0.38517 (-9.25)***	-0.26787 (-5.82)***	-0.08484 (-5.18)***	-0.04663 (-6.07)***
	R-square	0.4082	0.7943	0.1256	0.1644
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001
2011-2017	Intercept[a]	-1.23394 (-5.48)***	1.499013 (6.68)***	0.046513 (0.68)	0.245914 (3.84)***
	Beta[a]	0.122162 (5.56)***	-0.14309 (-6.56)***	-0.00291 (-0.42)	-0.02282 (-3.58)***
	R-square	0.6147	0.8941	0.0011	0.0741
	Test p-value[b]	<0.0001	<0.0001	<0.0001	<0.0001

[a] Significance levels: 1% ***, 5% ** and 10% *

[b] p-value in FE model denotes p-value of F-test, while in case of RE model it denotes p-value of Hausman test

Source: Author's calculation