**Growth and Development**

# Convergence in Europe Empirical Analysis on Two Groups of Countries of the European Union

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This paper examines the hypothesis of conditional convergence within the fifteen countries of the European Union, which became member states before May 2004, and between the groups of the same fifteen member states of EU and the ten countries that became members with the last enlargement.
Basic data input was GDP per capita for all EU countries, proxy variables were savings and depreciation rate. The data consisted of time series for 50 years (1950 – 2000) for EU-15 (old EU countries), while for EU-10 (new member states) the performance in terms of GDP from 1995 to 2007 (predicted values) was analyzed.
The presence of beta convergence among EU-15 countries and EU-15 and EU-10 (new EU members) countries was investigated in the first part of the empirical analysis. Starting with graphical analysis, the growth of GDP for different countries during the studied period was compared to the starting level of GDP. If the points in the graph are negatively correlated, then this is a sign of presence of beta convergence. Afterwards, the presence of beta convergence was tested by using the same but formalized approach, the regression analysis. If the partial regression coefficient for GDP p.c. is positive and statistically significant, then the presence of beta convergence among selected group of countries can be confirmed with statistical certainty. In the last part of the empirical analysis the presence of sigma convergence was tested. This type of convergence can be calculated as standard deviation of logarithms of GDP p.c. in the group of countries. This procedure measures the dispersion around determined average. If the dispersion is decreasing, that means that the countries are becoming increasingly similar to each other, in terms of the GDP p.c., and one can confirm the (sigma) convergence.
In both samples highly statistically significant beta convergence was confirmed. Furthermore, sigma convergence was discovered and proved. This confirms the hypothesis of convergence among the fifteen countries of the European Union in the period from 1950 to 2000. Additionally, convergence of ten EU newcomers to the average level of standards of living in the fifteen countries of the EU in the years from 1995 to 2007 is also discovered. Both confirm the existence of forces of convergence among the member states of the European Union.
One of the main objectives of the European Union is real convergence among the member states. To achieve this goal the EU formed a cohesion policy and backed it up with important structural funds. Those are used to finance projects in less developed member countries, such as improving the infrastructure and educational system and to restructure less perspectives industries. In this paper, the real convergence among old and new member countries was proved, which proves that Europe did not fail to reach one of its basic aims.

## Introduction

Before the expansion in 2004, European Union was relatively homogeneous region. However, with the expansion, countries with completely different history and, in the past, different economic systems, joined the relatively homogeneous group. The question is, whether countries of the European will be internally homogenous ever again. And this is the question about the convergence.

The phrase, “economic convergence” means that the variations of economic variables, among the groups of countries and regions, are diminishing. The aim of European Union is a long term convergence of the standard of all countries and regions. In this paper, we will study whether EU is successfully approaching towards reaching this objective.

In this paper, the convergence among »old« EU members (a term EU-15 will be used in the rest of the paper) and among »new« EU members and »old« EU member states was investigated.

In the first part of the research, the theoretical background of the growth theory is presented. The bases of this research area were presented by authors who used the neoclassical growth model, which suggests that convergence will occur, when certain conditions are satisfied. Such convergence guides to the final »steady-state« position of all countries. However, this theory did not entirely explain the phenomenon of convergence, therefore modern, endogenous theories started to come into sight. Such theories consider different variables, which help to explain economic growth and convergence.

In the second part of the paper, the empirical analysis, which investigates convergence in general and convergence in the European Union as well, is explained.

In the third part, the results of the empirical analysis are presented. It was found out whether the convergence in EU15 can be confirmed in the period from 1950 to 2000 and whether the convergence was present between EU15 and new member states of the European Union. The convergence was analysed using graphical analysis and regression analysis, which represented foundation for an analysis of beta and sigma convergence.

## Theoretical Background

The basic model which explains convergence among countries is neoclassical growth model, which was designed and explained by Solow (1956). This model assumes that countries with different economic parameters will, after a certain time, reach equivalent levels of income per capita and therefore converge to the same level of economic development.

The basic equation of this model is:

$$k'(t) = s \cdot f(k(t)) - (n + m + \delta) \cdot k(t),$$

The first variable of the equation, *k'(t)*, represents the change of the capital per unit of the effective labour. *sf(k(t))* represents the investment capital per unit of the effective labour, *s* is the savings rate and *f(k(t)* is the total production. The last part of the equation $(n + g + \delta)k(t)$ represents the substitute investments.

The equation above suggests that change in the capital intensity depends on the difference among the total investments per unit of the effective labour and the amount of the substitute investments. That means that the economy of a certain country will approach the equilibrium position, when investment per unit of the effective labour equals the substitute investment. Described equilibrium position is called “the steady state”.

In the steady state the capital intensity will not change, because the level of the investment will be just sufficient to keep capital intensity of labour on the same level.

The neoclassical model of economic growth, described above, gives the grounds for investigating convergence among countries. The basic idea of convergence is that the

countries with the lower income will grow faster than those with the higher income, since all countries gravitate to the same steady state. This idea comes from the one of the main characteristics of the neoclassical production function - the assumptions of constant economies of scale and diminishing returns of the capital. The returns of the capital are higher in countries that have the lower than average stock of capital. Thus, the economic growth will be higher in the countries that have lower stock of capital (relatively underdeveloped countries).

Two types of convergence are recognized by the economic theory. Those two types distinguish in the assumption whether all countries will eventually reach the same steady state (or not). These two types of convergence are absolute and conditional convergence.

1. Absolute convergence – the countries with the same stock of capital, the same population growth and the same production function will reach the same level of income (per capita) in the steady state. Described in different words – it is assumed that countries have the same steady states and therefore income differences are consequences of the initial differences in the stock of the capital per unit of the effective labour (Barro, Sala-i-Martin, 1992).

2. Conditional convergence – in this case, it is assumed that the countries can be positioned in different steady states, which means that the parameters, which describe steady state, can differ among countries. Therefore, different countries will achieve different levels of income per capita in the steady state. Baumol discussed the convergence clubs (as a part of the study, which confirmed the existence of the conditional convergence). Such convergence clubs are formed by countries with similar steady states and as a result, their income per capita converges to the common average of a certain club (Barro, Sala-i-Martin, 1992).

One of the main disadvantages of the neoclassical growth model is, that the steady state growth is determined exogenously (outside the model). As it was already mentioned, capital per unit of the effective labour is constant in the steady state, which means the growth of this category equals to zero. The growth of the production per unit of the effective labor will then also be equal to 0, as it is explained by the equations below:

$$q^* = f(k^*)$$
$$R_q = 0 \; in \; R_k = 0$$

The production per unit of labor equals total production, divided by the population.

$$q = \frac{Q}{L}$$

That means that the output, capital and labor grow at the same level in the steady state. This level can be described as the sum of the population growth and the growth of the technology (as represented by the equation bellow):

$$R_Q = R_K = n + m$$

Additional disadvantage of the neoclassical model is the assumption about diminishing returns of the capital. Romer, one of the early beginners of the endogenous growth theory, proved the presence of growing returns on capital and as a result, it was realized that the neoclassical assumption is no longer the most suitable for explaining growth.

The disadvantages of the neoclassical model caused the emergence of modern theories, which describe the factors that influence economic growth. Among the most famous authors of such theories are Sala-i-Martin, Barro and Temple. The most of the supporters of the endogenous theory agree, that it is not necessary that convergence ise present among more and less developed regions. The main argument are the returns on the capital (that are not necessarily diminishing), as it was described above.

Lucas (1988) considered growing returns of the human capital as one of the most important sources of the economic growth. In the modern world, we are witnessing integrations (such as EU) that cause the migration of the educated workforce from more to less developed regions. Hence, following this theory, it is possible that divergence would occur.

Relevant piece of theoretic work (for studying EU integration) was made by Viner, who suggested that convergence will be present, under the assumption of the workforce mobility, which is initiated by the accelerated international trade – that is opposite to what was forecasted by Lucas.

One of the simplest but also the most famous endogenous models is AK model. This model assumes that savings rates are exogenous and constant, level of technology is unchanged and it is assumed that the returns on capital are constant (instead of diminishing) (Van Den Berk, 2001).

Krugman studied integration convergence from a different perspective. He considered agglomeration and technological spill over as factors which influence convergence. He highlighted that it is cheaper to adapt the technology invented by someone else (imitation) instead of developing it. Therefore those countries, which are able to adapt the technology of the developed countries, will be able to converge, because they will technologically improve quicker than countries which develop the technology by themselves (Van Den Berk, 2001).

**Past Studies on Convergence**

One of the most important convergence researches was completed by Barro (Barro, 1999). The author used a sample of 98 countries and investigated, whether the relation between economic growth and the initial level of GDP p.c., can be confirmed. He studied period from 1960 to 1985. He refused the hypothesis about absolute beta convergence.

Hypothesis about universal (absolute) convergence was also investigated by Baumol in 1986 (Baumol, 1986). His founding was, that there are no proofs about the presence of absolute convergence, when studying all countries around the world. However, the results were slightly different when studying only a group of similarly developed countries. When he studied convergence on a sample of 16 industrialized countries (period from 1870 to 1979) his regression coefficient amounted to -0,995. Negative regression coefficient suggests that the beta convergence is present, and its value is almost -1, which leads us to the thought that the convergence is almost perfect.

Studies that followed, more or less confirmed Barro's results. Beta convergence of income per capita was confirmed on a sample of 100 OECD countries and as well among some USA states and regions of developed European countries.

Results, which suggested a very strong convergence inside the groups of industrialized countries, inspired Baumol to start thinking about the existence of "convergence clubs". Those are groups of countries that all together converge to a certain level of income per capita. The recognition of convergence clubs, on the other hand, represents a critic of a neoclassical growth model. This is because the combination of the convergence inside the convergence clubs and statistically insignificant convergence between the convergence clubs, leads to the existence of the conditional convergence.

Some studies on convergence among European transition countries were conducted (8 of those transition countries are now full members of EU). In a study made by UN/ECE (UN, ECE; 2000) the presence of beta convergence was confirmed in a period from 1989 to 2000, but only within the group of countries of the Southeast Europe. In the same study, sigma convergence was confirmed among the transition countries of Central Europe. The movement of income per capita among all transition countries was in a period 1989-2000 divergent. In a

group of countries from Central Europe, the divergent motion of income was noticed at the beginning of the transition process (from 1989 to 1991), however the phase of a convergence started straight after this period, and lasted till the end of the studied period (UN/ECE, 2000).

**Empirical Analysis of Convergence**

In the neoclassical growth model, the most important factors in the convergence analysis are initial income level and growth of income per capita. The negative relation should be present among both variables, which means that countries with lower initial income grow faster (Barro, Sala-i-Martin, 1992).

The empirical analysis on convergence in Europe consists of three parts. In the first part, the presence of beta convergence among old[1] EU members and as well among old and new[1] EU members was investigated with the graphical analysis of initial level of GDP p.c. and the growth of the income, in the studied period. The arrangement of the countries point on a negative correlation, in the case of the convergence of incomes. That means that countries with the lower income in the first period, undergo the higher economic growth.

In the second part of the empirical analysis, the presence of beta convergence was investigated using more formal procedure – regression analysis. If the regression coefficient of the initial level of income per capita is negative and statistically siginificant, the presence of beta convergence in a studied sample can be confirmed.

In the last part, the sigma convergence was investigated. Sigma convergence can be calculated as a standard deviation of the logarithms of incomes per capita in the group of countries. It measures dispersion of the values around certain average. In the case, sigma convergence is present providing that the dispersion of the income per capital will decrease. For the purpose of the better presentation of the results, the standard deviations for the logarithms of the income per capita will be illustrated graphically.

**Expected Results**

Following the neoclassical growth theory, convergence will be present only among countries with similar values of parameters that define steady state. Because of the different levels of savings rate, two countries will be positioned in different steady states. Therefore it is not necessary that the country with the lower level of income per capita will grow faster, but the growth of the capital will depend on specific steady state of the certain country. Taking into account the fact, that the savings levels among EU member differ, the convergence should not be expected, strictly followed the predictions of the neoclassical growth theory.

Following newer, endogenous growth theories, which include additional variables, it could be expected that the convergence will occur among EU members. This is because the integration process improves the trade openness increases and the education, mobility of the population also progress. With the EU Agendas, it was determined that one of the main aims of the integration is a long term convergence of standards of all countries and regions inside the integration. EU fights for the convergence with the cohesion funds, which cause the rearrangement of the assets from the more developed to the less developed regions. Hence we can expect that it will have a positive influence on convergence.

Former socialistic countries which form the group of new EU members (except Cyprus and Malta) started the path of the market economic system in 90's of the last century. Transition represented very turbulent period. In fact those countries had to implement new economic system on the grounds of old, socialistic system. This caused the closure of many

companies, which were not able to compete in the new system. It is obvious that crumbling of the companies causes the increase of the unemployed.

The closure of many companies was evident on an aggregate level as well; the former socialist countries recorded substantial negative levels of economic growth during the first years of transition.

Slovenian GDP reached its lowest point from the start of the transition process, in the year 1992. In 1992, it amounted 80% of the value in 1989. Slovakia's GDP has been declining even one year more and reached the lowest point of 80% of the GDP before the transition process. Slovakia, together with the Czech Republic, was among those countries, whose GDP fell the most. Some countries, for example Poland, started growing already in the year 1991.

As a result of the mentioned negative economic growth in the first years of the transition, the countries firstly had to catch up with what they have lost, only after that process, the converging to the average European income could have started. Up to the year 1999, the most of the transition countries (with the exception of Czech Republic) cached up with what they have lost in the first few years of transition. Some countries (Poland for example) were even faster in this process. Polish GDP in the year 1999 was 20% higher from their GDP in 1989.

West European countries (that are used as a benchmark in this paper), did not experience the similar process as described above. They followed the "normal" path of the GDP growth, therefore it can be expected that the period of 90's was a period of divergence or widening the gap of the differences in the levels of the incomes per capita among European countries.

Once East European countries overcame the biggest transition crisis, relatively fast (comparing to the Western European countries) economic growth has begun. The basic theory about absolute convergence suggests that countries with lower GDPs in the initial position grow faster. In accordance with neoclassical growth theory, fast economic growth is justified with the same steady states that all countries converge to (and different initial positions in terms of the GDP p.c.).

It can be expected that the initial GDP p.c. will have the biggest influence on the economic growth, which is in compliance with the endogenous growth theory. Underdeveloped countries benefit more, with the access to the bigger technological area, which is provided with the economic integration. The expectation is, that with this empirical analysis, it will be proved that the convergence is present among countries of the European Union.

**Empirical Analysis**

As stated in the beginning of this chapter, the presence of convergence in Europe was tested in this paper in three steps. First, we analyzed the convergence graphically. In the second part we used basically the same procedure just that it was more formal – it was done with the regression analysis. In the last, third step the presence of convergence among the countries in the sample was analyzed with the test of sigma convergence.

**Analyzed Data**

The subject of the analysis in the first part was to discover and analyze convergence among "old" members of the European Union (EU15) in the period from 1950 to 2000. Nevertheless the fact that in the 1950 European Union was constituted only of six member states, this year was used as the base year in the research of the convergence among the European countries.

The subject of the analysis in the second part was to discover potential convergence among two groups of countries, the "old" (EU15) and "new" (EU10) member states of the European Union, in the period from 1995 to 2007. The span from 1995 to 2007 was used because the new member states to the European Union became independant in the begging of 90's. First years of independence were the times of big economic difficulties and changes and it was therefore not reasonable to expect any convergence. For this reason year 1995 was used as the base year. In order to have the time span long enough, data until 2007 was used in the analysis, where the last three years were estimates calculated by European Statistical Office, Eurostat.

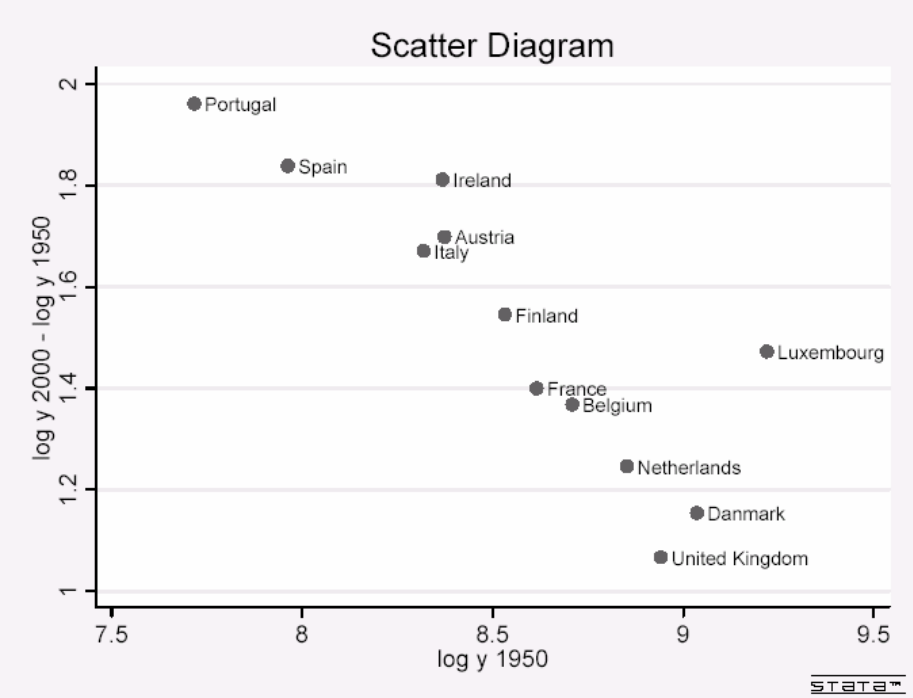
In the analysis of the convergence among "old" member states, the data for GDP per capita in American dollars in constant prices (Laspeyres index) was used for all years in the period over 1950 to 2000. In the second part the data on GDP per capita is given as a share of the GDP per capita of each new member state in the average GDP per capita in the EU15. This means that GDP per capita of a "new" member states is given as an index number, where EU15 equals 100[1].

Savings as the share of GDP per capita and population in absolute numbers were also used as the explanatory variables in the analysis of the convergence; for the period from 1950 to 2000 in the first part[1] and from 1995 to 2007 in the second part. Two more explanatory variables were used; growth of productivity and the depreciation rate. For both fixed values were used and were the same for all the countries; that is 0.05 for the growth of productivity and 0.075 for the depreciation rate.

**Graphical Analysis of the Convergence Among the EU10 and EU15 Countries**

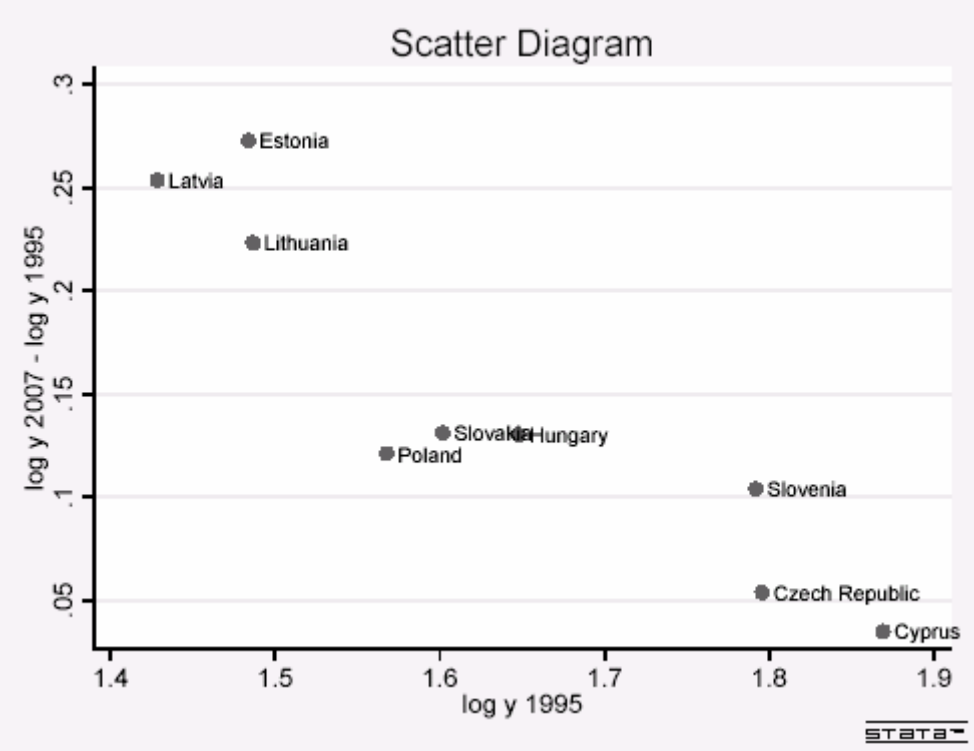
In the first step the existence of the convergence was tested graphically where the logarithms of GDP per capita in the base year (that is 1950 or 1995) were shown on the x-axis, whereas y-axis shows logarithms of the growth of the GDP per capita over the period from 1950 to 2000 in the case of group EU15 and from 1995 to 2000 in the case of EU10.

**Graph 1: Scatter plot that shows connection between the income per capita in the first year (1950) and the growth of it over the examined period.**



One can see from the graph above that the EU15 member states lay nicely around the negatively slopped line. This means that the relation between the level of income in the first observed year and the growth of the GDP per capita over the observed year is negative. This is the first sign of the presence of convergence in the group of EU15.

**Graph 2: Scatter plot that shows connection between the income per capita in the first year (1995) and the growth of it over the examined period.**




**Source: Eurostat, 2005; Own calculations**

Findings are similar when analyzing the convergence between the EU15 and EU10. As one can notice from the graph above, the relation between the categories on both axes is negative. This means that countries which started the development with the higher level of income per capita grew more slowly over the examined period compared to the countries starting with the lower income per capita.

Besides that, countries examined in this part of the analysis could be divided into three groups that differ in the income per capita in the first year and the pace of growth through the analyzed period.

- Countries with the lowest income per capita in the first year (1995) and the highest growth of GDP per capita over the span from 1995 to 2007. Those countries are Baltic countries, Latvia, Lithuania and Estonia.
- Countries with the medium income per capita in the first year (1995) and the medium growth of GDP per capita over the span from 1995 to 2007. Those countries are Hungary, Poland and Slovakia.
- Countries with the highest income per capita in the first year (1995) and the lowest growth of GDP per capita over the span from 1995 to 2007. Those countries are Slovenia, Cyprus and Czech Republic.

Graph above is in line with the neoclassical theory of growth which suggests stronger growth for countries with lower income per capita in the first observed year – countries in the first group had lower income per capita (e.g. Estonia), but performed better in the terms of the economic growth. Vice versa, countries starting from higher income per capita in the first year (e.g. Slovenia), performed worse in the terms of GDP growth over the observed period. Therefore one can conclude that EU10 countries that joined European Union in 2004 (without Malta) have the same steady state to countries in the group EU15, because EU10 countries were closing the development gap over the observed time and were therefore approaching the income level of the EU15 countries. This also means that all twenty five member states of the European Union form a convergence club (i.e. a group of countries with the same steady state).

Because of the negative relation between both categories on the x- and y-axis, one can conclude that countries from EU15 and EU10 group converged to the same level, which is the average level of development of EU15. It is therefore reasonable to expect convergence also in the second step of the analysis. We expect to prove statistically significant convergence among EU15 and EU10 countries by using the regression analysis.

**The analysis of the convergence between EU10 and EU15 by using the regression analysis (Beta convergence)**

Second step in the research of convergence in Europe is statistically more formal than the first step, but methodology of analysis is the same – to prove the negative relation between the categories the regression analysis was used.

The regression function tested in the analysis was as follows:

$$\lg y = a + b_1 \cdot \lg dp\_pc\_50(1995) + b_2 \cdot lcsave + b_3 \cdot \ln\_g\_d ,$$

where *lgy* represents the logarithms of the income per capita, *lgdp_pc_50 (_95)* represents the GDP per capita in the first year, which is 1950 in the first case and 1995 in the second, *lcsave* is the savings rate, whereas *ln_g_d* represents the rate of the substitution investment. For the analysis of the convergence the most important explanatory variable is GDP per capita in the first observed year (that is *lgdp_pc_50 (_95)*.

Regression analysis of the convergence within the group of EU15[1] countries showed that the partial regression coefficient is negative (-0.0185) for the explanatory variable GDP per capita in the first year of observation, that is 1950 (*lgdp_pc_50*). This proves convergence in the span from 1950 to 2000. It also means that the GDP per capita differences diminished over the examined time. The partial regression coefficient *lgdp_pc_50* is statistically significant with the t-statistics of -5.95 and the exact significance of 0.000, which makes it much lower to the marginal level of $\alpha = 0.05$.

The results of the regression analysis of the convergence between the groups of EU10 and EU15 also gave negative partial regression coefficient (-0.046) of the explanatory variable GDP per capita in the first year (1995). Result was, similar to the case examined in the previous paragraph, statistically significant, with the exact significance of 0.000, again much lower to $\alpha = 0.05$.

Both cases lead to the same conclusion: the hypothesis stating that the partial regression coefficient of the explanatory variable GDP per capita in the first year equals zero can be rejected with statistical significance. Therefore one can conclude that the income per capita of the EU15 countries shifted towards the same average and that the EU10 countries converged to the average level of income per capita in the EU15 countries over the examined periods. Both conclusions are supported with the statistically significant results of the regression analysis, that is, the statistically significant negative regression coefficient of GDP per capita in the first year. As the examined dependant variable was growth of GDP per

capita, both results are in line with the basic idea of convergence – countries with lower starting position in terms of GDP per capita grow faster compared to those with the higher income per capita over the examined period.

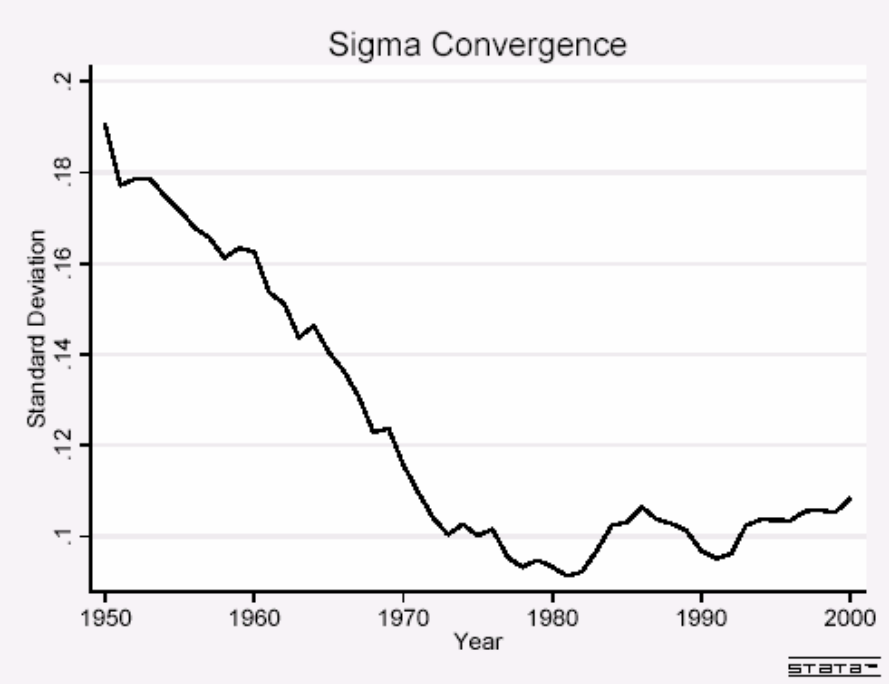
Conclusions found so far are encouraging for the further analysis. Beta convergence is needed (but not sufficient) prerequisite for sigma convergence. This means that by confirming the existence of beta convergence door is open for the analysis of sigma convergence.

**The analysis of the convergence between EU10 and EU15 on the basis of dispersion of income per capita (Sigma convergence)**

In the last, third step the presence of the convergence was tested by using standard deviation. Standard deviation measures the dispersion of the income per capita in the group of examined countries over some period of time. If the dispersion of income over the time diminishes the presence of sigma convergence can be confirmed.

In this part the graphs will be used in order to test and prove sigma convergence.

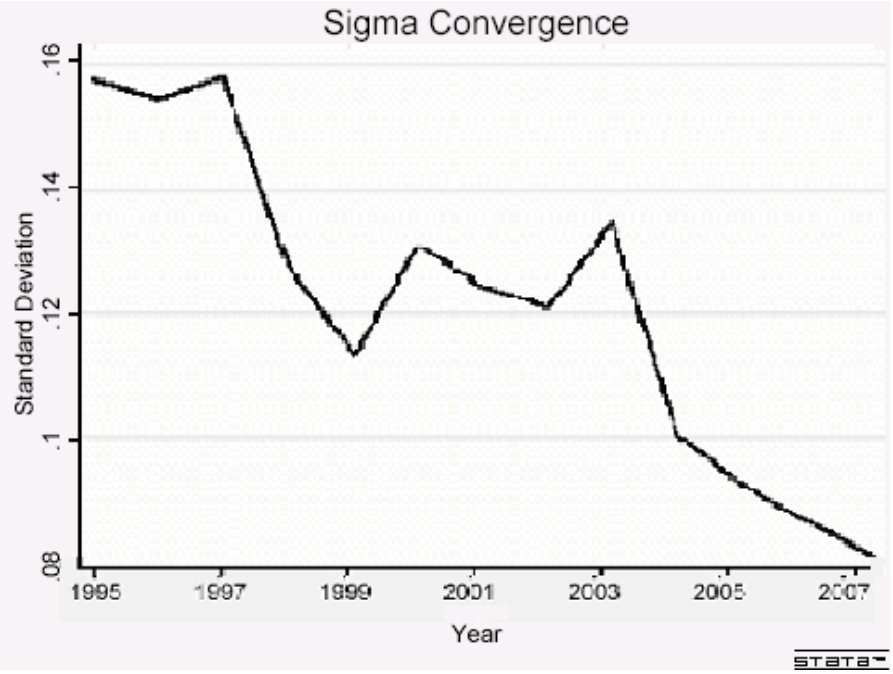
**Graph 3: Sigma convergence for EU15 countries over the period from 1950 to 2000**




**Source: Penn World Tables, 2005; Own calculations**

Graph above shows that the standard deviation in the group of countries from 1950 to 2000 was falling. Because standard deviation measures the dispersion of income and consequently the differences in the level of development, one can conclude that the differences among EU15 countries were diminishing, although the dispersion started to rise again in the late 90's. Those were the times when crisis occurred in the certain countries crisis (e.g. Germany, France), on the other hand some of them made a big economic progress (e.g.Ireland).

**Graph 4: Sigma convergence between EU10 and EU15 countries from 1995 to 2007**




**Source: Eurostat 2005; Own calculations**

In the Graph 4 one can see that the dispersion in income per capita in the EU10 countries over the period from 1995 to 2007 was reduced – the standard deviation in 1995 amounted 0.16, while it decreased to 0.08 in the last observed year 2007.

In both cases, as seen above, dispersion in income per capita (or standard deviation) diminished over the examined periods. This means that the differences in GDP per capita in the groups of countries EU10 and EU15 were reduced. Said in other words, they converged to same average level. For this reason sigma convergence can be confirmed within the EU15 countries over the span from 1950 to 2000, and between EU10 and EU15 over the years from 1995 to 2007.

## Conclusion

The basic idea of the theory of convergence is the idea of faster economics growth of those countries which have lower income per capita in the first year of observation. Idea is based on neoclassical growth theory – this theory assumes that countries in a certain group (also called convergence club) have same steady states. Furthermore, having same steady state means having same income per capita (in the steady state). As developing countries in Europe (e.g. EU10) have an income that is below the average of the EU15, it can be assumed that they have not achieved the steady state yet. And the difference between the steady state and the actual state of the economy (measured in income per capita) is the one generating the economic growth – bigger the difference is, bigger the economic growth will be.

This is just what it was discovered in the case of Europe in this paper – developing countries of the European Union grew faster in the observed period compared to those higher developed countries. Because the economic growth of lower developed countries was faster over the observed span, the development gap was closing over the time.

Convergence was tested and confirmed in this paper among the countries in the group EU15 and among the EU10 group, which over the observed time moved closer to the average level of income per capita in the EU15. Convergence in this paper was tested by two different analytical tools. Using first tool we proved the presence of beta convergence – the economic growth was faster in countries with lower starting level of GDP per capita (the result was statistically significant). In the second part, sigma convergence was proved, which means that the dispersion of income per capita decreased within the observed group of countries.

There are many factors that slow down or accelerate the economic convergence. One of the factors to accelerate the convergence in Europe is the economic integration, the European Union. The fact is that in general economic integrations are positive for the welfare of the countries involved. Consequently this means that the membership in an economic integration and therefore the removal of barriers to trade makes the position of the country involved in the integration better. Besides that, convergence in real terms is the mission that European Union wants to achieve. In order to achieve this goal, member states formed structural and cohesion funds to financially support the idea of convergence among the member states.

The main goal of the cohesion policy is to improve the infrastructure, the educational system, restructuring less perspective industries and to improve the standards of living in general. In the years from 2000 to 2006 a funding of €213 billion was provided to achieve the cohesion goal.

Cohesion funds are based on solidarity of the European countries- the most developed countries pay more into the cohesion funds than get out of it and vice versa for developing countries. The idea is based on the fact that not only the developing countries gain from the cohesion funds, also developed countries (that provide the funds) can utilize from the prosperity and progress in the developing countries.

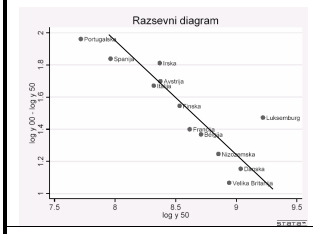
## Summary of Conclusion

**Table 1: Summary of results of the empirical analysis of convergence in Europe**

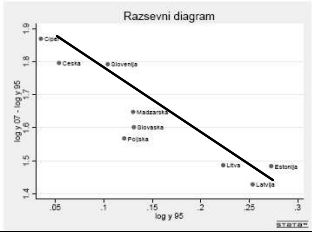
**BETA CONVERGENCE**

**Regression function:**

$$\lg y = a + b_1 \cdot \lg dp\_pc\_60(\_95) + b_2 \cdot lcsave + b_3 \cdot \ln\_g\_d$$




Scatter plot EU15




Scatter plot EU10

| | $b_1$ | **Exact significance *p*** | **Standard deviation** | $b_2$ | $b_3$ |
|---|---|---|---|---|---|
| **EU-15 (1950 – 2000)** | -0.01687 | 0.000 | 0.00286 | 0.01849 | 0.00890 |
| **EU-14 (1950 – 2000) without Luxemburg** | -0.01846 | 0.000 | 0.00310 | 0.01866 | -0.1059 |
| **EU-10 (1995 – 2007)** | -0,04647 | 0,000 | 0,158 | 0,01427 | 0,00779 |

**SIGMA CONVERGENCE**

| | | |
|---|---|---|
| **EU 14** | Standard deviation 1950: **0,190** | Standard deviation *decreased* over the period from 1950 to 2000 in the group of countries EU15 by **6.76 percent**. |
| | Standard deviation 2000: **0,105** | |
| **EU 10** | Standard deviation 1995: **0,158** | Standard deviation *decreased* over the period from 1995 to 2007 in the group of countries EU10 by **48.36 percent**. |
| | Standard deviation 2007: **0,081** | |

A general conclusion on the basis of the empirical analysis is that the convergence in Europe was proven in the group EU15 as well as in the group EU10 which converged to the level of development of the group EU15.

The presence of beta convergence was tested and proven by two analytical tools. In the first part the convergence was researched graphically, where x-axis was the level of GDP per capita in the first year of observation and y-axis was the growth of GDP per capita over the time. As expected, in both researched cases (as in the group EU15 and EU10) beta convergence was discovered, because countries with the lower income per capita in the first year grew faster over the time. This relation is therefore negative.

In the second part the same methodology was used, just that the whole procedure was more formal. Based on the regression analysis, the conclusion was the same as in the graphical analysis – the partial regression coefficient GDP per capita was in both cases negative and statistically highly significant. Beta convergence was therefore confirmed, which opened the door for further analysis of the convergence.

In the third step the presence of sigma convergence was researched. On the basis of standard deviation of the logarithms of income per capita sigma convergence was confirmed, because the dispersion of income decreased in both group of countries – calculation showed a 7 percent decrease in standard deviation in the EU15 group over the observed span of 50 years and a 48 percent decrease in the case of EU10 group. This clearly shows the presence of sigma convergence.

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