Verification of Convergence in Tax Mixes and Selected Tax Rates in the European Union

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Abstract — Common single market is one of the main priorities in the European Union. The main question of this paper is whether the European Union has been meeting its target especially in taxations. The paper focuses on the question whether the tax systems are converging in the context of fiscal pressure, tax mixes, and tax rates of selected taxes. Specifically, the authors focus on the value added tax rates and social security contribution rates. These taxes were selected as representatives of different groups with a relatively high share in tax mixes of the Member States. They also differ in the classification into direct and indirect taxes and in the level of their harmonization/coordination in the EU. In order to achieve the goal of this paper, Beta and Sigma convergences were used. The result is that the process of tax harmonization is complicated but tax mixes, fiscal pressures, VAT standard rates and social security contribution rates for employees are converging during the analysed period of 1965 - 2011.

***Keywords* –** Convergence, taxation, fiscal pressure, tax burden, tax mixes, tax rates, VAT, SSC, EU.

I. Introduction

CURRENTLY, the European Union is a unique community that combines both economic and political partnerships. The first step in European integration consisted in strengthening economic cooperation between the Member States whose goal was to establish a single market, i.e. free movement of goods, persons, services, and capital [12] and a common currency, the euro.

If a country intends to join the European Union, first, it needs to go through accession negotiations. Basically, it is an agreement on how and when the candidate country adopts and implements the rules and procedures of the contemporary members of the Community. However, such negotiations also include financial matters (e.g. contribution of the new member into the EU budget) or possible transitional measures and exceptions.

As a result, the original purely economic-oriented cooperation gave birth to a community that is now

cooperating in a number of areas. Among others, these include the tax policy that – through harmonization – can contribute to the creation of a single market by eliminating distortions that arise by transitions between individual Member States.

The European Union is still trying to converge tax systems, which should lead to removal of all obstacles to the creation of the single market. This effort should result in a single tax system that would be applied by the entire Community and that should provide equal benefits for all of its members.

The issues of coordination, approximation, and harmonization of tax systems in the EU are addressed, for instance, in [14] or [16]. The very methodology that is used to verify the objective of this paper is dealt with in [3] and [9].

This paper aims to verify whether there is convergence between the tax systems of the Member States as regards the convergence of tax mixes and tax quotas of the Member States.

For better illustration, the employed methods were also applied to rates of selected taxes. Here, the analysis was performed only for the states which were members of the EU in the analysed year. Specifically, the authors focused on VAT and social security contribution rates. These taxes were selected as representatives of different groups of taxes. The difference lies not only in the basic classification into direct and indirect taxes, but also in the degree of their harmonization/coordination already achieved by the EU. While VAT is characterized by a high degree of harmonization, social security contributions (as well as personal income tax) are typical with their autonomous status, for which the EU applies merely certain coordinating measures; here, in the form of international treaties.

II. Methodology and Data

A. Data

The source of the data is secondary information provided by the OECD and Eurostat agencies.

Tax mixes are divided in classes according to the OECD classification, with the missing data was left out for the purposes of the following analysis.

Table I Example of Fiscal Pressure Data

Period of 1965 - 2011		Period of memberships in the European Union	
Dependent variable	Explanatory variable	Dependent variable	Explanatory variable
0.215	3.522	0.014	3.722
0.338	3.438	0.338	3.438

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-0.107	3.665	-0.041	3.599
0.468	3.401	0.173	3.696
-0.107	3.591	0.070	3.415
0.354	3.414	-0.048	3.817
0.255	3.532	0.255	3.532
0.155	3.453	0.155	3.453
0.554	2.888	0.356	3.086
-0.244	3.817	-0.054	3.627
0.102	3.216	-0.022	3.340
0.712	3.043	0.049	3.707
0.292	3.321	0.292	3.321
0.148	3.490	0.148	3.490
-0.072	3.526	0.002	3.453
0.675	2.765	0.190	3.251
-0.344	3.697	-0.100	3.453
-0.062	3.663	-0.038	3.639
0.760	2.688	0.082	3.366
0.286	3.505	-0.069	3.860
0.150	3.416	0.124	3.441

Source: OECD Tax Revenue Statistics 2012 edition, own processing

B. Methodology

The aim of this paper is to analyse whether there is convergence in the area of tax quotas and tax mixes in the EU countries. A tax quota is understood as the overall tax burden, which is determined as a proportion of the total tax revenue to GDP. A tax mix shows representation of individual taxes in the total tax revenues.

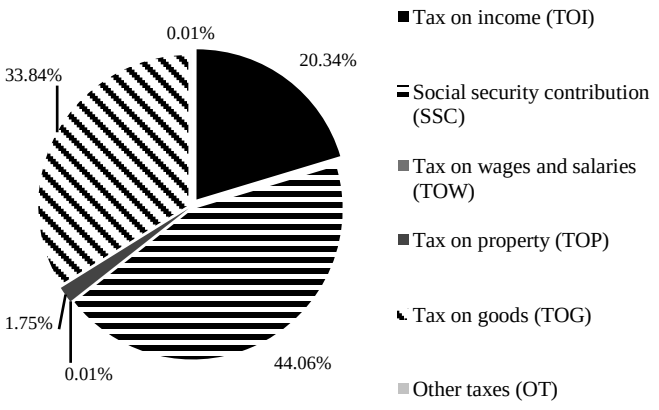

Fig. 1 Example of the Tax Mix of the Czech Republic in 2011 (%)
Source: OECD, Tax Revenue Statistics 2012 edition and own processing

The paper uses abbreviations for the individual groups of taxes: FP means fiscal pressure, TOI is short for taxes on income and gains ("1000" in the classification of the OECD), SSC for social security contributions (2000), TOW for taxes on payroll and workforces (3000), TOP for taxes on property (4000), TOG for taxes on goods and services (5000), and OT for other taxes (6000).

The term "European Union" includes all 27 Member States.

We analysed whether there was convergence of tax quotas and tax mixes between 1965 and 2011 in all current EU Member States and also during periods when individual states became EU members (e.g. for the Czech Republic, between 2004 and 2011, etc.) .

The methods used were the causal analysis and synthesis of the information obtained, as well as induction and deduction, the application of which results from the need to create an objective and systematic quantitative description of the issue. Other methods employed for meeting the objective are specified below.

1) Arithmetic Mean

To obtain the average values, we used the arithmetic mean. The mean was used to determine average values for the entire EU. The calculations always include the values of the countries since the year they officially accessed the EU.

$$\bar{A} = \frac{1}{n}\sum_{i=1}^{n} a_i \quad (1)$$

where $\bar{A}$ is arithmetic mean, a_i is tax rate for the Member State, n is quantity of variables.

2) Beta Convergence

This method was used also in [3] or [11]. The Beta convergence considers growth of variables in dependence on the initial values (the so-called "Barro regression"). This concept of convergence focuses on the fact that countries with low initial values grow faster than countries with high initial values. In this case, it is convergence of tax mixes to the average value which is defined as the average of all EU Member States in a given year.

This approach allows estimation of the annual growth rate or rate of β-convergence.

$$\ln\left(\frac{y_t}{y_0}\right) = \alpha + \beta \ln(y_0) + \varepsilon \quad (2)$$

where T is the last year of the analysis (2011), 0 is the initial year of the analysis (1965 or the year of a country's accession to the EU), y represents tax mixes in different time periods or tax quota. α is a level constant, β is the regression coefficient, and its significant negative value indicates the Beta convergence, ε is a random component.

The equation (2) expresses the growth rate of the tax mix/tax quota (left side of the equation), which depends on its initial level (y0), or more precisely on its difference from the average level in the EU.

In other words, the regression coefficient β expresses how much of the difference – to the average of the EU – countries "on average" managed to eliminate during the given period. Thus, the greater the coefficient β in absolute value, the faster the convergence/divergence. The paper utilizes the classic method of least squares.

Twenty observations were used for both variants, and the missing values were abstracted. For the part concerning the rates, 24 observations were used for reduced VAT rates, 27 observations for standard VAT rates, 16 observations for rates

of social security contributions of employees, and 18 observations for rates of social security contributions of employers and self-employed persons. Here as well was used the period between 1968 and 2011, while missing values were abstracted.

Furthermore, it should be emphasized that the Beta convergence is a condition for the Sigma convergence, where the Sigma convergence uses absolute values. However, this relationship does not have to work conversely [20].

3) Sigma Convergence

The time development of convergence or divergence of tax mixes can be determined by measuring the distance. One such indicator was used in [1]. For n countries, the average distance from the average (Di) was measured by the index (D).

$$Dt = \frac{1}{n}\sum_{i=1}^{n} D_t^i = \frac{1}{n}\sum_{i=1}^{n}\sum_j\sum_j S_{jt}^i - S_{jt}^{EU} \quad (3)$$

where i is short for country, j is short for tax, t is the year, S^i_{jt} is the proportion of the tax in the total tax revenues, and S^{EU}_{jt} is the average of the EU. The Sigma convergence is based on the development of variance in time. This variance can be analysed using various indicators; here, it is the standard deviation.

$$\left|\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(a_n^i - E\ (a)^2}\right| \quad (4)$$

where σ is the standard deviation, a_i is the amount of the tax mix of i-year and n-state, E represents the arithmetic mean of the EU.

The Sigma convergence is constructed in order to obtain additional information about the development of the Beta convergence, which is not able to provide this information itself. In this case, the Sigma convergence includes countries at the moment of their accession to the EU. This means that before the accession, their existence was taken into account, even for determination of the average value for the whole EU. The smaller the standard deviation, the higher the convergence (and vice versa). Thus, if the standard deviation curve decreases, there is convergence during the given period.

III. Results for Tax Mixes and Tax Pressures

A. Beta Convergence

The analysis of the tax mixes and tax quota demonstrated convergence of the given variables for both examined periods. The summary of the results is provided in the tables below.

TABLE II BETA CONVERGENCE OF TAX MIXES IN THE EU AREA IN 1965 – 2011

	FP	TOI	SSC	TOW	TOP	TOG	OT
β	-0.879	-0.537	**-0.262**	-0.529	-0.394	-0.905	-0.619
t	-7.563	-3.622	**-1.956**	-1.911	-3.151	-4.675	-2.61
p-val	$< 10^{-4}$	0.002	**0.065**	0.098	0.005	0.00016	0.026
R^2	0.751	0.422	**0.168**	0.342	0.343	0.535	0.405

The table above shows that all the analysed dependences are significant; the significance level is always less than 10%, in some cases even less than 1%. The Beta coefficient is negative in all the examined groups. This indicates convergence over the whole period between 1965 and 2011 both in tax quotas and groups of individual tax revenues.

The fastest is the convergence of indirect taxes (TOG), which are, in terms of harmonization, of the greatest interest for the EU. The coefficient of determination (R2), in this case, also shows a high value (0.535), indicating that the initial value of the tax mix is able to explain the 53.5% variance of the growth rate between the countries.

Another high values were revealed in the coefficient of determination of tax quotas (FP), which stands at 75.1%. The convergence rate, in this case, is also high, which indicates overall convergence of tax systems.

However, these harmonized indirect taxes were not in place throughout the entire analysed period, and other tax groups are not on such a high degree of harmonization. Therefore, the authors believe that the convergence of tax countries is rather influenced by globalization itself – as described in [14] – since most countries were not members of the EU during the examined period, and this trend of convergence is also evident throughout all OECD countries [5].

At the lowest level of mutual convergence stand the tax mixes of social security contributions and income from property taxes. In these areas, convergence is poor, as well as the coefficient of determination.

In the EU, therefore, there was convergence of tax mixes, thus further meeting of the objective of convergence of tax systems, regardless of whether they were members of the European Union or not.

TABLE III BETA CONVERGENCE OF TAX MIXES IN THE EU FOR THE MEMBER STATES

	FP	TOI	SSC	TOW	TOP	TOG	OT
β	-0.424	-0.232	**-0.221**	*-1.55*	-0.22	-0.482	*-0.026*
t	-3.134	-1.841	**-5.191**	*-0.938*	-1.778	-2.989	*0.242*
p-val	0.005	0.081	**0.00005**	*0.417*	0.091	0.008	*0.813*
R^2	0.341	0.151	**0.586**	*0.227*	0.143	0.32	*0.005*

Table 3 illustrates the convergence in situations where the initial value was the variable of the year in which the country officially joined the Community, and the last value was the value as at 2011.

Even here, there is apparent convergence of tax mixes, however, individual dependences are lower than in the previous case (about half). Also, the coefficients of determination decreased, indicating an increase of the examined variables in the given models. One reason for this change – leaving out the impact of globalization – may be absence of the changes necessary for the accession to the Community; which were not included in the analysis simply because the initial value taken into account was as late as the year of the country's joining the EU.

The coefficients of determination get again one of the highest values in tax quotas and indirect taxes, however, even in this case they are lower, only 34.1% and 32%.

Of note, however, are the results of social security

contributions, where the convergence rate remained the same, but at the same time the coefficient of determination increased. The initial value of this part of the budget revenue can explain the 58.6% variance of the growth rate between the countries compared to the original 16.8%.

Another exception is the insignificant dependence in tax revenues from salaries and wages (TOW), as well as in tax revenues from other taxes (OT); therefore, it is not possible to confirm that there is any Beta convergence there. Even the coefficients of determination R^2, in this case, amount to smaller values than in the previous case.

IV. Sigma Convergence

As mentioned above, the Sigma convergence completes the picture of the Beta convergence and illustrates its course. The graphs below provide information on the development of the Sigma convergence in the analysed periods.

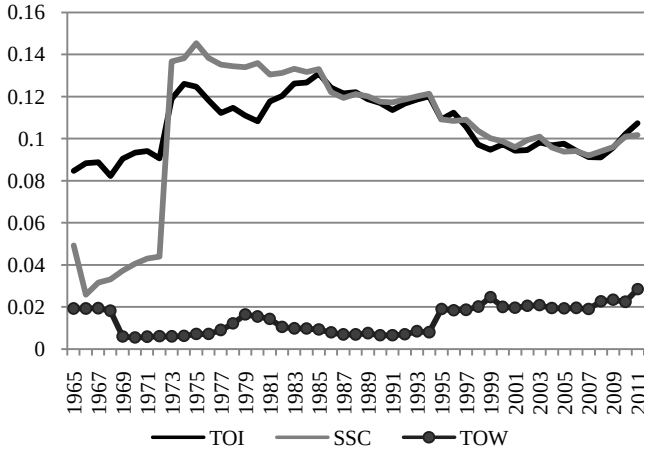

Fig. 2 Sigma Convergence of TOI, SSC, and TOW in the EU in 1965 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

The graph above shows the development of standard deviations between 1965 and 2011. Until 1975, there is noticeable divergence in the tax mixes of social security contributions, however, after this year, convergence starts to occur until the end of the analysed period. This is shown also by the result of the Beta convergence.

The tax mix of income taxes indicates the same course, but as late as from 1985. An interesting development can be seen in the standard deviation of the tax mix of salaries and wages, which shows an entirely opposite course. The reason for this development will be subject of further research.

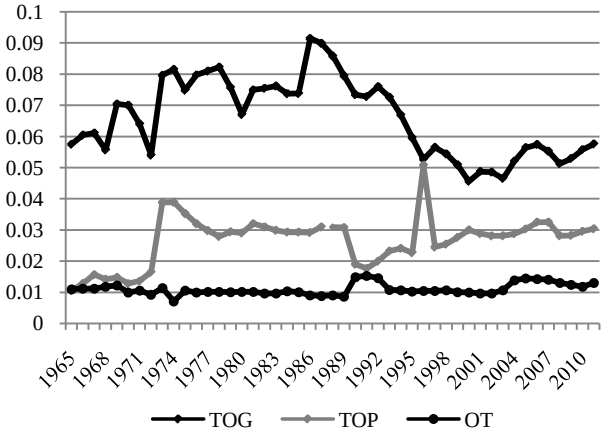

Fig. 4 Sigma Convergence of TOG, TOP, and OT in the EU in 1965 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

As for the tax mixes of indirect taxes, there is the same development of convergence/divergence as in the case of income taxes. Until 1985, there was divergence, which then turned into steep convergence. The reason for this turnover may be the mandatory introduction of value added tax in the EU Member States, which took place in the 1980s.

According to the Sigma convergence, the tax mixes of property taxes and other taxes do not meet the convergence objective, however, in this case, it is not possible to claim that there is divergence as the Sigma convergence is not a condition for confirmation of the Beta convergence, which was not refuted in these taxes in the period of 1965 – 2011 [20].

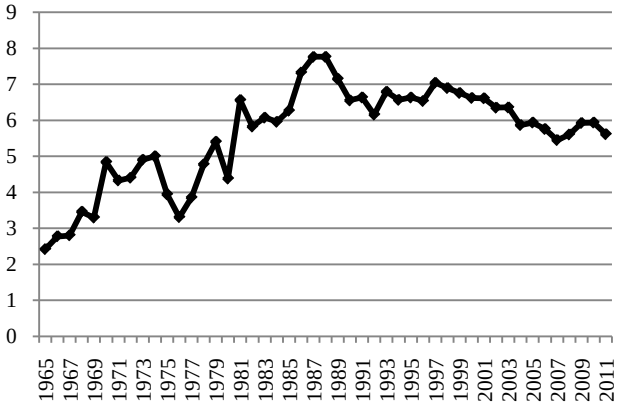

Fig. 3 Sigma Convergence of Fiscal Pressure in the EU in 1965 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

The development of the Sigma convergence in the tax quota nearly exactly follows the development of the tax mix of indirect taxes, income taxes, and social security contributions. Graph 4 shows the change in the growing trend of the standard deviation in 1985, from which point there is convergence of the overall tax burden in the EU.

Similarly interesting is always the end of the analysed period, when Europe was struck by the global economic crisis; between 2007 and 2009, the development of the Sigma convergence shows divergence of tax mixes, thus of the tax quota.

V. Convergence of VAT and SSC Rates

For a more detailed representation of the examined issue of tax convergence in the EU – thus of fulfilment of the primary objectives of the EU – Chapter 4 will focus on two specific taxes: VAT and social security contributions (although social security contributions are not taxes in the literal sense, however, they will be addressed as such in this paper). These taxes were selected as representatives of the two main groups of taxes from two points of view. On the one hand, each of them belongs to one of the basic groups (direct and indirect taxes), while on the other hand, they represent taxes with great and low coordination/harmonization in the EU.

VAT is one of the most harmonized taxes in the EU (together with environmental and excise taxes), while social security contributions belong to the group of taxes which are subject only to EU coordination.

VAT legislation is governed by directives and regulations that prescribe the Member States to incorporate these rules into their national legislation, which creates a compact and interconnected system. Although Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax allows the Member States, in some cases, to set their own rules, other tax rules have been determined firmly. If a Member State fails to incorporate these rules into its own legislation, it could face sanctions imposed by the EU. Furthermore, citizens of such a country could – despite absence of such EU rules in the national legislation – claim their rights that arise under European legislation.

Compared to VAT, social security contributions seem to have assumed a rather independent position in the Member States. Their coordination is based on certain agreements that address, for instance, payments from the social security system in situations where a policyholder (premium payer) migrated across EU countries.

The following sub-chapters discuss convergence or divergence using the methods employed for examination of tax mixes, i.e. the Beta and Sigma convergence. They will examine VAT rates and subsequently the rates of social security contributions.

A. Beta Convergence

Analysis of rates of selected taxes verified presence of convergence of the set variables in 1968 – 2011. The summary of the results is provided in the tables below.

Table IV Beta Convergence in the EU Member States (1968 – 2011)

	Standard VAT rates	Reduced VAT rates	SSC employee	SSC employer	SSC self-employed
β	-0.762	-0.526	-0.673	-0.087	0.049
P-val	$< 10^{-5}$	$< 10{,}4 * 10^{-4}$	$< 10^{-5}$	0.655	0.706
R^2	0.815	0.393	0.874	0.012	0.009

The dependence of the **standard VAT rates** is significant at less than 1% significance level. The Beta coefficient is negative, indicating convergence in the given period, and the coefficient of determination (R2 = 0.815) shows that the initial value of the standard VAT rate may explain the 81.6 % variation of the growth rates between the Member States. It also indicates the high quality of the model.

The convergence of the **reduced VAT rate** in the EU Member States was also verified for the analysed period. The results of the Beta convergence were similar to that of the standard rate. The only differences were the speed of convergence (which was lower here) and the lower coefficient of determination, the amount of which (39.3%) confirmed that this model contains other significant variables.

Compared to the results for the standard VAT rate, there was a significantly weaker convergence and lower variation of the growth rate.

Rates of **social security contributions for employees** were the last rates to start converging in the EU. Even here, dependence is significant at a significance level of less than 1%. The coefficient of determination is again quite high (over 87.4 %), which also supports the quality of the model.

Compared to the results of the Beta convergence in the standard VAT rate, however, convergence is weaker, while with a higher variation of the growth rate. However, compared to the reduced VAT rate, convergence is slightly higher with a significantly higher variation of the growth rate.

Subject of the last analysis was the Beta convergence of the **rates of social security contributions for employers and self-employed persons**. The rates for employers showed convergence. However, it could not be verified as the significance level exceeded 30 %. Similarly, the significance level was high in the rates of social security contributions for self-employed persons. Therefore, neither here can we verify convergence of these rates in the EU during the analysed period.

B. Sigma Convergence

As mentioned above, the Sigma convergence completes the results of the Beta convergence. Overview of the development of the Sigma convergence is provided in the below graphs.

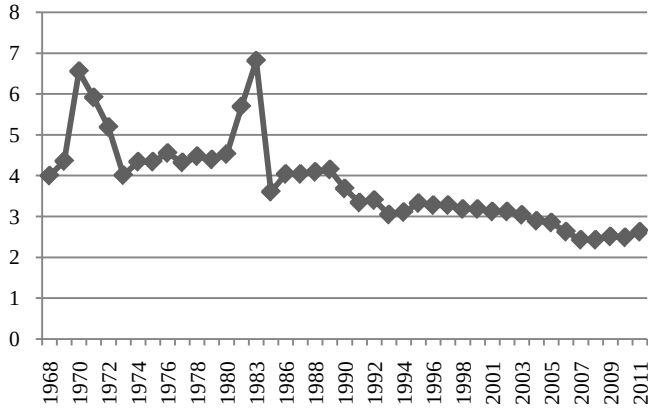

Fig. 5 Sigma Convergence of Standard VAT Rates in 1981 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

The declining trend of the curve on Fig. 5 completes the total result of the Beta convergence of the **standard VAT rate** in the EU during the analysed period. However, there are two significant fluctuations (divergences) that occur between 1970

and 1972 and between 1982 and 1984. These are caused mainly by the oil crises that affected not only the EU Community.

Thus, the Sigma convergence does not invalidate the results of the Beta convergence. From the trend in Fig. 5, it can be concluded that the Beta convergence results were confirmed.

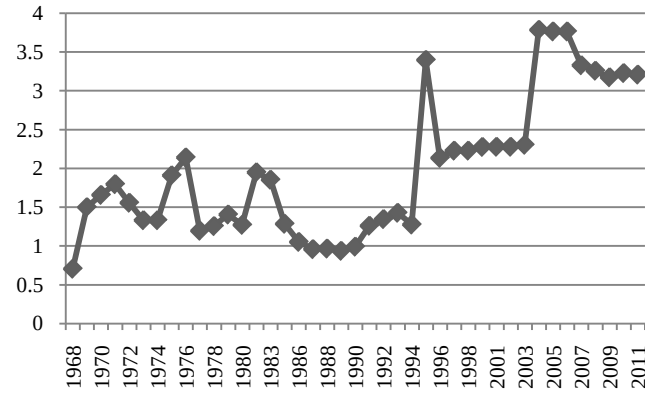

Fig. 6 Sigma Convergence of Reduced VAT Rates in 1981 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

The graph above shows the development of the standard deviation of **reduced VAT rates**. Even here, there is clear divergence in the 1970s, 1980s, and even 1990s, when the world was struck by the oil crises. The growing trend in the curve of the standard deviation on the above graph shows that the Sigma convergence was not confirmed in reduced VAT rates. However, we cannot disprove that there was not Beta convergence of reduced VAT rates [20] as the Sigma convergence is not a condition for the Beta convergence.

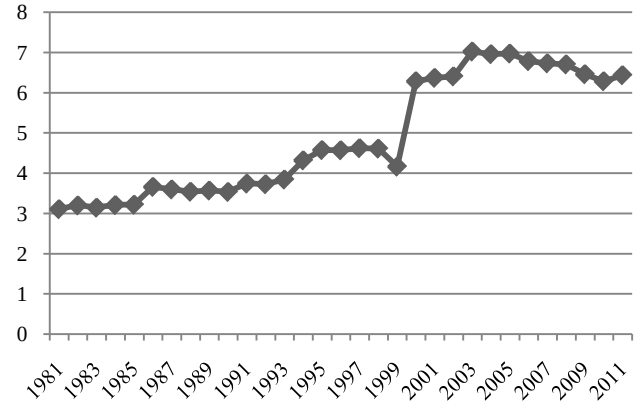

Fig. 7 Sigma Convergence of SSC Rates – employee in 1981 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

The growth of the curve in Fig. 7 clearly shows divergence of the **rates of social security contributions for employees**, although the Beta convergence was fully demonstrated. The Sigma convergence only completes the picture of the Beta convergence and illustrates the difference from the EU countries average values in the given year.

As in the previous case, however, it is not possible to conclude that the Sigma convergence refutes the conclusions of the Beta convergence. It only cannot confirm them.

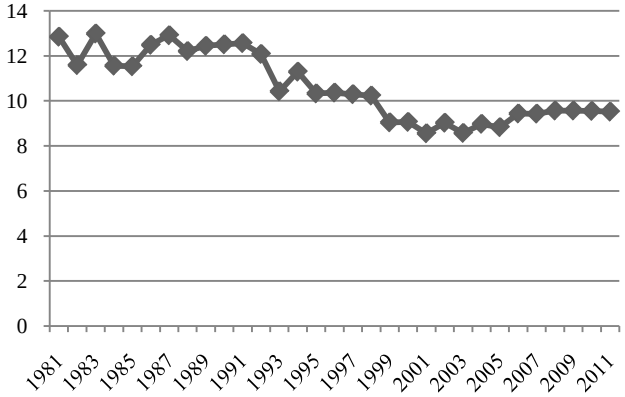

Fig. 8 Sigma Convergence of SSC Rates – employer in 1981 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

Although the Beta convergence was confirmed in the case of the rates of social security contributions for employers, even the Sigma convergence points to it – see Fig. 8. We can therefore assume that if we had better data, convergence would be confirmed in both cases. In this case, however, it cannot be fully verified.

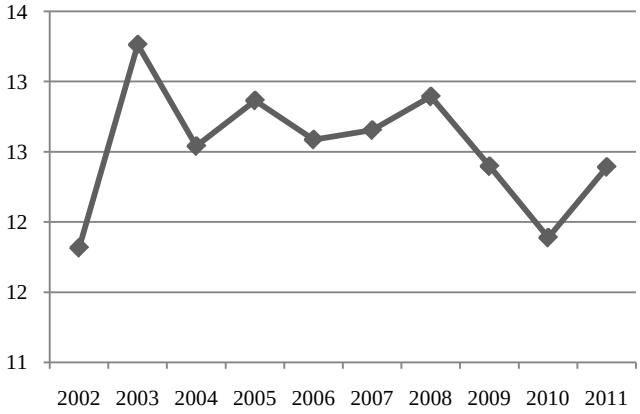

Fig. 9 Sigma Convergence of SSC Rates – Self-employed Persons in1981 – 2011 (%)
Source: OECD Tax Revenue Statistics 2012 edition, own processing

In the case of rates of social security contributions for self-employed persons, the Sigma convergence would confirm the result of the Beta convergence; however, it was not verified. The curve here does not show any clear trend and so convergence can neither be refuted nor confirmed.

VI. Conclusion

The results presented use the traditional neo-classical methods for finding out convergence of tax systems of European countries. The paper deals with the question of whether the European Union fulfils the objective of a single market also in the field of tax policy. In this area, based on all assumptions, there should be convergence of tax systems of the Member States, with aim to eliminate distortions arising from the transition between individual Member States.

To meet the objective, we used the methods of the Beta and Sigma convergence. Convergence was examined separately. At first, for all contemporary EU Member States, regardless of

whether they had been EU members or not. This confirmed the fact that there is convergence even if a country is only located in the given area and is not an official member of the EU. The second methodology took into account only the states when they were official members of the Community.

The Beta convergence between 1965 and 2011 of the group of all the current Member States confirmed the existence of convergence of tax mixes (graded according to the OECD classification) and tax quotas. Their convergence occurred even when the contemporary Member States had still not been official members of the Community. The reasons may be, in particular, globalization and the ongoing trend of convergence, as described in [14] or [5], but also the convergence effort by the countries seeking to join the EU.

The second methodology of the Beta convergence took into account only the Member States since the moment they became official members of the Community (thus, it considered only the EU). In this case, the convergence of tax mixes was confirmed, but at a lower rate than with the previous methodology. It was confirmed for income taxes, indirect taxes, and property taxes. It is interesting that the revenues from social security contributions did not show that significant decrease in the second methodology; in fact, the coefficient of determination increased nearly to 60%. The tax mixes of salaries and wages, as well as other taxes, showed no significant dependence, and the Beta convergence, in this case, cannot be confirmed.

The Beta convergence itself, however, does not give a complete picture of the course of convergence of tax mixes and quotas. Therefore, we also used the Sigma convergence, which completes the overall picture of convergence of the tax mixes and tax quotas. In the tax quota, in this case (using the Sigma convergence), convergence was confirmed since 1985, as well as in the tax mix of income taxes and indirect taxes.

Using the Sigma convergence, tax revenues from social security contributions converged since 1975. However, according to the Sigma convergence, tax revenues from wages, other taxes, and property taxes in this period diverge. This, however, does not mean that there was no convergence as the Sigma convergence is not a condition to confirm the Beta convergence [20]. Therefore, the convergence demonstrated throughout the analysed period using the Beta convergence could not be completely disproved.

The result of the analysis is the statement that the tax mixes in the European Union converge throughout the entire analysed period of 1965 – 2011. Considering the EU Member States only since their official accession to the EU, convergence also occurs, however, it is slower and the number of explained variables is increased as the coefficients of determination decreased. In revenues from other taxes, wages and salaries, convergence was neither confirmed nor refuted.

Analysis of rates of selected taxes demonstrated convergence using the Beta convergence in the standard VAT rate, reduced VAT rate, and the rate of social security contributions for employees. In the rate of social security contributions for employers and self-employed person, the Beta convergence was not verified.

The Sigma convergence demonstrably confirmed the results of the Beta convergence only for the standard VAT rate and social security contributions for self-employed persons. In others examined tax rates, the Sigma convergence did not unambiguously confirmed the conclusions of the Beta convergence. However, based on the fact that the Sigma convergence did not confirm convergence, it cannot be concluded that there was convergence (Slavík, 2007).

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