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Tax Models in the EU: a Cluster Analysis

Nikolay Velichkov*

Kristina Stefanova**

Summary

This paper examines the differences between the various tax systems within the EU. Using a cluster analysis and on the basis of different tax system indicators, three distinct and relatively homogenous models are derived that reflect directly the tax structure and also indirectly its macroeconomic projections. The resulting groups generally include countries with close geographic location and similar traditions, history, and degree of economic development which in itself is a prerequisite for similarities in their tax systems.

Key words: taxation, tax system, tax models, EU, cluster analysis

JEL classification: E62, H20, H21, H24, H25

1. Introduction

In view of the continuing efforts to uphold the European socio-economic model and the attempts to overcome the respective challenges, the issue of strengthening the coordination of EU Member States policies is becoming more and more pressing. This is of critical importance for the smooth operation of the EU and an essential condition for ensuring consistency of national level actions with the common European priorities. The deepening of European integration is particularly relevant for the coordination of fiscal policies (Velichkov, 2016a; Petrova, 2016). The present emphasis is primarily on spending policies. While EU Member States have shown some strengthening of integration with respect to the budgets expenditures side, especially since the latest Stability and Growth Pact reforms (Petrova, 2016), there are substantial differences on the revenue side. Considering the significant direct and indirect impact of tax systems on the different dimensions of the macroeconomic environment, the tax structures in both the individual Member States and the Union as a whole should be the focus of heightened attention.

In that sense, the objective of this paper is to outline the distinctions in the European Union with respect to tax systems. Along with the differences, the similarities between individual groups of countries under common tax models are also studied. For the purposes of the paper, a cluster analysis approach based on various national level policies criteria is used, given that this is the most widely accepted method in similar classifications across countries, including those within the EU. The published literature in this area is limited. Traditionally, the focus has been on the heterogeneity in the EU with respect to the state's ability to provide social protection and sustainable welfare for citizens, and therefore most theoretical (Esping-Andersen, 1990; Ferrera, 1996; Bonoli, 1997; Sapir, 2006) and empirical (Bertola at al., 1999; Kautto, 2002; Ferreira et al., 2005; Fenger, 2007; Draxler et al., 2010) classifications have made use of primarily social indicators (share of public

* Chief Asst Prof, University of National and World Economy, Department of Economics, email: nn_velichkov@unwe.bg

** Asst Prof, University of National and World Economy, Department of Economics, email: kristina_petrova_s@abv.bg

social expenditures in GDP, inequality, well-being, and poverty indicators, among others) to differentiate between individual social models and welfare states.

At the same time, the formation of particular social models also reflects to a great extent the adopted national level tax models and the achieved economic development level. Countries with generous welfare states tend to be the ones that have long been wealthy (Krugman et al., 2001). There are also some empirical studies that focus on patterns in the differences in national spending policies (Ferreiro et al., 2013; Petrova, 2014), which are also expected to fairly approximate the tax models within the EU.

Some studies, in particular, address the formation of individual tax models, but their focus is on the impact of globalization on the characteristics of national tax systems and the formation of tax models. Heinemann (2000) looked at the impact of globalization on some characteristics of fiscal policies (tax revenue structure, government expenditures structure, government debt, budget size) among 21 OECD countries, using cluster and discriminate analysis, and revealed the globalization's effect on tax revenue structure. Kubatova et al. (2008) conducted an analogous study that reached similar results. By applying the methodology of Kubatova et al. (2008), Luković (2015) studied the impact of globalization on the tax system characteristics of 36 European countries from three perspectives: 1) tax burden on business activity; 2) structure of tax rates; 3) taxes expressed as share of commercial profit. On the basis of these three frames of reference, separate cluster analyses were performed, though this approach does not fully encompass all characteristics of the rendered tax models. The study also involved European countries that are not members of the EU. The present study differs in this respect, as it intends to address tax competition within the EU, as well as the supranational efforts to achieve some convergence of national fiscal policies.

The paper is structured as follows. The first section analyzes various macroeconomic projections of the tax system. The second section looks at some conceptual questions pertaining to the chosen analysis methodology. The third section presents the results of an original empirical study that identifies individual tax patterns across the EU based on different tax system indicators.

2. Macroeconomic projections of the tax system

The tax system has profound effects on the sustainability of the macroeconomic environment. Macroeconomic stability is an important factor for business investment and for economic performance as a whole. For this reason, tax systems and the associated budget stabilizers play a significant role in moderating the fluctuations in macroeconomic dynamics by supporting the macroeconomic system's sustainability through established and tested mechanisms for mitigating the economic cycle manifestations that do not require any direct intervention on the part of government. A number of economists assign the integrated budget stabilizers a key role in maintaining macroeconomic stability, primarily because they are not subject to the typical internal lags that largely undermine the effectiveness of discretionary stabilization measures (Noord, 2000; Brunilla, Buti, Veldt, 2002; Auerbach, A., Feenberg, 2000; Braconier, Holden, 2001). This is one of the reasons fiscal policies in a number of countries are based primarily on the action of automatic stabilizers that mitigate the impact of economic instability and overcome its manifestations.

Furthermore, the tax system structure has a clear influence on the growth and sustainable development of the economy mainly through its impact on investment

decisions and labor supply. Empirical research in the context of endogenous growth has subjected this to an in-depth analysis. Considering the tax competition among countries, it is worth noting that a number of countries have been restructuring their tax systems in order to boost competitiveness. In this context, a number of empirical studies focus on the relationship between tax revenue structure and long-term economic dynamics (Arnold, 2008, Widmalm, 2001, Lee, Gordon, 2005).

The external effects of tax competition are more pronounced within the EU. This is explained by the fact that the common market and the principles of free movement of people, goods, and capital lead to greater mobility of tax bases. Therefore, reducing the tax burden in one Member State may be the reason for relocating the tax base from a neighboring Member State where the tax burden is higher. Furthermore, there are very limited possibilities for taxing foreign nationals within the Union, which has an influence on the tax exporting effects. These two circumstances are traditionally considered the leading cause of increased tax competition under European integration, leading to a downward trend in tax rates. In this respect, a number of studies emphasize that the reduction of corporate tax rates for the Union as a whole during its Eastern enlargement period can be interpreted as evidence pointing to stronger tax competition between Member States (Keuschnigg et al., 2014).

The above reasoning suggests that the tax system structure reflects the impact of various factors and conditions, which explains the marked heterogeneity in the tax models of individual countries even within an economically integrated union such as the EU.

3. Methodology

The cluster analysis approach is the method of choice for the empirical grouping of EU countries, as it is the most widely accepted for grouping countries according to various indicators. It allows for the simultaneous classification of multiple units according to several criteria in a relatively small number of rather homogenous groups, referred to as clusters. The purpose of this classification is for EU countries to be grouped into models according to twelve tax system indicators that reveal its different dimensions and serve as classification criteria. This determines whether separate tax patterns are distinguished within the EU and provides for drawing conclusions with regard to both differences and similarities between some countries forming a common tax model.

The choice of criteria for grouping into separate tax models is crucial. It is necessary to identify features that, on one hand are common to all countries, and, on the other, can be specified in a system of indicators with sufficient differentiation significance (Petrova, 2014). Moreover, it is important to fully encompass many aspects of the tax systems. For these reasons, twelve tax system indicators have been selected that describe to a large extent the tax systems of the EU countries. The classification criteria are as follows:

- Total taxes as percent of GDP (totalTax);
- Direct taxes as percent of total taxation (dTax);
- Indirect taxes as percent of total taxation (indTax);
- Social contributions as percent of total taxation (socContr);
- Taxes on consumption as percent of total taxation (consTax);
- Taxes on capital as percent of total taxation (capTax);
- Taxes on labor as percent of total taxation (labTax);
- Implicit tax rates on consumption (implTaxRcons);
- Implicit tax rates on labor (implTaxRlab);
- Effective average tax rates (EATR);

- Top statutory personal income tax rates (topPITR);
- Top statutory corporate income tax rates (topCITR).

Given that the cluster analysis approach does not use time series but classifies a given number of units at a given point in time or averaged data over a given period, for the purposes of this study average annual data is used for all presented variables. In order to preserve time consistency, the empirical information refers to the period after 2002[1]. Averaging is the commonly used technique to eliminate the impact of extreme values. Data on these indicators was obtained from Eurostat as the EU's standardized statistical authority.

Prior to interpreting the cluster results, the study examines whether the selected criteria can be considered significant for model differentiation within the EU. This significance is estimated according to the conditional F-test (Fischer's test).

The k-means method (nonhierarchical clustering method) is applied, because it is a fast approach to working with a wide range of variables for many units of the studied population and allows for differentiation of homogeneous clusters, as is the choice in this study.

4. Results

In order to establish whether all selected criteria can be deemed as significant for model differentiation within the EU, the conditional F-test is applied. The results in Table 1 present that the majority of the selected criteria are model differentiating factors.

The results of the F-test indicate that nine of the selected criteria are statistically significant at a 5% significance level and one at a 10% significance level. Two of the criteria are statistically insignificant (implicit tax rate on labor and taxes on labor as percent of total taxation), which means that they have no role in the differentiation of the tax patterns in the EU.

Top statutory personal income tax rate, direct taxation as percent of total taxation, and effective average tax rate have the greatest differentiation significance. This demonstrates

Table 1. Differentiation significance of the criteria according to the F-test

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
totalTax	137,593	2	21,710	25	6,338	0,006
dTax	937,217	2	35,875	25	26,124	0,000
indTax	195,242	2	27,047	25	7,219	0,003
socContr	868,340	2	42,864	25	20,258	0,000
consTax	286,795	2	27,523	25	10,420	0,001
labTax	62,785	2	54,140	25	1,160	0,330
capTax	97,394	2	30,405	25	3,203	0,058
implTaxRcons	69,069	2	15,400	25	4,485	0,022
implTaxRlab	11,286	2	39,044	25	0,289	0,751
EATR	396,409	2	16,225	25	24,432	0,000
topCITR	439,976	2	19,388	25	22,694	0,000
topPITR	1463,746	2	52,586	25	27,835	0,000

Source: Cluster analysis results.

[1] The averaging period final year for individual indicators is determined by the latest available data. For all indicators, the final year is 2014, 2015 or 2016, except for Croatia for the implicit tax rate on consumption, where the final year is 2012. The studied timeframe includes available data on all Member States (28 up to the last year of the analyzed period), regardless of their stage of inclusion in the EU.

that the EU countries' models differ mostly with regard to the characteristics of the tax systems that serve as the basis for the identification of groups with similar characteristics.

Having established that the majority of the selected indicators can be significant with respect to the differentiation of various tax models within the EU, the concrete classification results are presented next.

The cluster-analysis derived Table 2 shows the grouping of countries into three clusters, with respectively 14, 11, and 3 countries in each.

policy criteria have obtained similar results (Petrova, 2014; Fenger, 2007; Draxler, van Vliet, 2010 etc.).

The new Member States of Central, Eastern, and Southeastern Europe, with the exception of Slovenia, are grouped into one cluster, which is indicative of a significant similarity in their tax systems. Slovenia is often separated from the CEE countries model and considered part the old Member States model, even when differentiating individual social models within the Union (Ferreira, Figueiredo, 2005).

Table 2. Cluster membership

Cluster	1	2	3
Countries	Belgium	Bulgaria	Denmark
	Germany	Czech Republic	Ireland
	Greece	Estonia	Sweden
	Spain	Croatia	
	France	Cyprus	
	Italy	Latvia	
	Luxembourg	Lithuania	
	Malta	Hungary	
	Netherlands	Poland	
	Austria	Romania	
	Portugal	Slovakia	
	Slovenia		
	Finland		
	UnitedKingdom		

Source: Cluster analysis results.

The resulting clusters show that they generally include countries with close geographic location and similar traditions, history, and degree of economic development. The obtained results are consistent with the accepted assumption that the development of tax systems is to a large extent determined historically and depends on the degree of economic development of a given society. The shared characteristics in the different groups are also a prerequisite for the similarity in the tax systems that are highly sensitive to government intervention. It should also be emphasized that other empirical studies that classify EU countries according to different

Apart from Slovenia, Malta also falls into the large group of old Member States, which means that their tax systems structures are similar to those of the other 12 countries in the cluster. The grouping of Slovenia and Malta together is supported by other empirical classifications by criteria characterizing budgetary policies (Petrova, 2014).

Denmark, Ireland, and Sweden are grouped in a separate cluster. This reflects the specificities in their tax models that distinguish them from other EU Member States. Given the significant similarities in their tax systems that are not typical

of other EU countries, the grouping of the two Scandinavian countries together is far from surprising. The more interesting fact is that this group also includes Ireland. Considering the specificities in Ireland's tax model, grouping it together with Denmark and Sweden was prompted by the more pronounced differences from the tax system characteristics in the other two clusters. This is supported by the obtained results (Table 3), which show that the third cluster is the most heterogeneous in comparison with the rest.

The resulting clusters are consistent with certain tax models within the EU that reflect not only the tax structure but also indirectly reveal some of its macroeconomic projections. Information on the specific model profiles can be found in figure 1, in which the final cluster centers are presented. These indicate the mean values of the grouping indicators for the cluster countries.

The first cluster is characterized by the highest tax burden on capital compared to the other groups - 11.29 percentage points higher than the second cluster and 6.72 percentage points higher than the third. Considering this, it is not surprising that in comparison to the other two, this group shows the highest level of the top statutory capital income tax rate (around 30% on average) and the highest share of capital taxes in total tax (about 21% on average).

This cluster typically approximates the relative importance of different types of tax revenue - direct, indirect, and social contributions. The first cluster shows the most pronounced tax system balancing with respect to the consumption, labor, and capital taxation. The difference between the predominant tax burden on labor and the tax burden on consumption that is most favorably taxed is 14.17 percentage points. The maximum differences between tax burdens on consumption, labor, and capital for the other two clusters are respectively 17.45 percentage points for the second group of countries and 14.93 percentage points for the third.

The second cluster shows the lowest ratio of tax revenue to GDP. By adopting the level of tax revenues compared to GDP as an indicator of the size of government in the economy, it can be concluded that the size of the public sector in this group of countries is smaller than that of the public sector in the other two groups. This implies a weaker redistributive role of the budget through the tax system in the second cluster countries. This is also historically conditioned because the size of the state in the economy is a matter of public consensus and is difficult to change. The greater ratio of tax revenue to GDP in the old Member States is related to the establishment of their large welfare states.

As far as the relative importance of the individual components of tax revenues in the second cluster countries is concerned, a certain specificity has been identified. It relates to the fact that the tax system in this group is based primarily on indirect taxation, with the resulting revenue accounting for the highest relative share of the total tax revenue. It can be pointed out that Bulgaria holds a leading position with respect to this indicator, given that this share averages 52.4%, which is 17.6 percentage points higher than the EU average. Consequently, the dominance of indirect taxation places the tax revenues of the second group in a strong dependence on the dynamics of domestic demand. It should be noted that direct taxation has the lowest relative significance. As a result, it is not surprising that this cluster shows the lowest levels of top statutory personal

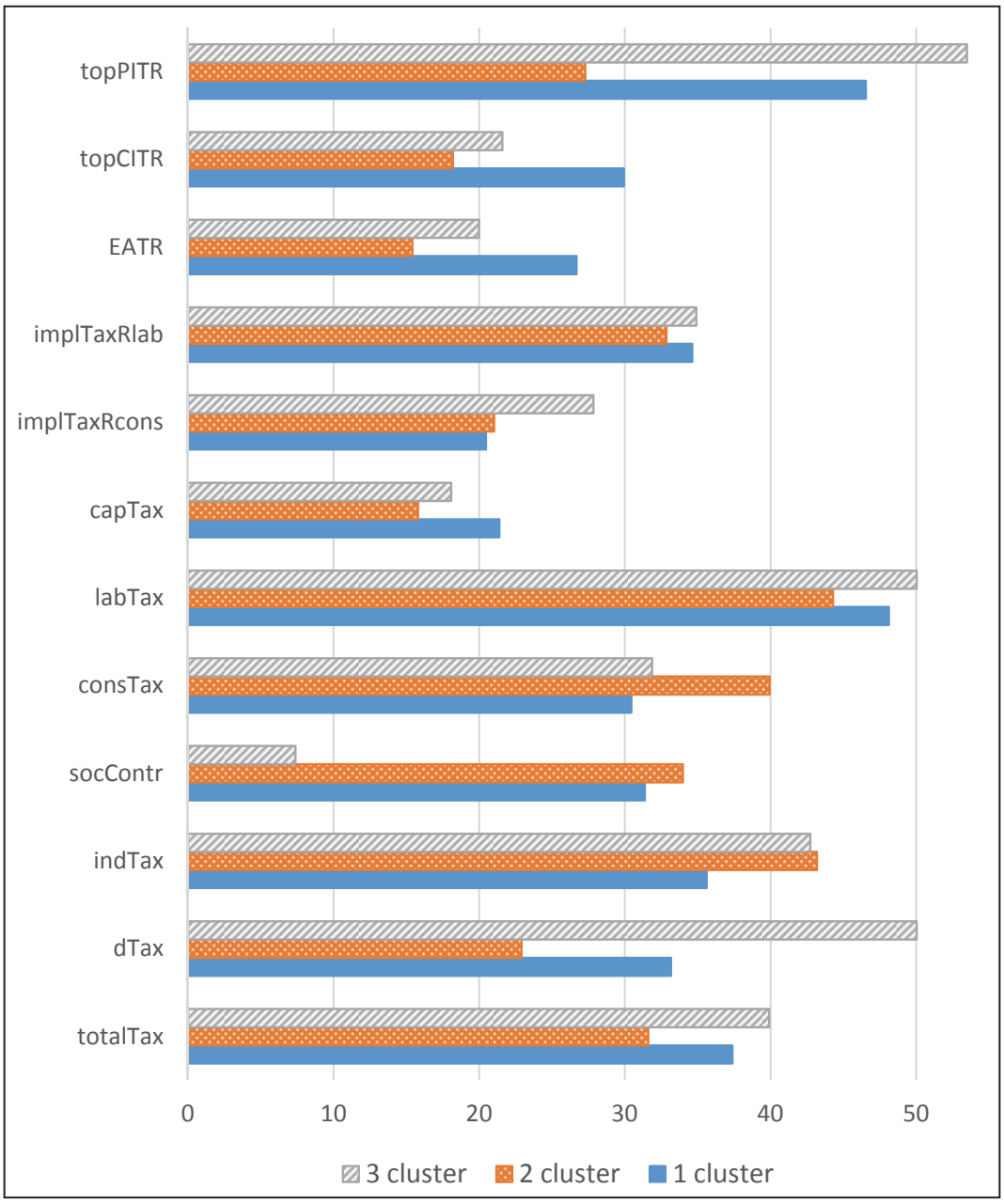

Fig. 1. Final Cluster Centers

Source: Cluster analysis results.

and corporate income tax rates. It should also be emphasized that some of the second cluster countries employ flat taxation, which has been traditionally associated with a relatively small amount of direct tax revenue.

These tax system characteristics also affect the ability of automatic budget stabilizers to reduce fluctuations in GDP which depends on the progressive nature of taxation, considering that the tax stabilization role is stronger in a more progressive tax system[2]. This is the reason why the built-in budgetary mechanisms to mitigate fluctuations in GDP have very limited role in some countries in Central and Eastern Europe with proportional income tax (Velichkov, 2015, 2016b). In addition, flat taxation strengthens income differentiation and increases inequality.

The second group of countries also exhibits certain specificities with respect to the tax burden on consumption, labor, and capital. It typically has the lowest tax burden on capital, and Bulgaria has the most favourable treatment of capital income in the EU. In Bulgaria, the tax burden on capital is about 2.2 times lower than the EU average over the studied period. In comparison to the tax burden on capital for the second cluster, the tax burden on consumption and labor is significantly higher, respectively 5.61 percentage points and 17.45 percentage points. Given the discussed relatively low level of top statutory personal income tax rate, it can be conceded that the insurance burden has the most significant weight in tax burden on labor in the countries of the second group.

In view of the low tax burden on capital and the relatively higher tax burden on labor resulting from the level of social security burden in the second cluster, there is a strong disproportion in the taxation of different types of income. In that sense, tax systems in these countries generally treat capital income considerably more favorably than labor income. This can be explained by their lower level of economic development and the need to attract more capital investments.

In the *third cluster*, the level of tax revenue compared to GDP is the highest, which implies a larger size of the state in the economy and a higher reallocation through the budget by means of the tax system. This cluster is also characterized by the highest relative weight of direct tax revenue in total tax revenue, while indirect tax revenue is of secondary significance and income from social contributions is more of a symbolic significance. The third cluster countries also exhibit the typical for EU higher tax burden on labor as compared to the tax burden on consumption. Considering the already low relative significance of social contributions, it is logical that the tax burden on labor is predominantly determined by personal income taxes. This is also confirmed by the relatively high level of the top statutory personal income tax rate compared to the levels in the other two clusters. Denmark shows the highest value of this indicator, which is about 19.4 percentage points higher than the EU average over the studied period.

As already discussed, the cluster analysis approach covers relatively homogeneous groups of countries, but there are differences within each group. This heterogeneity can be analyzed by calculating coefficients of variance that measure the dispersion between the countries in each group. In addition, coefficients of variation between individual clusters have also been calculated to provide information on the dispersion between the different tax models (see Table 3).

The results show heterogeneity is highest between countries of the third cluster, taking into account the highest

[2] The automatic budget stabilizers operation is also related to changes in government spendings associated primarily with unemployment benefits.

average spread. The coefficient of variation in this group is the highest in terms of the relative share of social and health insurance contributions in total tax revenues.

The second cluster exhibits smaller average dispersion in comparison to the third. Capital taxes as percentage of total taxation and top statutory personal income tax rates have the highest coefficients of variation (around 35%) , while total taxes as percent of GDP and indirect taxes as percent of total taxation have the lowest.

The first group of countries has the lowest average dispersion. Therefore, it can be assumed that this cluster shows the greatest homogeneity in comparison with the rest. Top statutory personal income tax rates indicate the highest degree of homogeneity with dispersion under 11%.

Concerning the dispersion between the individual clusters, the highest degree of heterogeneity is observed in the share of social contributions and direct taxes in total tax revenues, followed by top statutory personal income tax rate, and highest statutory corporate income tax rate. The lowest level of dispersion is observed in the implicit tax rate on labor and taxes on labor as a percentage of total taxation which is consistent with the drawn conclusions regarding their differentiation significance with respect to the formation of the individual tax models.

Table 3. Dispersion across and within clusters

	First cluster dispersion	Second cluster dispersion	Third cluster dispersion	Dispersion across models
totalTax	11,69	10,85	23,57	11,73
dTax	18,66	15,27	23,51	38,73
indTax	12,93	12,61	16,84	10,47
socContr	21,97	17,14	102,88	60,52
consTax	17,03	13,83	12,91	15,00
labTax	14,94	15,63	20,11	6,16
capTax	25,48	34,57	34,13	15,28
implTaxRcons	18,51	18,94	16,11	17,78
implTaxRlab	20,52	15,05	17,62	3,27
EATR	17,30	18,59	24,15	27,45
topCITR	14,27	19,83	35,52	26,06
Average	*16,98*	*18,90*	*28,46*	*22,04*

Source: Author`s calculations.

5. Conclusions

The analysis has established that there are clear differences between EU Member States with regard to their tax systems. At the same time, similarities between some countries allow them to be grouped into three relatively homogeneous groups. These groups include countries with a relatively close geographic location, similar traditions, history, and degree of economic development. The differentiation of the tax model in CEE countries and in the old Member States according to the

selected criteria in this study increases the reliability of the obtained results. The development of tax systems is largely historically conditioned and depends on the degree of economic development of a given society. The results are consistent with the findings of other empirical studies, which also reconfirms their reliability. The differentiated models reflect directly the tax structure and also indirectly some of its macroeconomic projections. Despite the development of the European Union and the attempts at a gradual convergence of national level policies, including fiscal policies, the general structure of these models is expected to persist in the near future. Even if unification is possible in some areas, a strong convergence cannot be expected in terms of the share of tax revenue in GDP, the relative significance of individual types of tax revenue, or the direct tax rates due to the different objectives of tax policies and the public perceptions of the tax system in individual groups of countries. In this respect, the idea of tax harmonization in the EU, with the relevant debates intensifying in recent years, seems difficult to achieve. This idea would be implementable if a stronger convergence between the Member States is reached, both in terms of the overall economic performance and the conditions and factor dependence of the ongoing economic processes.

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