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The Czech evidence for the explanatory power of formula factors on profitability

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Abstract

The allocation formula for the distribution of the Common Consolidated Corporate Tax Base (CCCTB) should include the three equally weighted formula factors that are considered to have the largest impact on the generation of profit/loss. The objective of the paper is to analyse the explanatory power of the proposed formula factors from the perspective of Czech independent enterprises. The analysis is based on the comparison of coefficients of determination as the indicators of explained variability of a regression model. The paper concludes that the proposed formula factors, as defined by the CCCTB Draft Directive, are able to explain almost 35% of the variance in profit/loss but also indicates that the other balance sheet items can have a higher explanatory power.

Keywords

Common Consolidated Corporate Tax Base, formula apportionment, regression analysis.

JEL Classification: H25, K34, C13

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1. Introduction

The effort of the European Union (EU) to harmonize the corporate tax system by implementing the Common Consolidated Corporate Tax Base (CCCTB), with the main objective of unifying the rules for the definition of the corporate income tax base, dates back to 2001. In 2004 the Working Group of the European Commission on the CCCTB (WG-CCCTB) was settled. Subsequently more than 60 proposals were published until the final publishing of the CCCTB Draft Directive on 16 March 2011. The proposal relates to the common definition and structure of the corporate income tax base for companies operating in the EU and sets the mechanism for the tax base consolidation within a group of companies. The main purpose of the CCCTB system is not the harmonization of corporate income tax rates but the establishment of common and clear rules for determining the tax base and thereby achieving simplification and greater transparency of national tax systems.

The consolidated tax base of a group of companies will be distributed among the member states on which territory individual members of a company group operate based on the allocation formula, that is, formula apportionment. The allocation formula should be composed of three equally weighted factors: the volume of tangible fixed assets, the volume of payroll costs combined with the number of employees and the volume of sales. According to Fuest (2008), the basic idea underlying the sharing mechanism for the tax base is that companies should pay taxes in proportion to their economic presence in a country, which is measured by the presence of employees, assets and sales.

The structure of the proposed CCCTB formula was inspired by the formula known as the Massachusetts formula, which has been commonly used in the United States of America since 1933. However, as stated in the KPMG Guide on CCCTB (KPMG International Cooperative, 2012), nowadays many states have moved (or are moving) to formulas that place greater weight on the sales factor. Moreover, eleven US states consider sales as only an apportionment factor since they view the increased sales factor weighting as an economic development toll.

Controversially in relation to the above, the European Parliament proposed an amendment to the weight of factors incorporated into the formula apportionment on 12 April 2012. According to it, the factors should not be equally weighted but the weights should be changed as follows: 45% for the payroll factor, 45% for the tangible fixed assets factor and just 10% for the sales factor. The European Parliament stated that the reason for the proportional reduction of the weight of the sales factor was to ensure that the CCCTB system will not significantly differ from the internationally recognized principle, which gives limited taxing rights to the source country. According to the European Parliament, the reduction of the sales factor is also necessary since a higher proportion may lead to a greater possibility of tax base manipulation, which may especially arise through independent sales agents located outside the CCCTB group company, who will complete the sale on behalf of it but will move the destination of sales from the intended state to the state of choice.

The main objective of the paper is to analyse the explanatory power of the proposed formula factors on the generation of profit/loss of a company from the perspective of Czech individual enterprises. The paper further deals with the variety of combinations of the formula factors to examine the most powerful combination of variables for the explanation of the highest proportion of variability in the profit/loss.

The paper is structured as follows: section 2 introduces the main characteristics of the proposed formula factors and provides a brief overview of the related literature; section 3 specifies the data and methods; section 4 presents and discusses the main results; and section 5 concludes.

2. Theoretical overview

The suggestion of the European Commission for the harmonization of the corporate income tax system within the EU through the introduction of the CCCTB system has stimulated the extensive scientific work of many researchers. One group of them mainly discusses the overall concept of the CCCTB system and the method for its possible implementation into national tax systems (Mintz, 2007; McLure, 2008; Dankó, 2012). The next group of researchers is focused on the analysis of the impacts of the introduction of the CCCTB system on tax revenues (Devereux and Loretz, 2007; Fuest et al., 2007; Ernst & Young, 2010).

Since the paper analyses the suitability of the formula factors in the allocation mechanism, namely formula apportionment, the further theoretical overview refers to the arrangement of the allocation formula and the definition of the individual formula factors.

The proposed allocation formula for the CCCTB (stated by Article 86 of the CCCTB Draft Directive) is based on three macroeconomic factors: labour, sales and tangible fixed assets. The sales factor, according to Petutschnig (2010), reflects the demand side, while the labour and assets factors reflect the supply side.

Sales will be attributed to the member state of the *destination* of the sales (i.e. the place where the dispatch or transport of the goods ends) rather than to the *origin* country. As mentioned by Trandafir (2011), the destination principle for assigning sales is argued to be preferable because it is less mobile than the location of assets and employees. The assets factor will include only tangible fixed assets, specifically property, plant and equipment, at their tax written down value, and will be attributed to the entity that is using these assets. Assets with a valuation of more than 1,000 EUR, which are capable of participating in the generation of revenues of a respective company for a period longer than one year, will be considered as eligible tangible fixed assets. All intangible and financial assets will be excluded. Thus, it is possible that countries with a larger share of services will be disadvantaged; on the other hand, countries with labour-intensive industries will benefit from the allocation formula. To compensate for the lack of intangibles, the European Commission proposed in Article 92 section 2 of the CCCTB Draft Directive that *in the five years that follow a taxpayer's entry into an existing or new company group, its assets factor shall also include the total amount of costs incurred for research and development, marketing and advertising by the taxpayer over the six years that preceded its entry into a group*.

The Draft Directive does not provide one harmonized definition of an employee but instead proposes that the definition of an employee will be derived from the national definition of an employee of that EU member state on the territory of which the employee performs her/his services (Article 90 of the CCCTB Draft Directive). To prevent any conflicts stemming from different employee definitions, the WG-CCCTB suggests a system of mutual recognition of the various employee definitions by the other EU member states involved. According to Eberhartinger and Petutschnig (2014), a narrow definition along the lines of a full-time permanent worker/employee in one member state may meet rather liberal definitions that include part-time contracts, leased workforce or certain self-employed contractors in other member states.

The proposed allocation mechanism does not reflect the functions performed, risks assumed and intangible assets owned by the CCCTB group companies. This will, according to the KPMG study (KPMG International Cooperative, 2012), favour more tangible asset-intensive companies and apportion less taxable profit to companies managing such companies that would generally receive the residual profit/loss from an arm's-length perspective.

Roggeman et al. (2012) examined the explanatory power of the proposed formula factors on the variation in profit. They employed firm-level data from the Amadeus database for the European companies operating in the manufacturing and service sector[1] in the year 2008. Their results showed that the European proposed allocation factors only explain 28% of the variation in profit. They also indicated that the sales factor is the dominant factor in explaining the profit and the costs of employees are the most accurate labour factor. Hines (2008) showed that the apportionment factors sales, assets and payroll (constituting the combination of labour compensation and the number of employees) perform very poorly in explaining the variation in income between firms.

According to the study by Cobham and Loretz (2014), using tangible assets as the formula factor allocates more of the tax base to lower-income countries, while most countries are major winners if the number of employees is used. In contrast, apportionment according to the operating turnover or the costs of employees will allocate a larger share to higher-income countries. In the case of placing a positive weight on capital in the allocation mechanism, each jurisdiction partially turns the corporate income tax into a tax on capital and thereby shifts part of the multinationals' rents to domestic workers, whose wage income and welfare increase, compared with a formula containing labour as the sole apportionment factor (Runkel and Schjederup, 2007). Anand and Sansing (2000) considered the choice of apportionment factors in a setting in which states differ in their goods demand. They showed theoretically and empirically that importing states have an incentive to place more weight on the sales factor in comparison with exporting states.

Eberhartinger and Petutschnig (2014) considered which kind of employee definition (narrow or broad)

[1] Manufacturing sector NACE codes 15–36 and services sector NACE codes 50–74 and 92.

chosen by a particular member state will be preferable from the point of view of the allocated share in the consolidated tax base. Their analysis showed that the individually rational strategy of any member state regarding the definition of an employee with the aim of maximizing the volume of the apportionment factor and the allocated share of taxable income is to define the term employee broadly given the fact that the tax difference and differences in the volume of atypical employment schemes are disregarded.

3. Data and methodology

The paper analyses the explanatory power of the proposed formula factors incorporated into the CCCTB allocation mechanism on the profitability of a company.

The analysis is based on the evaluation of coefficients of determination of various models analysed following the ordinary least squares method (OLS method), a method for the examination of the parameters of regression functions that are linear in parameters. Single, that is, models with one dependent and one independent variable, as well as multiple, that is, models with more than one independent variable, regression models are analysed in the paper. The parameters of the regression are determined by unrestricted regression models as well as by restricted regression models in which the equal weight of parameters is considered.

Firm-level data from the Amadeus database (Amadeus database update no. 234, up to 13 March 2014) were used for the analysis in the paper. The data of active, independent (i.e. unconsolidated) companies registered in the Czech Republic with a published value of profit/loss for the taxable year 2012 were employed in the research. The methodological approach of Hines's study (2008) was followed; it states that to estimate the extent to which the apportionment factors explain the variation in firm profitability it is helpful, for the purposes of data comparability and data quality, to consider evidence from firms located in a single country. The data that refer to the taxable year 2012 were used. The initial data sample before its further adjustment consisted of 111,295 companies with a published value of profit/loss before taxation for the year 2012.

For the sample, the following data were employed: tangible fixed assets (TFA), operating turnover (OPT), number of employees (NoE), labour compensation (CoE) and profit/loss before taxation (PL). In addition, information about the volume of intangible assets (IFA) and total assets (ToFA) was collected for further analysis if the proposed formula factors were able to explain the highest proportion of profitability. All the financial data are expressed in thousands EUR.

As a proxy for the sales formula factor, the operating turnover was considered. The operating turnover is usually defined as the total output from economic activity carried out over a certain period, usually measured by the total revenues related to sales of goods, products and services under the ordinary business activity reduced by warranty claims and rebates. The operating turnover is therefore usually equal to the volume of sales.

All companies with a missing value for any variable as well as with negative values for tangible fixed assets and labour compensation (i.e. payroll costs) and all extreme values below the first percentile and above the ninety-ninth percentile were excluded from the sample. The final sample contained complete information on all the variables for 65,404 companies. Table 1 presents the descriptive statistics of all the variables in the year 2012.

Table 1 Descriptive statistics: all variables in thousands EUR, except the number of employees; active companies in the Czech Republic with a published value of profit/loss before tax for 2012

Name of variable	Mean value	Standard deviation	Min. value	Max. value
Profit/loss before taxes (PL)	53.66	225.39	–526.90	3,015.65
Sales (OPT)	1,579.18	4,401.15	0.00	63,844.42
Tangible fixed assets (TFA)	417.10	1,373.20	0.00	19,351.05
Number of employees (NoE)	18	41	3	375
Labour compensation (CoE)	22.47	568.94	1.27	7,282.04

All the observed variables are correlated in a positive and significant way at the 5% significance level. The correlation matrix is reported in *Appendix 1*.

4. Results and discussion

The paper analyses the explanatory power of the proposed formula factors on the generation of profit/loss of companies operating on the territory of the Czech Republic and considers the suitability of the formula factors, as designed by the CCCTB Draft Directive, for incorporation into the CCCTB allocation mechanism. The analysis was based on the examination of regression models that consider one or more independent variables. The OLS method for both unrestricted and restricted regression was used. The analysis of the explanatory power of the proposed formula factors was based on the comparison of coefficients of determination (R^2), which expresses the proportion of the total variability of the dependent

variable (response variable) that is explained by the regression model. Profit/loss before taxes (PL) was considered as the dependent variable, and those that are involved in the allocation formula for distribution of the CCCTB were employed as the independent variables. Positive linear links between the independent variables and the dependent variable were assumed. The arranged regression models were as follows:

$$PL_n = \beta_0 + \beta_1 CoE_n + ..., \quad (1)$$

where PL_n considers the profit/loss before taxes as the dependent variable, which is explained by different numbers of independent variables. As mentioned before, both unrestricted and restricted regressions, in which the equal weight of independent variables is considered, were carried out. For the purposes of the restricted regression model with more than two independent variables, different numbers of constraints were designed.

Tables 2 and 3 report the values of unadjusted coefficients of determination (R^2) as well as the values of adjusted coefficients of determination (adj. R^2) for different unrestricted (Table 2) and restricted (Table 3) regression models. With the assumption that the comparison of the explanatory power of the analysed regression models based on the values of unadjusted coefficients of determination may be distorted by different numbers of independent variables, it would be more appropriate to use values of adjusted coefficients of determination that are able to eliminate the distortion caused by the different numbers of independent variables. Since the differences between the calculated unadjusted and adjusted coefficients of determination are negligible, the comments provided are related to the values of unadjusted coefficients of determination (R^2).

In the top part of Table 2 may be seen the results for the regression models with individual independent variables; in the middle part of Tables 2 and 3 the models in which the individual variables are combined are shown. The lower parts of Tables 2 and 3 show the results of the regression with three, and respectively four, independent variables.

All the coefficients of determination are statistically significant at the 1% significance level. Furthermore, the statistical significance of each proposed regression model was analysed by the F-test. It can be observed from the above tables that all the proposed models are statistically significant at the 1% significance level.

It is apparent from Tables 2 and 3 that the highest proportion of variability is explained by both unrestricted and restricted regression models with four independent variables, that is, by the operating turnover factor, volume of tangible fixed assets, number of employees and labour compensation. These four variables, which are also included in the allocation formula of the CCCTB system, are able to explain almost 35% of the variability of the unrestricted regression model.

Table 2 Explanatory power of the proposed apportionment factors on profit/loss generation: dependent variable profit/loss before taxes; number of observations 65,404; unrestricted regression models

	Unrestricted		
Independent variable(s)	R^2	Adj R^2	F-statistics
CoE	0.2701***	0.2700***	24,197.78***
NoE	0.1772***	0.1772***	14,083.71***
TFA	0.1452***	0.1452***	11,113.75***
OPT	0.2911***	0.2911***	26,856.39***
TFA NoE	0.2161***	0.2160***	9,012.47***
OPT NoE	0.3044***	0.3043***	14,307.00***
CoE TFA	0.2889***	0.2889***	13,284.43***
CoE OPT	0.3318***	0.3318***	16,240.32***
OPT TFA	0.3141***	0.3140***	14,972.13***
NoE OPT TFA	0.3191***	0.3191***	10,218.2***
CoE OPT TFA	0.3411***	0.3411***	11,286.12***
OPT TFA NoE CoE	0.3490***	0.3490***	8,764.74***

Table 3 Explanatory power of the proposed apportionment factors on profit/loss generation: dependent variable profit/loss before taxes; number of observations 65,404; restricted regression models

	Restricted (i.e. equally weighted)		
Independent variable(s)	R^2	Adj R^2	F-statistics
CoE			
NoE			
TFA			
OPT			
TFA NoE	0.1504***	0.1504***	11,575.71***
OPT NoE	0.2920***	0.2920***	26,973.41***
CoE TFA	0.2236***	0.2236***	18,839.93***
CoE OPT	0.3078***	0.3077***	29,076.55***
OPT TFA	0.3137***	0.3137***	29,889.99***
NoE OPT TFA	0.3141***	0.3141***	29,956.66***
CoE OPT TFA	0.3252***	0.3252***	31,519.64***
OPT TFA NoE CoE	0.3254***	0.3254***	31,549.78***

In line with the objective of the paper, it was further examined whether it is possible to design an allocation mechanism with different combinations of variables that may be able to explain a higher proportion of the variability in profit/loss of a particular company. Two additional variables were included in the analysis: the volume of total assets, which is based on the

explanatory definition of the Amadeus database defined as the sum of the total current assets, long-term receivables, investments in unconsolidated subsidiaries, other investments, net taxable volume of property, plant and equipment and other assets; and the volume of intangible fixed assets, which, according to the CCCTB Draft Directive, should be excluded from the fixed assets factor. The extent of the data sample was reduced by the addition of the two new variables to 64,245 companies with complete data for all the variables considered. The descriptive statistics of all the variables included in the reduced data sample as well as the correlation matrix are available in *Appendix 2* and *Appendix 3*. Tables 4 and 5 report the results of the analysis of the explanatory power of the models including the two additional variables: Table 4 presents the results for the unrestricted regression, while Table 5 shows the results for the restricted regression.

Table 4 Explanatory power of the proposed apportionment factors on profit/loss generation: dependent variable profit/loss before taxes; number of observations 64,245; unrestricted regression models

	Unrestricted		
Independent variable(s)	R^2	Adj R	F-statistics
OPT ToFA CoE	0.3626***	0.3626***	12,179.10***
OPT ToFA NoE	0.3502***	0.3502***	11,541.22***
OPT ToFA NoE CoE	0.3685***	0.3684***	93,70.94***
OPT IFA TFA CoE NoE	0.3384***	0.3383***	6,570.88***

The top parts of Tables 4 and 5 analyse whether it would not be better to use the total volume of assets (ToFA) as a proxy for fixed assets measurement instead of the volume of tangible fixed assets (TFA). The total volume of assets (ToFA) was analysed in the combination with the operating turnover and payroll factors, which were divided into two individual factors, namely the number of employees and labour compensation. There were two reasons for this division of the payroll factor. Firstly, if the labour compensation (i.e. payroll costs) is considered as a proxy for the payroll factor, the explanatory power of already-mentioned US Massachusetts formula is analysed. Secondly, it has to be mentioned that the relevance of the number of employees referred to in the Amadeus database for the Czech companies is questionable since it seems that the values are entered based on the size of a particular enterprise.

From Tables 4 and 5 it can be observed that the proportion of explained variability increases if the variable ToFA is involved in the regression models instead of TFA.

The middle parts of Tables 4 and 5 analyse the explanatory power of the allocation formula, as stated by the CCCTB Draft Directive, with the total assets factor (ToFA) instead of the tangible assets factor (TFA). Here it is observable that the model with the ToFA has a higher explanatory power on profit/loss before tax generation. The reason for this could be that the ToFA is able to explain better the overall business activity of a particular company and its impact on profit/loss generation since this factor reflects both fixed assets and financial assets, which in certain types of industry sector could constitute an important indicator of profitability.

Table 5 Explanatory power of the proposed apportionment factors on profit/loss generation: dependent variable profit/loss before taxes; number of observations 64,245; restricted regression models

	Restricted (i.e. equally weighted)		
Independent variable(s)	R^2	Adj R	F-statistics
OPT ToFA CoE	0.3475***	0.3475***	34,216.36***
OPT ToFA NoE	0.3410***	0.3410***	33,245.03***
OPT ToFA NoE CoE	0.3476***	0.3476***	34,231.39***
OPT IFA TFA CoE NoE	0.3150***	0.3150***	29,539.07***

In the last part of the analysis the sum of intangible fixed assets (ITA) and tangible fixed assets (TFA) was considered as a fixed assets factor instead of the total assets (ToFA). In comparison with both models (i.e. a model with just the tangible fixed assets variable and a model with the total assets), a lower explanatory power may be observed. The lower explanatory power of the model with intangible fixed assets could constitute quite a good argument for why the European Commission proposes to exclude this factor from fixed assets measurement for the distribution of the CCCTB tax base.

The results of the paper are partially in line with the results of Roggeman et al. (2012), who stated that the allocation formula proposed by the CCCTB Draft Directive seems to be the best-performing formula. On the other hand, they supposed that the proposed formula should contain just a single labour compensation factor without its combination with the number of employees. This was not confirmed by the results of the paper even though the relevance of data related to the number of employees is quite questionable. A topic for further research may be to consider the evaluation of the explanatory power of the formula factor with regard to the industry sector and to prove the relevance of the special definition of the formula factors for certain type of industries, as stated in Articles 98–100 of the CCCTB Draft Directive.

5. Conclusion

The paper dealt with the evaluation of the explanatory power of the proposed formula factors on the profitability of Czech independent enterprises.

The main aim of the paper was to consider the suitability of the allocation formula factors for incorporation into the allocation mechanism for the CCCTB system. The methodology advice of Hines (2008) was followed in the paper, indicating that for better comparability and evaluation of the results obtained, it is helpful to use data from one region.

The analysis was based on the estimation of a wide variety of regression models via the ordinary least squares method. Based on the comparison of the coefficients of determination, the paper concludes that the proposed CCCTB formula factors are able to explain almost 35% of the variability in profitability of companies but shows that the indicator of total assets may have a larger impact on the generation of profit/loss since this factor reflects both fixed assets and the volume of financial assets, which in certain types of industry sectors could constitute an important indicator of profitability.

The results obtained are in line with the previous study by Roggeman et al. (2012), concluding that the formula proposed by the CCCTB Draft Directive seems to be the best-performing formula, and they concur with the conclusion of Hines (2008), indicating that these factors perform poorly in profitability explanation since the proportion of explained variability is only around 35%. The main contribution of the paper is to provide evidence for the explanatory power of the CCCTB formula factors from the perspective of the Czech Republic. The results obtained might be beneficial for the complex evaluation of the proposed tax harmonization method through the CCCTB system from the point of view of the Czech Republic.

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Appendix 1 Correlation matrix for the initial sample of companies

Correlation matrix, n = 65,404, 5% both sides critical value 0.0077					
PL	OPT	NoE	CoE	TFA	
1.0000	0.5395	0.4209	0.5197	0.3811	PL
	1.0000	0.6113	0.6938	0.4565	OPT
		1.0000	0.8773	0.4997	NoE
			1.0000	0.5056	CoE
				1.0000	TFA

Appendix 2 Table of descriptive statistics for the adjusted sample of companies: number of observations 64,245; all variables in thousands EUR, except for the number of employees; active companies in the Czech Republic with a published value of profit/loss before tax for 2012

Name of variable	Mean value	Standard Deviation	Min. value	Max. value
PL	51.60	215.46	–522.37	2,960.52
OPT	1,534.95	4,230.42	0.00	62,124.20
TFA	406.37	322.75	0.00	18,717.47
NoE	18	40	3	375
CoE	219.74	543.70	1.27	7,162.44
ITA	2.86	16.44	0.00	290.32
ToFA	1,100.98	2,837.82	0.00	47,878.57

Appendix 3 Correlation matrix for the adjusted sample of companies

Correlation matrix, n = 64,245, 5% both sides critical value 0,0077							
PL	OPT	ToFA	TFA	IFA	NoE	CoE	
1.0000	0.5294	0.5579	0.3725	0.2066	0.4077	0.5077	PL
	1.0000	0.7056	0.4428	0.2517	0.5970	0.6845	OPT
		1.0000	0.7773	0.2776	0.5717	0.6524	ToFA
			1.0000	0.2123	0.4917	0.5017	TFA
				1.0000	0.2691	0.3196	IFA
					1.0000	0.8780	NoE
						1.0000	CoE