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AN EMPIRICAL INVESTIGATION INTO THE DESIGN OF AN EU APPORTIONMENT FORMULA RELATED TO PROFIT GENERATING FACTORS

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ABSTRACT. The European Commission (EC) has the intention to establish a Common Consolidated Corporate Tax Base, which requires an allocation formula to fairly distribute the consolidated tax base among all group entities. A fair distribution would mean that the allocation is closely related to the profit generating factors of the underlying entities. The EC supposes that fixed tangible assets, sales and labour are the dominant factors in the generation of profit. This paper analyses the profit generating capacity of these factors and of the alternative factor intangible assets. The results show that the proposed factors only explain 28% of the variation in profit. Moreover, the results indicate that recognized intangibles do not increase R2 significantly. However, for R&D intensive companies, adding the market less book value to proxy for unrecognized intangibles increases the explanatory power with 30%. This suggests that for these companies unrecognized intangibles could be important in generating profit.

KEYWORDS: CCCTB, apportionment formula, fairness, international corporate taxation, European Union.

JEL classification: D63, F23, H25, H87.

Introduction

Europe is faced with several tax obstacles[1] which harm the international competitiveness of its multinationals (EC, 2001a). The European Commission (EC) believes that a Common Consolidated Corporate Tax Base (CCCTB) is the only comprehensive solution to remove the underlying causes of these obstacles (EC, 2001b). This new tax system determines the tax liability of a company belonging to a CCCTB group by applying four distinct steps. Firstly, each group member calculates its taxable profit according to the same set of rules. Secondly, the individual tax bases are summed up to the consolidated tax base. Thirdly, the consolidated tax base is allocated to the different group members by means of an apportionment formula. Finally, each member state has the right to apply its own tax rate to the specific share of the overall tax base. (EC, 2001b; Schön *et al.,* 2008)

Some of the main benefits[2] of a CCCTB arise from the consolidation aspect. However, an unavoidable consequence of consolidation is the need to apportion the consolidated tax base among the different group members. According to the Commission, the consolidated tax base should be distributed in an equitable and efficient manner (EC, 2006). Both in the European and the American literature, 'equity' and 'efficiency' are two generally accepted tax principles. (Agundez-Garcia, 2006; Freedman *et al.,* 2008; Fuest, 2008; Hellerstein, 2005; Schmidt, 1986; Spengel *et al.,* 2007)

In the context of an apportionment system, the *equity* principle asks for a fair distribution of the common tax base among the different group members. The literature mentions different types of fairness for apportionment purposes. (Agundez-Garcia, 2006; Fuest, 2008; Spengel *et al.,* 2007) An obvious way is to distribute the common tax base according to the 'true' geographical source of income. However, in a multinational environment it seems impossible to determine the 'true' source of income (Hellerstein, 2005).

[1] For example, the increased compliance costs and double taxation. For more details on the main tax obstacles, see EC (2001b).
[2] For example, the elimination of intra-group transactions and the offset of losses within the group.

As an alternative, Agundez-Garcia (2006) mentions the 'equal capacity to earn income' approach in order to reach a fair apportionment system. A fair distribution would mean that the allocation of the consolidated tax base is closely related to the profit generating factors of the underlying entities. (Agundez-Garcia, 2006; Hellerstein, 2005) This approach is reflected in the Commission's conviction that "an apportionment formula (AF) should be based on factors that reflect the source of income generation as closely as possible" (EC, 2006, p.5).

In order to achieve an *efficient* apportionment system, different goals should be attained. First of all, the tax system should be neutral, which means that it should not influence economic agents' behaviour. The apportionment formula, for example, should not introduce incentives to shift factors. Moreover, the formula should be simple and cost efficient in order to reach the European objective to reduce compliance costs. Finally, the new formula should be enforceable and tax evasion should be avoided. (Agundez-Garcia, 2006; Spengel *et al.,* 2007) However, it is not that obvious to fulfil the equity and the efficiency principle simultaneously. A formula including two factors, for example, could be cost-efficient and reasonably fair but could, nevertheless, leave room for tax planning opportunities. In this paper we focus on the equity principle and leave the efficiency principle out of consideration.

With respect to the allocation of the consolidated tax base, the CCCTB proposal includes an equally weighted three factor formula containing fixed tangible assets, sales and labour (EC, 2011). The Commission supposes that these factors are the dominant factors in the generation of profit and therefore believes that these factors are potentially fair factors to be included into the EU apportionment formula. In spite of this intention, the choice of the allocation factors remains an important subject of discussion (EP, 2011). Another pertinent question is how these factors should be weighted. (EC, 2007a; Hellerstein *et al.,* 2004)

Previous literature already focused on the fairness of an apportionment mechanism to share the consolidated tax base. (Henszey *et al.,* 1983; Hreha *et al.,* 1986; Schmidt, 1986; Sheffrin *et al.,* 1984). In a more recent study, Hines (2010) shows that the proposed formula does a poor job in allocating the consolidated tax base in a fair way. To our knowledge, the current literature mainly focuses on the allocation factors of large companies without taking SMEs into consideration. However, CCCTB will be available for all sizes of companies. The system would especially benefit SMEs as they would incur less compliance costs when they decide to expand their activities across the EU (EC, 2011). Also, the current literature does not contain any empirical research on the potential role of alternative factors in the allocation of the common tax base.

We contribute to the literature by filling these gaps. Using European firm level data, we first investigate to what extent the European proposed allocation factors represent profit generating activities when taking into account all sizes of companies. Second, we examine if the allocation factors should be equally weighted. Finally, we analyse and discuss the profit generating capacity of the alternative factor intangible assets, which can be seen as the success factors of the modern company.

Our main results show that the European proposed allocation factors fixed tangible assets, labour and sales only explain 28% of the variation in profit. Constraining the apportionment factors to be equally weighted, hardly changes this result. Further, the results indicate that recognized intangible assets, as extracted from the balance sheets, play a rather minor role in the generation of profit. However, the market less book value as a proxy for unrecognized intangibles tends to be important in explaining profit.

The paper is organized as follows. Section 2 gives a brief history about the development of the apportionment formula in the US, Canada and Europe. The theoretical framework and research questions are presented in section 3. The data is given in section 4. Section 5 presents the methodology and results. Section 6 provides conclusions.

1. Brief History of the Apportionment Formula

The system of apportionment formula is well-known in the American states, the Canadian provinces and Swiss cantons,[3] which have many years of experience with this system. In the next paragraphs, we give a brief overview of the development of formula apportionment in the US and Canada. We also sketch the progress Europe has made in its development of a possible future sharing mechanism.

1.1 United States

At the start of the 20th century most states gradually began to impose corporate income taxes[4]. Initially, corporate income taxes were determined on the basis of separate financial reports. However, business groups viewed separate accounting as unsuitable[5] for their purposes, since more and more corporations conducted their business in several states. This forced most states to adopt an apportionment formula by the end of the 1930's. In the early years of apportionment, the states used formulas that captured a wide range of income generating factors. In 1929, the formulas included items like property values, inventory, manufacturing costs, payroll, accounts receivable, (net cost of) sales and purchases. To bring order to this chaotic situation and to stimulate uniformity, the National Tax Association (NTA) recommended in 1933 the use of the "Massachusetts formula". This formula includes property, payroll and sales and gives equal weights to these factors. The Massachusetts formula was widely applied among the states by the 1950s, especially with the introduction of the Uniform Division of Income for Tax Purposes Act (UDITPA) of 1957 and the Multistate Tax Compact (MTC) of 1967. UDITPA not only defined the Massachusetts formula, but also provided uniform definitions of the allocation factors. According to the UDITPA definitions, property equals the average value of the taxpayer's owned or rented tangible property used in the taxing state. The property definition does not include intangibles, although some states include certain intangible property, such as computer software. Payroll equals the total amounts (wages, salaries, commissions, etc.) paid as a compensation of employees, whereas the sales by destination factor includes all gross receipts (sales of goods and services, rentals and royalties) net of returns, allowances and discounts. The aim of the MTC, which incorporates the UDITPA definitions, was to "promote uniformity and compatibility in significant components of tax systems" (Hey, 2008, p.27). However, the application of UDITPA and MTC does not limit states to deviate from the recommended rules. States may alter the rules for their own purposes. Since the early 1980s, there has been a tendency to place a greater weight on the sales factor while decreasing the weight on property and payroll. Nowadays, the double-weighted sales formula is the most commonly-used formula. This is seen as the states' efforts to use the apportionment formula to promote economic development

[3] The description of the Swiss system is beyond the scope of this paper. Swiss cantons are free to choose their own apportionment factors. For further details see Daly, Weiner (2003).

[4] Before the corporate income tax was introduced at the federal level, most states adopted taxes on capital stock (franchise taxes) and not on net profits (Hey, 2008).

[5] For example, business groups had difficulties with applying the right arm's length price (Weiner, 1999).

because the establishment of new branches within the state is encouraged by the more tax attractive production factors capital and labour. Moreover, most in-state headquartered companies sell most of their product out of state and these sales are by consequence taxed abroad. Finally, industry-specific formulas have been introduced that deal with special characteristics of certain industries such as construction, transportation, financial institutions, broadcasting, etc. For example, income from the transportation industry is apportioned by the number of miles, number of passengers carried or tons of freight. (Hellerstein *et al.,* 2004; Hey, 2008; Indiana Fiscal Policy Institute, 1989; Weiner, 2005; Weiner, 1999)

1.2 Canada

By the end of the 1930s, the federal government and all Canadian provinces levied corporate income taxes[6]. During World War II the provinces nevertheless had to cede the right to tax corporate income to the federal government to finance the war. After the war, a model provincial corporation income tax act was created and from then on, the provinces regained control over their corporate income tax. This act recommended a single-factor apportionment formula including destination based gross receipts, which was incorporated in the first Tax Rental Agreement (TRA). Seven provinces joined the first TRA, only Ontario and Quebec used a different apportionment formula. In 1946, a second TRA added a payroll factor to the formula, with gross receipts and payroll weighted by one-half each. The intention of the tax authorities was to balance the interests of the marketing and manufacturing provinces. At the start of the 1960s, Ontario and Quebec joined the second TRA and adopted the federal allocation rules. Although provinces could depart from the two-factor formula, their policies were harmonized. This harmonization was facilitated by the federal government, which incurred all the provincial administration and collection costs in exchange for using the federal allocation formula. The uniformity continues to exist even though Ontario, Alberta and Quebec no longer participate in the corporate tax collection agreements. Notwithstanding this fact, the three provinces define their tax base and apportionment formula in close accordance with the federal agreements. In brief, for the past half century the Canadian provinces have generally used an equally weighted payroll and gross receipts formula. For industries with particular characteristics, the Canadian provinces apply specific formulas. Income from airlines, for example, is apportioned on the basis of fixed assets and revenue plane miles. (Daly *et al.,* 2003; Mintz, 1999; Mintz *et al.,* 2003; Weiner, 2005; Weiner, 1999; Wildasin, 2000)

1.3 Europe

In March 2011, the European Commission launched a proposal for a Council directive on a Common Consolidated Corporate Tax Base (EC, 2011). In line with the priorities set in Europe 2020[7], CCCTB has the intention to remove the underlying causes of tax obstacles and stimulate cross border economic activities. There is a considerable interest in Europe to allocate the consolidated tax base using an apportionment formula similar to the American Massachusetts formula. Namely, the Commission prefers an equally weighted three factor formula including sales, labour and capital. Labour and capital would represent the supply

[6] Some provinces taxed corporate income before the federal government adopted corporate income tax at the start of the 20th century. Until the First World War, there was no coordination between the provinces and federal government (Weiner, 2005).
[7] Communication from the Commission, 'Europe 2020: A strategy for smart, sustainable and inclusive growth', (EC, 2010).

side on the generation of companies' income and sales would represent the demand side[8]. As opposed to the Massachusetts formula, the Commission suggests a labour factor that consists of *two* equally weighted elements, namely payroll and number of employees. As regards assets, it is suggested that only fixed tangible assets should be taken into account in order to avoid problems with respect to valuation and mobility. To compensate for the lack of intangibles, the EC proposes that "in the five years that follow a taxpayer's entry into an existing or new group, its asset factor shall also include the total amount of costs incurred for research, development, marketing and advertising by the taxpayer over the six years that preceded its entry into the group" (EC, 2011, p.51). With respect to sales, only proceeds of goods and services should be covered. (EC, 2007b; EC, 2004; EC, 2001b)

2. Theoretical Framework and Research Questions

It is widely recognized that an apportionment formula should distribute the consolidated tax base among the various entities in a fair way. As explained in section 1, fair means that the factors used in the apportionment formula should reflect how income is actually generated. Musgrave (1984) mentions two ways to look at the generation of profits.

According to the *supply-based view*, first of all "the factor inputs should be measured in a way that reflects their inclusion in the production function" (Musgrave, 1984, p.241). Following this definition, production inputs like capital and labour seem to be natural candidates to be taken into account. However, several authors defend the idea that only capital would be appropriate to share the consolidated tax base. Sorensen (2004) and Mintz (1999) argue that the corporation tax is intended as a tax on the return on capital and not as a tax on other factors. Moreover, Hellerstein, McLure (2004) believe that there is little theoretical foundation for basing apportionment on labour costs because labour costs can differ significantly between taxing jurisdictions. Including labour would harm the implicit assumption of using optimal allocation factors, i.e. relative prices of production factors should not differ across jurisdictions.

Secondly, according to the *supply/demand-based view,* Musgrave (1984) argues that a sales factor could be added to the origin based production factors. Such a formula would recognize the contribution of marketing jurisdictions (i.e. the jurisdictions where sales take place) to profits. However, some authors doubt whether 'demand' is an income generating factor as demand is nowadays not used as a criterion for assigning taxing rights between jurisdictions. Although most economists would favour an origin or supply-based view to distribute income, there is no real scientific way to choose between the two. (EC, 2007a; Mintz, 1999)

Some studies verified the fairness of certain apportionment formulas. Using actual state tax returns, Henszey, Koot (1983) investigate the Pennsylvanian equally-weighted three factor formula and conclude that the formula actually reflects how business income of multinational groups is generated. Another study was carried out by Sheffrin, Fulcher (1984) who show that formula factor modifications in the US lead to disparate effects at the industry level. Also Hreha, Silhan (1986) address the issues of apportionment formula fairness in the US, taking into account the factors sales, property and payroll. Their results show that the factor payroll distorts the allocation of income and that a property and sales formula should be preferred. The research of Schmidt (1986) extends the work of Hreha, Silhan (1986) by also

[8] The sales factor was the most controversial issue in the apportionment formula. Some experts are proponents of "sales by origin", others of "sales by destination". For more details on the proposed apportionment factors see EC (2007b).

studying the industry effects. The results show that property, payroll and sales significantly reflect income and that these factors are stable over time but not across industries. Moreover, Schmidt (1986) indicates that two or three factor formulas perform as well as the standard three factor apportionment formula. More recent studies by Hines (Hines, 2008, 2010) show that the apportionment factors sales, property and labour (payroll and number of employees) do a very poor job in explaining variation in income between firms. Also, Hines (2010) suggests that labour should play no role in allocation formulas.

The current literature focuses on the profit generating capacity of the factors sales, tangible assets and labour. Intangible assets are left out of consideration. However, studies show that intangible assets represent an important and growing component of total capital stock and can be considered as the 'crown jewels' of the modern company (Corrado *et al.,* 2009; Hellerstein, 2005; Hulten *et al.,* 2008). Moreover, intangibles enhance firms' competitive advantage and performance (Marrocu, 2012). Given this evolution, another stream of research has developed a *knowledge-capital* model where firms' intangible assets should be included as an input factor in the production function in addition to physical assets and labour (Jaafar, 2010; Marrocu, 2012; O'Mahony *et al.,* 2009). From the point of view of fairness, jurisdictions, where intangible assets are present, have a strong claim to profits that are associated with those assets and therefore intangible assets should be included into the apportionment formula. Ignoring intangible assets would allocate a low share of the consolidated tax base to corporations where these assets such as patents and software are often developed (Sorensen, 2004; Li, 2002).

In this paper we first examine to what extent the proposed allocation factors tangible assets, labour and sales represent profit generating activities. Based on the economic theories explained before, we expect all factors to have a positive and significant contribution to the generation of profit. Second, we consider the alternative of including intangible assets. In line with the knowledge-capital theory, we expect intangibles to have a positive and significant contribution as well.

3. Data

We use firm-level data from the Amadeus database for the European manufacturing and service sectors in the year 2008[9]. We consider the unconsolidated statements of non-listed companies registered in one of the 27 EU member states.[10] We select a sample of corporations that are defined as an SME or large company[11]. In particular, we only select companies with a minimum number of ten employees and with a minimum total turnover or minimum total assets of two million euros.

For this sample we collect the following data: tangible fixed assets (fta), intangible fixed assets (ifa), sales (sal), number of employees (emp), labour compensation (cos) and profit/loss before taxation (pl)[12]. Companies with missing values are excluded from the sample. Also, extreme values below the 1st percentile and above the 99th percentile are dropped[13]. A final sample of 12,027 companies is retained, containing complete information on the dependent and independent variables.

[9] Manufacturing: NACE codes 15-36 and service: NACE codes 50-74 and 92.1-2
[10] We do not use the consolidated statements because these statements do not link the profit of an entity with its allocation factors. Unconsolidated statements of companies belonging to a consolidated group, could be distorted by profit shifting. As a robustness check we isolate and analyze the unconsolidated statements of independent companies and find similar results.
[11] According to the definitions of the European Commission (EC, 2007).
[12] Tax data are confidential and unavailable; therefore we use financial data as a proxy.
[13] As a robustness check, we also drop extreme values below the 5th and above the 95th percentile and find similar results.

Table 1. Descriptive statistics, all variables are in thousands except for number of employees, 2008 (unlisted companies)

	Unlisted companies			
No. of obs. = 12,027	**Min.**	**Max.**	**Mean**	**Std.**
Profit/loss before tax	-6,010	31,512	867	2,696
Sales	1,385	561,359	21,685	38,172
Tangible fixed assets	4	101,469	3,465	8,060
Intangible fixed assets	0	18,526	375	1,324
Number of employees	10	1,381	79	124
Cost of employees	215	57,763	3,066	5,010

Source: Amadeus database.

Table 1 presents descriptive statistics for all variables in the year 2008. The average profit before taxation is € 867,000. Further, the sample has an average sale of € 21,685,000, average tangible and intangible assets of € 3,465,000 and € 375,000 respectively, average labour compensation of € 3,066,000 and an average of 79 employees. The correlation matrix is reported in *Appendix 1*. All variables are correlated in a positive and significant way.

4. Methodology and Results

4.1 Evaluation of the Proposed Apportionment Factors

In this first part of section 5, we analyse to what extent the allocation factors, as proposed by the EC, represent profit generating activities. In particular, we use regression techniques to analyse the relationship between profit and allocation factors sales, assets, cost of employees and number of employees. Therefore, we compose 11 regressions including one, two or three factors[14]. Firstly, the parameters of the regressions are determined by the data using ordinary least squares (unrestricted regressions). Secondly, the parameters of the regressions are restricted to be equal (restricted regressions). *Table 2* reports the coefficients of determination, R^2, which represent the percentage of the variance in profit explained by the variables in the regression[15]. All R^2 are significant at the 1% level. Based on the R^2, the table also provides a ranking of the formulas with the first one being the most accurate. Further, *Table 2* shows that the restricted formulas perform less than the unrestricted. However, constraining the formulas hardly influences the ranking order of the different formulas. It is remarkable that all formulas including sales perform highly, irrespective of the number of factors included. The best performing formula is the unrestricted three factor formula including cost of employees as labour factor (11).

[14] To avoid multicollinearity and double weighting of the labour factor, cost of employees and number of employees are not simultaneously entered into an equation.

[15] A property of R^2 is that it is a non-decreasing function of the number of explanatory variables present in the model. (Gujarati, 2009, p.201). In this paper we are especially interested in the size of the R^2 increase when adding (a) new variable(s).

Table 2. Profit prediction accuracy among proposed apportionment factors (unlisted companies)

	Unrestricted			*Restricted (equally weighted)*	
No. of obs. = 12,027	R^2	Rank all[a]	Rank 2 & 3	R^2	Rank[a]
One factor					
(1) sal	0.2413***	6			
(2) tfa	0.0507***	11			
(3) emp	0.0965***	10			
(4) cos	0.1981***	8			
Two factors					
(5) sal & tfa	0.2437***	5	5	0.2420***	4
(6) sal & emp	0.2475***	4	4	0.2415***	5
(7) sal & cos	0.2767***	2	2	0.2572***	1
(8) tfa & emp	0.1101***	9	7	0.0523***	7
(9) tfa & cos	0.2024***	7	6	0.1366***	6
Three factors					
(10) sal , tfa & emp	0.2484***	3	3	0.2422***	3
(11) sal, tfa & cos	0.2768***	1	1	0.2558***	2

Notes: [a] Each formula was given a rank, with 1 the most accurate. ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

A more in-depth study of the proposed three factor formula can be obtained by investigating the incremental R^2. This is the increase in R^2 when adding a new independent variable to a regression already containing previously entered variables. If the incremental R^2 is significant, the newly added variable is deemed important in the regression equation. To determine the causal priority of the variables, we start from the production function theory. This economic theory believes capital and labour to be the main variables explaining income (Musgrave, 1984). The inclusion of the sales factor as a reflection of the demand side of creating income is under discussion (see section 3). According to these findings, the sales factor is the last variable to be included into the regression equations. However, we could not find a logical reasoning for ordering the factors assets and labour. Therefore, we start with the labour factor in a first model and with the assets factor in a second model. These two models are formed twice, once with cost of employees (A and B) and once with number of employees (C and D) as their labour factor. Results of the incremental regression analysis are presented in *Table 3*. All incremental R^2 are significant at the 1% level, which means that all added variables are deemed important in the regressions. In what follows, the results in *Table 3* are analysed in more detail.

First including cost of employees into the equation (1A) gives a significant R^2 of 0.1981. This indicates that this factor explains a significant proportion of the variation in profit. Adding assets (2A) to this equation, results in a significant incremental R^2 of 0.0043. This means that the assets factor explains a significant proportion of the variance of profit above the variance already explained by the factor cost of employees. Similarly, the factor sales accounts for a significant proportion of the variation in profit above the variation already explained, namely 0.0744 (3A). First entering fixed tangible assets into the equation (1B) gives a significant incremental R^2 of 0.0507. Adding the cost of employees (2B), R^2 increases with 0.1517. Introducing the sales factor adds again 0.0744 to R^2 (3B). This last result indicates that also the demand factor sales are important in explaining profit. The models using number of employees as labour factor (C and D) can be analysed in the same way.

Comparing step 1A with 1C, we can notice that cost of employees explains a bigger share of the variance in profit than number of employees. Moreover, comparing step 2B with 2D we can remark that cost of employees adds 0.1517 to R^2, while number of employees only adds 0.0594. As a result, we could state that cost of employees is a more accurate labour factor compared with number of employees, which can also be concluded from the results in *Table 2*.

Table 3. Incremental regression analysis proposed apportionment factors (unlisted companies)

No. of obs. = 12,027		R^2	Incremental R^2	P-value
With cost of employees as labour factor				
1A	cos	0.1981		0.0000
2A	cos + tfa	0.2024	0.0043	0.0005
3A	cos + tfa + sal	0.2768	0.0744	0.0000
1B	tfa	0.0507		0.0000
2B	tfa + cos	0.2024	0.1517	0.0000
3B	tfa + cos + sal	0.2768	0.0744	0.0000
With number of employees as labour factor				
1C	emp	0.0965		0.0000
2C	emp + tfa	0.1101	0.0136	0.0000
3C	emp + tfa + sal	0.2484	0.1383	0.0000
1D	tfa	0.0507		0.0000
2D	tfa + emp	0.1101	0.0594	0.0000
3D	tfa + emp + sal	0.2484	0.1383	0.0000

Source: created by authors.

The importance of the variables can also be determined by means of their standardized betas[16]. *Table 4* reports the betas resulting from the three factor formula including number of employees (formula 10) and the three factor formula including cost of employees (formula 11) as labour factor. These formulas can be formally written as:

$$pl_i = \alpha + \beta_1 sal_i + \beta_2 fta_i + \beta_3 emp_i + \varepsilon_i \quad (1)$$

$$pl_i = \alpha + \beta_1 sal_i + \beta_2 fta_i + \beta_3 cos_i + \varepsilon_i \quad (2)$$

Table 4. Proposed apportionment factors as determinants of profit (unlisted companies). The table represents standardized beta coefficients and robust standard errors are presented between brackets

	Profit/loss before tax	
No. of obs. = 12,027	**(10)**	**(11)**
Sales	0.4387***	0.3475***
	(0.0022)	(0.0022)
Tangible fixed assets	0.0336*	0.0122
	(0.0066)	(0.0066)
Number of employees	0.0816***	
	(0.4449)	
Cost of employees		0.2321***
		(0.0151)
R^2	0.2484***	0.2768***

Notes: ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

[16] The standardized beta coefficients can be interpreted as if the regressor increases by one standard deviation, on average, and the regress increases by β*standard deviation units. (Gujarati, 2009, p.158).

As expected, all bets are positive and significant. *Table 4* also shows that sales do a relative important job in explaining profit. Cost of employees explains the variance in profit more than the number of employees, which is consistent with prior findings. Looking at the assets factor, we can notice that this factor is significant but rather small. The beta coefficients of all other formulas are positive and significant and can be distributed upon request.

4.2 Evaluation of the Apportionment Factor Intangible Assets

4.2.1 Recognized Intangible Assets

In this second part of section 5, we analyse to what extent the alternative factor intangible assets represents profit generating activities. We simply use the item intangible fixed assets (ifa), extracted from the balance sheets, as a proxy variable for intangibles. In particular, we evaluate 12 regressions composed of one, two, three or four factors. We form unrestricted and restricted regressions as explained in 5.1. *Table 5* reports the R^2 from all regressions and provides a ranking of the formulas with 1 being the most accurate. Comparing the R^2 of the unrestricted with those of the restricted regressions, we remark that the unrestricted formulas perform better than the restricted formulas and that the ranking order of both sets strongly resembles. The best performing formula is the unrestricted four factor formula including cost of employees as labour factor. Further, the regressions including intangible assets have very similar R^2 compared with the regressions excluding intangible assets (see *Table 2*).

Table 5. Profit prediction accuracy among proposed apportionment factors and intangible assets (unlisted companies)

	Unrestricted		**Restricted (equally weighted)**	
No. of obs. = 12,027	**R^2**	**Rank[a]**	**R^2**	**Rank[a]**
One factor				
(12) ifa	0.0192***	12		
Two factors				
(13) ifa & sal	0.2419***	6	0.2418***	6
(14) ifa & fta	0.0609***	11	0.0567***	10
(15) ifa & emp	0.1007***	10	0.0266***	11
(16) ifa & cos	0.1981***	8	0.1890***	7
Three factors				
(17) sal, fta & ifa	0.2440***	5	0.2423***	4
(18) fta, ifa & emp	0.1131***	9	0.0582***	9
(19) fta, ifa & cos	0.2024***	7	0.1383***	8
(20) ifa, sal & emp	0.2476***	4	0.2420***	5
(21) ifa, sal & cos	0.2769***	2	0.2573***	1
Four factors				
(22) sal, fta, ifa & emp	0.2485***	3	0.2424***	3
(23) sal, fta, ifa & cos	0.2770***	1	0.2557***	2

Notes: [a] Each formula was given a rank, with 1 the most accurate. ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

A more in-depth study of the profit generating capacity of the alternative factor intangible assets can be obtained by investigating the incremental R^2. The results of this analysis are presented in *Table 6*. Two different models are used, one with cost of employees and one with number of employees as a labour factor (E and F). For both models, adding the factor intangible assets does not increase R^2 in a significant way. This surprising result means that recognized intangibles are not important in explaining the variation in profit above the variation already explained by the proposed three factors. In particular, the proposed formula including cost of employees (1E) significantly explains the variation in profit for 27.68%. Adding recognized intangibles to this equation results in an incremental R^2 of 0.0002, that is not significant. The model including number of employees (F) leads to similar results.

Table 6. Incremental regression analysis intangible assets (unlisted companies)

No. of obs. = 12,027		R^2	Incremental R^2	P-value
With cost of employees as labour factor				
1E	(cos, tfa, sal)	0.2768		0.0000
2E	(cos, tfa, sal) + ifa	0.2770	0.0002	0.4021
With number of employees as labour factor				
1F	(emp, tfa, sal)	0.2484		0.0000
2F	(emp, tfa, sal) + ifa	0.2485	0.0001	0.5934

Source: created by authors.

Table 7 reports the standardized beta coefficients of the formulas (22) and (23), including the three factors proposed by the Commission and the factor recognized intangible fixed assets:

$$pl_i = \alpha + \beta_1 sal_i + \beta_2 fta_i + \beta_3 ifa_i + \beta_4 emp_i + \varepsilon_i \quad (3)$$

$$pl_i = \alpha + \beta_1 sal_i + \beta_2 fta_i + \beta_2 ifa_i + \beta_4 cos_i + \varepsilon_i \quad (4)$$

The coefficients of the factor intangibles are small and not significant. Again, this indicates that intangibles, as extracted from the balance sheets, do a poor job in explaining the variation in profit.

Table7. Apportionment factors as determinants of profit (unlisted companies). The table represents standardized beta coefficients and robust standard errors are presented between brackets

	Profit/loss before tax	
No. of obs. = 12,027	**(22)**	**(23)**
Sales	0.4373***	0.3488***
	(0.0022)	(0.0022)
Tangible fixed assets	0.0329*	0.0132
	(0.0067)	(0.0066)
Intangible fixed assets	0.0101	-0.0166
	(0,0386)	(0.0402)
Number of employees	0.0801***	
	(0.4495)	
Cost of employees		0.2360***
		(0.0154)
R^2	0.2485***	0.2770***

Notes: ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

4.2.2 Unrecognized Intangible Assets

A possible explanation for this unexpected result could be that current accounting methods require most intangibles to be expensed. As a consequence, capitalized intangibles do not reflect many firms' valuable intangible assets (Barth *et al.,* 1999; Dedman *et al.,* 2009; Penman, 2009). Therefore, we look elsewhere to capture firms' intangible assets. The stock market could act as an independent valuation source that provides more objective assessments of the value of firms' intangibles (Choi *et al.,* 2000).

We form a second sample consisting of listed companies that otherwise meet the same criteria as explained under section 4. A final sample of 259 listed companies is retained, containing complete information on the dependent and independent variables. We use the market less book value of equity (mlb) to proxy for unrecognized intangible assets. Notwithstanding the fact that this residual is a catch-all category, several studies suggest that the difference between a company's market value and its book value results would to a great extent be due to the intangible assets not reflected in the balance sheet (Lev, 2004; Whitwell *et al.,* 2007). As unrecognized intangible assets tend to be large and important (Danthine *et al.,* 2007; Dedman *et al.,* 2009; Penman, 2009), we expect market less book to have a positive and significant contribution to the generation of profit.

For the year 2008, *Appendix 1* presents descriptive statistics for all variables of the listed companies. The average profit before taxation is € 29,361,000. Further, the sample has an average sale of € 540,745,000 and average tangible and intangible assets of € 155,690,000 and € 13,149,000 respectively. The average labour compensation amounts € 79,610,000 and the average number of employees is 1,276. The average market less book value equals € 256,838,000. *Appendix 1* presents the correlation matrix indicating that all variables are correlated in a positive and significant way.

For this sample of listed companies, we want to investigate to what extent recognized and unrecognized intangible fixed assets could explain the variance of profit above the variance already explained by the factors as proposed by the Commission. In order to do this, we investigate the incremental R^2 statistics which can be found in *Table 8*. We start form the best performing three factor formula including cost of employees as labour factor (G). Adding the factor intangibles (2G) results in a small incremental R^2 of 0.0241 that is only significant at the 10% level. Introducing the factor market less book significantly increases the R^2 with 0.2450, which results in a total R^2 of 0.7320. Consistent with the expectations, this result indicates that the market less book value plays an important role in explaining the variation in profit.

Table 8. Incremental regression analysis intangible assets and market less book (listed companies)

No. of obs. = 259	Factors	R^2	Incremental R^2	p-value incremental	p-value total model
1G	(cos, tfa, sal)	0.4629			0.0000
2G	(cos, tfa, sal) + ifa	0.4870	0.0241^{*}	0.0995	0.0001
3G	(cos, tfa, sal, ifa) +mlb	0.7320	0.2450^{***}	0.0050	0.0000

Notes: ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

Based on the distribution of its forecast errors (y-hat(y)) relative to its forecasted profits (hat(y)), a Wilcoxon signed rank test is used to determine which formulas are significantly more accurate than the others. This Wilcoxon test is a nonparametric test which ranks paired differences between any two observations. The results of this test can be found in Table 9. The third column of this table computes the residual sum of squares for the proposed formula including the best performing labour factor cost of employees (11), the formula adding ifa (23) and the formula adding mlb (24). We notice that the formula including mlb (24) exhibits the lowest degree of allocative error and the proposed formula (11) the highest. For an overview of the Z-statistics, we refer to *Appendix 1*. The fourth column of *Table 9* summarizes the results of these comparisons and indicates that the formula including market less book (24) performs significantly better than the two other formulas. Moreover, the formula including ifa (21) does not perform significantly better than the formula without ifa (11).

Table 9. Paired comparison of prediction errors (listed companies)

No. of obs. = 259	Formula	Residual Sum of Squares (RSS)	Significantly more accurate than[a]
(24)	cos, tfa, sal, ifa, mlb	1.47E+12	(23), (11)
(23)	cos, tfa, sal, ifa	2.82E+12	
(11)	cos, tfa, sal	2.95E+12	

Notes: [a] The Wilcoxon matched-pairs signed ranks test is used to identify which differences were significant among the formulas. Significance at 1% level.

Source: created by authors.

For a more in-depth analysis, we split up our sample into sectors that can be characterized as R&D intensive or non R&D intensive. For example, chemicals can be considered as a high R&D intensive sector whereas the food sector is low R&D intensive (Castello *et al.,* 2010; Uppenberg, 2011). For more details on this division we refer to *Appendix 2*. Empirical research has shown that stock markets consider R&D investments as a significant profit creating activity (Choi *et al.,* 2000). So, for R&D intensive companies we expect market less book to have a more positive and significant contribution to profit than for non R&D intensive companies.

Table 10 shows the results of the incremental regressions for companies active in R&D intensive and non R&D intensive sectors. First, analysing the results of the R&D intensive companies, we remark that the model without mlb is not significant. This means that for these companies, the model including the proposed allocation factors, with or without ifa, does not explain the variance of profit in a significant way. Adding the mlb factor to the model results in a significant incremental R^2 of 0.2982. Second, investigating the results of the non R&D intensive companies, we notice that the model without mlb explains the variance of profit in a significant way. Particularly, the model including the proposed allocation factors has a significant explanatory power of 45.72%. Adding recognized intangibles does not significantly increase R^2, which is in line with previous results. Including mlb to the formula results in a small incremental R^2 that is significant at the 10% level. Consistent with the expectations, these results suggest that for the R&D intensive companies, unrecognized intangible assets could be important in explaining profit.

Table 10. Incremental regression analysis: R&D intensive and non R&D intensive companies (listed companies)

	Factors	R2	Incremental R2	p-value incremental	p-value total model
R&D intensive companies, No. of obs. = 118					
1H	(cos, tfa, sal)	0.4931			0.2631
2H	(cos, tfa, sal) + ifa	0.5516	0.0585	0.1469	0.3502
3H	(cos, tfa, sal, ifa) +mlb	0.8498	0.2982***	0.0050	0.0001
non R&D intensive companies No. of obs. = 141					
1I	(cos, tfa, sal)	0.4572			0.0000
2I	(cos, tfa, sal) + ifa	0.4937	0.0365	0.1298	0.0000
3I	(cos, tfa, sal, ifa) +mlb	0.5262	0.0325*	0.0967	0.0000

Source: created by authors.

In a final analysis, we include a dummy variable for R&D intensive companies (D). The dummy equals 1 if the company is active in an R&D intensive sector. Otherwise the dummy takes the value zero. We include the interaction variable 'dummy R&D intensive*mlb' (D*mlb) which gives us the opportunity to study the effect of mlb for R&D intensive companies. *Table 11* presents the results of the following regression:

$$pl_i = \alpha + \beta_1 sal_i + \beta_2 fta_i + \beta_3 ifa_i + \beta_4 cos_i + \beta_5 mlb_i + \beta_6 D_i + \beta_7 (D_i * mlb_i) + \varepsilon_i \quad (5)$$

The effect of mlb on profit is positive and significant for both R&D intensive and non R&D intensive companies. However, for R&D intensive companies an increase of one standard deviation in mlb, on average, increases profit with 0.8103 standard deviation (0.2727+0.5376), which is higher than for non R&D intensive companies (0.2727). This suggests that for R&D intensive companies unrecognized intangible assets could be more important in generating profit than for non R&D intensive companies.

Table11. Apportionment factors as determinants of profit (listed companies). The table represents standardized beta coefficients and robust standard errors are presented between brackets

No. of obs. = 259	Profit/loss before tax
	(25)
sales	-0.5460
	(0.0216)
tangible fixed assets	0.2213***
	(0.0178)
intangible fixed assets	0.0618
	(0.1208)
cost of employees	0.4398
	(0.1331)
market less book value (mlb)	0.2727*
	(0.0169)
dummy r&d intensive	-0.0722***
	(6619.027)
mlb x dummy r&d intensive	0.5376*
	(0.0344)
R-squared	0.7669***

Notes: ***, **, * indicate significance at the 1, 5 and 10% level respectively.

Source: created by authors.

Conclusions

The European Commission is convinced that the consolidated tax base of multinational groups opting for CCCTB should be distributed in a fair way. A fair distribution would mean that the allocation of the consolidated tax base is closely related to the profit generating factors of the underlying entities. The Commission supposes, that fixed tangible assets, sales and labour are the dominant factors in the generation of profit and therefore considers these factors as potentially fair factors to be included into the EU apportionment formula. Using European firm level data, we investigate to what extent the allocation factors as proposed by the EC represent profit generating activities taking into account all sizes of companies. Moreover, we examine if the allocation factors should be equally weighted. Finally, as intangibles represent an important and growing component of total capital stock, we analyse the profit generating capacity of this alternative factor.

In order to answer these research questions, we first collect a sample of unlisted European companies for the manufacturing and service sectors. In order to evaluate the extent to which the apportionment factors explain the variation in profit, we analyse the standardized beta coefficients, the R2 statistics and the predictions' errors of the regressions. To study the effects of using equal weights, we form two sets of formulas. The first set represents unrestricted regressions where the weights are determined by the data and not by prior choices. The second set contains restricted regressions applying equal weights to the different apportionment factors. In general, constraining the formulas has a negligible influence on the ranking order of the different formulas. A more in-depth study of the proposed formulas reveals that the best performing formula is the three factor formula including sales, tangible assets and labour costs. These three factors significantly explain 28% of the variation of profit between firms. Moreover, the results indicate that the demand factor sales is the dominant factor in explaining profit and cost of employees is the most accurate labour factor. Further, the results show that adding intangible assets, as extracted from the balance sheets, do not increase the R2 statistics. This may suggest that recognized intangible assets play a rather minor role in the generation of profit. Second, we form a sample of listed companies for which we use the market less book value of equity to proxy for unrecognized intangible assets. We split up our sample into sectors that can be characterized as R&D intensive or non R&D intensive. For R&D intensive companies the proposed allocation factors do not explain the variation in profit in a significant way. However, adding the market less book value significantly increases the explanatory power of the model with an absolute value of 30 %. This suggests that for R&D intensive sectors unrecognized assets could be important in generating profit.

To our knowledge, this is the first empirical study looking at profit generating capacity of the apportionment factor intangible assets within European context. It could be argued that for simplicity and efficiency reasons intangibles should be excluded from the asset factor. However, from a fairness point of view, omitting intangible assets is highly unsatisfactory since this would mean ignoring a significant portion of assets for many multinationals. Moreover, this would ignore one of the potentially most important profit generating factors. Countries where intangible assets are abundantly presented have a strong claim to profits associated with those assets. Therefore, leaving out intangibles from the apportionment formula should be compensated. The Commission's proposal to temporary include in the asset factor previously incurred costs for research, development, marketing and advertising could be a first, but less far-reaching step in the right direction. Nevertheless, future research should be directed towards practical solutions for valuing and locating intangible assets.

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EMPIRINIS ES PELNO KŪRIMO VEIKSNIŲ PASKIRSTYMO FORMULĖS TYRIMAS

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SANTRAUKA

Europos komisija (EK) ketina sukurti bendrą konsoliduotą pelno mokesčio bazę (BKPMB), siekdama pašalinti visas mokesčių kliūtis, šiuo metu kenkiančias tarptautinių bendrovių konkurencingumui. Šiai naujai mokesčių sistemai reikėtų sukurti paskirstymo formulę, kuri tarp grupės narių teisingai paskirstytų konsoliduotą mokesčių bazę. Teisingas paskirstymas reikštų tai, kad jis būtų glaudžiai susijęs su pagrindinių narių pelno kūrimo veiksniais. EK daro prielaidą, kad ilgalaikis materialusis turtas, pardavimai ir darbo užmokesčio sąnaudos yra pagrindiniai pelno kūrimo veiksniai. Straipsnyje tiriamas šių veiksnių poveikis pelno kūrimui ir parodoma, jog jie paaiškina tik 28 % pelno pokyčių. Be to, proporcingai paskirsčius šių veiksnių pokyčius, rezultatas mažai tesikeičia. Straipsnyje analizuojama ir alternatyvaus veiksnio – nematerialiojo turto, kuris šiuo metu gali būti laikomas svarbiu modernios bendrovės komponentu, – galimybė generuoti pelną. Rezultatai rodo, kad pripažintas nematerialusis turtas reikšmingai nepadidina R^2. Rinkos vertė, didesnė už balansinę vertę, parodo nepripažintą MTP įmonių nematerialųjį turtą; tada pelno pokyčius galima paaiškinti apie 30 %. Tai rodo, jog šioms bendrovėms nepripažintas nematerialusis turtas gali būti svarbus kuriant pelną.

REIKŠMINIAI ŽODŽIAI: BKPMB, paskirstymo formulė, teisingumas, bendras tarptautinis apmokestinimas, Europos Sąjunga

Appendix 1

Correlation matrix (unlisted companies)

No. of obs. = 12,027	Profit/loss before tax	Sales	Tangible fixed assets	Intangible fixed assets	Number of employees	Cost of employees
Profit/loss before tax	–	–	–	–	–	–
Sales	0,4175***	_	_	_	_	_
Tangible fixed assets	0,1490***	0,4456***	_	_	_	_
Intangible fixed assets	0,0385***	0,2647***	0,1953***	_	_	_
Number of employees	0,2499***	0,5855***	0,4841***	0,2592***	_	_
Cost of employees	0,3134***	0,6659***	0,4081***	0,3101***	0,8479***	_

***, **, * indicate significance at the 1, 5 and 10% level respectively.

Descriptive statistics, all variables are in thousands except for number of employees, 2008 (listed companies)

	Listed companies			
No. of obs. = 259	Min.	Max.	Mean	Std
Profit/loss before tax	-142,000	2,031,000	29,361	145,921
Sales	772	44,300,000	540,745	3,393,686
Tangible fixed assets	18	5,622,658	155,690	675,535
Intangible fixed assets	0	651,300	13,149	54,866
Number of employees	15	69,954	1,276	5,820
Cost of employees	786	5,125,000	79,610	425,626
Market less book	-552,291	16,900,000	256,838	1,379,845

Correlation matrix (listed companies)

No. of obs. = 259	Profit/loss before tax	Sales	Tangible fixed assets	Intangible fixed assets	Cost of employees	Market less book
Profit/loss before tax	–	–	–	–	–	–
Sales	0.4596***	_	_	_	_	_
Tangible fixed assets	0.3608***	0.7178***	_	_	_	_
Intangible fixed assets	0.2477***	0.4414***	0.3067***	_	_	_
Cost of employees	0.4106***	0.8247***	0.6671***	0.5582***		_
Market less book	0.3813***	0.1778***	0.1098*	0.1790***	0.2083***	_

***, **, * indicate significance at the 1, 5 and 10% level respectively.

Wilcoxon Z-statistics

No. of obs. 259	Wilcoxon Z-statistics[a]	
Formula	**(21)**	**(24)**
(11)	0.169	3.741
(21)	_	3.178
(24)		_

[a] The Wilcoxon Matched-Pairs Signed Ranks test is used to identify which differences of (|y-hat(y)|/|hat(y)) are significant among the formulas. If the Wilcoxon Z-statistic is greater than 2.58, the difference in the ranks between the two formulas was deemed to be significant at the 1% level.

Appendix 2

Sample description industries

Two-Digit NACE	Industry Description	Number of Observations
R&D intensive sectors (118)		
24	Manufacture of chemicals and chemical products	20
30	Manufacture of office machinery and computers	4
31	Manufacture of electrical machinery and apparatus n.e.c.	10
32	Manufacture of radio, television and communication equipment and apparatus	12
33	Manufacture of medical, precision and optical instruments, watches and clocks	15
34	Manufacture of motor vehicles, trailers and semi-trailers	4
353	Manufacture of other transport equipment	1
72	Computer and related activities	52
R&D non intensive sectors (141)		
15	Manufacture of food products, beverages	27
16	Manufacture of tobacco products	1
17	Manufacture of textiles	4
18	Manufacture of wearing apparel; dressing and dyeing of fur	5
20	Manufacture of wood and wood products	5
21	Manufacture of pulp, paper and paper products	3
22	Publishing, printing and reproduction of recorded media	17
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail	4
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	37
52	Retail trade, except of motor vehicles and motorcycles: repair of personal and household goods	9
60	Land transport; transport	4
61	Water transport	5
62	Air transport	1
63	Supporting And auxiliary transport activities; activities of travel agencies	10
64	Post and telecommunications	9