

THE IMPACT OF TAX REGIMES ON THE EFFECTIVENESS OF R&D ALLOWANCES - AN INVESTIGATION OF SEPARATE TAXATION AND FORMULA APPORTIONMENT WITHIN THE FRAMEWORK OF R&D

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Abstract

This study investigates the effectiveness of R&D allowances within the framework of different tax regimes, namely Separate Taxation (ST) and Formula Apportionment (FA). In order to take the characteristics of R&D activities as well as the importance of the labor in R&D activities into account, a model within the framework of principal-agent setting is designed, where the impact of investments decisions is also investigated. In the model, R&D allowances are represented by means of expenditure-based allowances. Because of the analytical limitations, non-linear optimization and genetic algorithm are used for the investigation of the model designed. The outcomes show significant differences between ST and FA regarding the effectiveness of R&D allowances, impact on the compensation of managers and employees as well as on the welfare of owners (or employers). Under both, with and without R&D, FA enables to achieve a higher total surplus (net profit) compared to ST.

Keywords: Management incentives, Tax allowances, Separate Taxation, Formula Apportionment

JEL: H25, J33, O31

1. Introduction

Because of the significant contribution of R&D to the economic growth and innovation governments use different tools to stipulate and attract the R&D activities or investments in their countries. This paper focuses on R&D incentives within the framework of enhanced-deduction of R&D expenditure, which is one of the most used kind of tax incentives for R&D activities. Here, a juxtaposition is made between Separate Taxation (ST) and Formula Apportionment (FA), where the first mentioned is the widely-used corporate income taxation (CIT) principle, whereas the latter is in practice in USA and Canada and its implementation is intended within the EU. This means a significant geographical enlargement of FA practice. Further, as the R&D activities are characterized by their labor intensity, the compensation packages play also an important role here. The review of literature shows that R&D incentives under FA as well as principal-agent setting have been disregarded so far. This gap arises the question: 'What is the impact of R&D incentives on the management incentives under ST and FA?'. In order to answer this question, we designed a model based on principal-agent setting within the framework of compensation packages and conducted a non-linear optimization. The outcomes show significant differences between ST and FA referring to the content of compensation packages, their reactions to CIT rates and the net profit.

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2. Related Literature

In general, various studies reveal the impact of CIT on the investment decisions. It is to mention that these studies are mainly characterized by their macro-level perspective, where the impact of CIT at intra-firm level has been disregarded so far (see e.g. Buettner et al., 2011; Hellerstein and McLure, 2004). Because of its contribution to the economic growth and sustainability as well as the impact of CIT on the investment decisions (see e.g. Griffith et al., 1995; Hall and Van Reenen, 2000), R&D incentives show an increasing trend used by governments to attract the R&D activities and influence the investment behavior of companies. These tools show a wide range of kinds (such as direct subsidies, input and output-oriented tax incentives, allowances and credits), where however the preferential tax treatment (e.g. enhanced deduction) of R&D expenditures show an increasing trend (see e.g. Apelt et al., 2016). For instance, with its publication, European Commission (2017) amended its proposal for a Common Consolidation Corporate Tax Base (CCCTB) within the EU with the enhanced-deduction of R&D. In general, CCCTB proposal intend CIT based on 1) a common set of regulations, 2) tax base allocation based on Formula Apportionment, and 3) cross-boarder loss offset. This means a switch from the widely used practice of the source-based principle, namely Separate Taxation (ST), which is based on the regulations of jurisdictions, where the corporation is resident. This switch to FA and its appropriateness caused intensive discussions (see e.g. Altshuler and Grubert, 2011; Buettner et al., 2011; Hellerstein and McLure, 2004; Mueller, 2010). Further the implementation of FA will lead to a geographical enlargement of FA practice from USA and Canada to the European Countries. The following two figures gives an overview of ST and FA (within the CCCTB framework) practice.

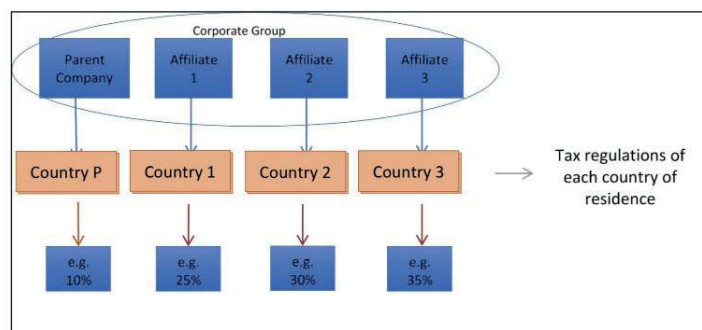


Figure 1. Overview steps of ST

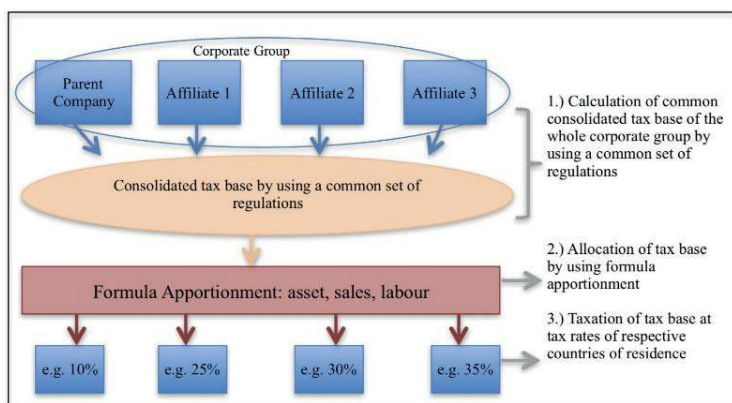


Figure 2. Overview steps of FA (Example of FA within CCCTB (Common Consolidated Corporate Tax Base))

Further, R&D activities are characterized on one hand by their labor intensity (see e.g. Appelt et al, 2016; D’Andria, 2017) and on the other hand by their information asymmetry and uncertainty. These aspects of R&D impact the behavior of owners (employers) as well as of managers (employees). Here, the principal-agent setting enables to take these characters of R&D activities and investments into account. In general, studies investigating the impact of CIT at intra-firm level, namely management compensation packages within the principal-agent setting, are characterized by their focus on ST (see e.g. Voßmerbäumer, 201; Göx, 2008). The review of literature reveal that only one study, namely D’Andria et al. (2016), investigates the impact of R&D incentives within the principal-agency theory. However, this focuses, as in case of other studies, on ST and takes only wages into account, where the investments remain disregarded.

3. Model

In order to answer the research question, we designed a model based on principal-agent setting, which enables us to take the trends and characteristics of R&D activities into account. The model consists of a multi-jurisdictional corporation (MJE) (principal) with two agents in two different counties (managers or employees). The agents bring output of x_i and receive compensation of w_i which are formulated as in the following equations:

$$x_i = a_i(p_i + q_i b_i) + \varepsilon_i \quad \varepsilon_i \sim N(0, \sigma_i) \quad (1)$$

$$w_i = v_i x_i + f_i \quad (2)$$

Here, p_i represents the productivity of agents; a_i the effort of agents; q_i the marginal productivity of investment, b_i the amount of investment and ε_i the normally distributed noise term.

Because of the risk and effort averse behavior of agents, the certainty equivalent function ($CE(w_i)$) represents their objective function formulated as:

$$CE_i = (x_i v_i) - \frac{a_i^2}{2} - \frac{r_i}{2} v_i^2 \sigma_{x_i}^2 \quad (3)$$

On the other hand, the principal is not able to observe the agents' effort, however she is informed about their objective function $CE(w_i)$ as well as their constraints of participation and incentive, formulated as in the following two equations:

$$CE_i(w_i) > u \quad (4)$$

$$a_i^* = \underset{x}{\operatorname{argmax}} CE_i(w_i) \quad (5)$$

The aim of the principal is maximize her objective function (TS) by determining the optimal amount of b_i and v_i in the compensation packages of agents.

When the CIT is not taken into account, TS is formulated as in Eq. (6), whereas Eq. (7) represents TS with CIT under ST without R&D allowances and Eq. (8) with R&D allowances (given by Y_i):

$$TS = \sum_{i=1}^2 (x_i - w_i - z_i) \quad (6)$$

$$TS_{ST} = \sum_{i=1}^2 [(1 - t_i)(x_i - w_i - z_i)] \quad (7)$$

$$TS_{ST_Y} = \sum_{i=1}^2 [(1 - t_i)(x_i - w_i - z_i) + (Y_i t_i (w_i + z_i))] \quad (8)$$

Whereas, when TS of principal is subject to taxation under FA, the factors for the tax base allocation have to be determined firstly. Here, we used two equally weighted formula of wages (w_i) and assets (represented by b_i) given as in the following:

$$fa_i = \frac{1}{2} \frac{w_i}{\sum_{i=1}^2 w_i} + \frac{1}{2} \frac{b_i}{\sum_{i=1}^2 b_i} \quad (9)$$

The objective function TS is reformulated as in the following, when no R&D incentives are provided:

$$TS_{FA} = \sum_{i=1}^2 [(1 - t_i fa_i)(x_i - w_i - z_i)] \quad (10)$$

In case of R&D incentives, the tax base is calculated based on the following equation:

$$TBase_{FA_Y} = \sum_{i=1}^2 [(x_i - w_i - z_i) - (Y_f (w_i + z_i))] \quad (11)$$

Hence, under FA TS is reformulated as in the following:

$$TS_{FA_Y} = \sum_{i=1}^2 [(x_i - w_i - z_i) - (t_i fa_i) TBase_{FA_Y}] \quad (12)$$

4. Numerical Analysis

As a closed-form solution of the model is limited (esp. under FA, under ST the dependency of b_i on v_i and vice versa) we conducted a numerical analysis for the model represented above. Here we used the following parameters:

$$p_i = 2; \sigma_i = 2; c_i = 0.5; q_i = 1; r_i = 1;$$

The outcomes of our analysis show that neither the compensation package (v_i) and nor the investment (b_i) are impacted by CIT under ST. By contrary, FA leads to a decrease of (v_i) in the high tax country, and hence offers a higher v_i in the low-tax country compared to ST (see Table 1)³.

Table 1. Without tax allowances $t_1 = 0.3, t_2 = 0.1$

	Without CIT		ST		FA	
$v_1 v_2$	0.1667	0.2	0.2	0.1668	0.186	0.1734
$b_1 b_2$	1	0	0	1	0	1
$w_1 w_2$	0.6253	0.4	0.4	0.626	0.346	0.6765
$f_1 f_2$	0.3752	0.24	0.24	0.3756	0.2076	0.4059
$a_1 a_2$	0.5	0.24	0.4	0.5	0.372	0.5202
$x_1 x_2$	1.5	0.8	0.8	1.5012	0.744	1.5606
$fa_1 fa_2$	0	0	0	0	0.1692	0.8308
$tb_1 tb_2$	0	0	0.12	0.0875	0.0519	0.0849
$TS TB$	1.025	-	0.8425	0.2075	0.8852	0.1368

The following figures represent the outcomes across different CIT rates. As shown in Figure 5, FA leads always to a higher TS, the compensation and its components are more sensitive under FA than under ST (see Figures 4 and 5).



Figure 3. v_1 under ST vs. FA

³ Because of the identical agents assumptions, in case of Without CIT an inverse representation of the outcomes related to v_i and b_i is possible.



Figure 4. w_1 under ST vs. FA



Figure 5. TS under ST vs. FA

Also when taking R&D incentives into account, FA enables the principal to achieve a higher TS by optimally designing the compensation packages and investment decisions (see Table 2):

Table 2. With tax allowances $\gamma_i = 0.25, t_1 = 0.3, t_2 = 0.1$

	ST		FA	
$v_1 v_2$	0.1907	0.2058	0.1993	0.1793
$b_1 b_2$	1	0	0.0001	0.9999
$w_1 w_2$	0.8182	0.4235	0.3972	0.7233
$f_1 f_2$	0.4909	0.2541	0.2383	0.434
$a_1 a_2$	0.5721	0.4116	0.3986	0.5379
$x_1 x_2$	1.7163	0.8232	0.7972	1.6136
$fa_1 fa_2$	0	0	0.1773	0.8227
$tb_1 tb_2$	0.1008	0.0294	0.0359	0.0554
$TS TB$	0.8815	0.1302	0.9301	0.0913

Across different CIT and R&D incentive rates, the following two figures (see Figures 6 and 7) show that compensation packages under FA and ST vary from each other, however this impacts the TS and tax burden (TB) of principal to a smaller extent (see Figures 8 and 9).



Figure 6. v_1 under ST vs. FA with $\gamma_i = \{0,1\}$

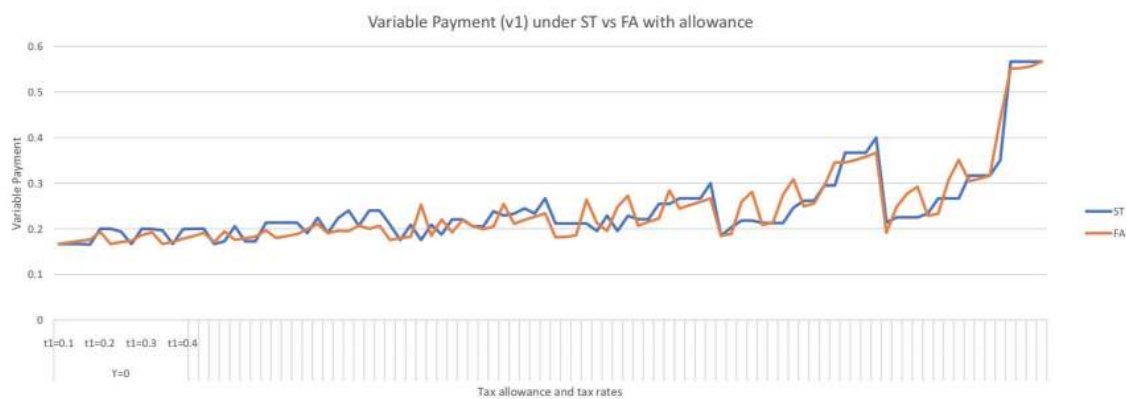


Figure 7. w_1 under ST vs. FA with $\gamma_i = \{0,1\}$

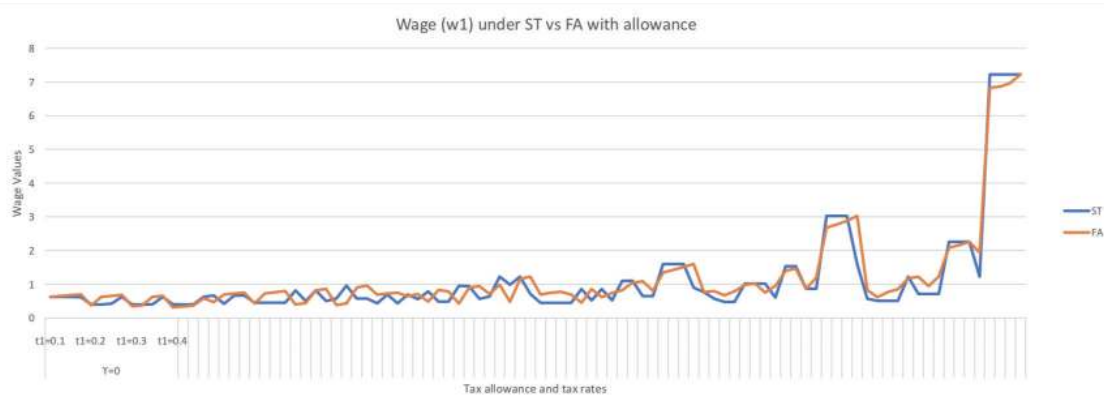


Figure 8. TS under ST vs. FA with $\gamma_i = \{0,1\}$

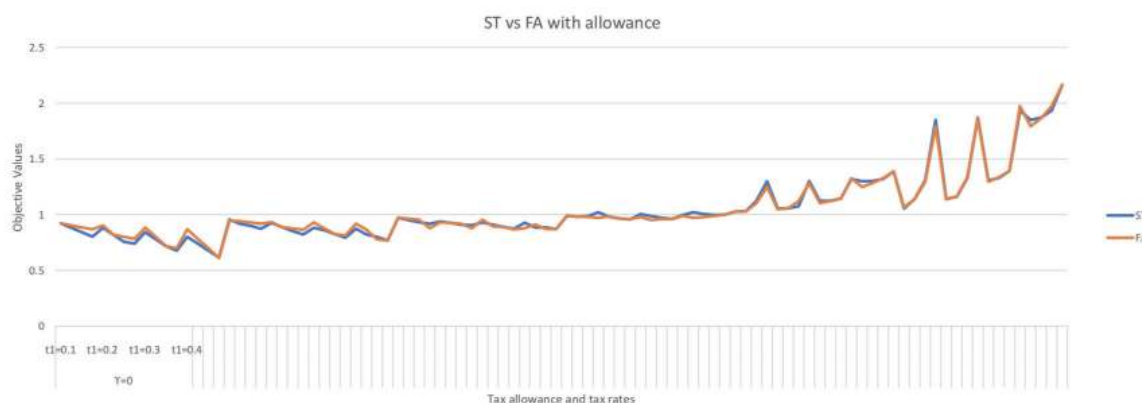


Figure 9. TB under ST vs. FA with $Y_i = \{0,1\}$

5. Conclusion

This study aimed at analyzing the impact of different tax regimes, namely ST and FA, on the management compensations and investment decisions within the framework of R&D activities. Here, we investigated the impact of R&D allowances under different tax regimes. Because of the higher practical relevance, R&D allowances were represented by expenditure based allowance (enhanced deduction of R&D expenditures) in the model designed. Further, the model is based on principal-agent setting. Because of the limitations on analytical solvability a numerical analysis is conducted within the framework of non-linear programming. Here, we implement genetic algorithm.

The outcomes show, that CIT shows neutral impact under ST when no R&D incentives are offered. However, both the agents' as well as the principal's welfares show higher dependency on CIT rates under FA. An interesting outcome is, that in case of R&D incentives agents' welfare (w_i) is impacted by CIT to a wider range under FA than it does under ST. However, this gap in w_i leads to lower differences in welfare (TS) of principal.

This work contributes to the area of international taxation and existing literature by extending the principal agency-theory and R&D incentives to the framework of FA. Further, in contrast to the existing literature, we applied non-linear optimization and genetic algorithm in order to investigate the model designed.

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